ISPRA

Italian National Institute for Environmental Protection and Research

ITALIAN ENVIRONMENTAL DATA YEARBOOK 2012

KEY TOPICS

STATO DELL'AMBIENTE

42 / 2013

SISTAN
SISTEMA STATISTICO NAZIONALE

ARPA APPA
AGENZIE REGIONALI E DELLE PROVINCE AUTONOME PER LA PROTEZIONE DELL'AMBIENTE

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ENVIRONMENTAL DATA
YEARBOOK 2012

STATE OF THE ENVIRONMENT

KEY TOPICS

State of the Environment 39/2013

LEGAL INFORMATION

The ISPRA was established by Italian Law 133/2008, which converted and amended Italian Decree Law 112 of 25 June 2008, published in the Official Gazette no. 195 of 21 August 2008. The ISPRA carries out functions that were formerly carried out by the APAT (*Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici* – Environmental Protection and Technical Services Agency), INFS (*Istituto Nazionale per la Fauna Selvatica* – National Institute for Wildlife) and ICRAM (*Istituto Centrale per la ricerca scientifica e tecnologica Applicata al Mare* – Central Institute for Scientific and Technological Research Applied to the Sea.

ISPRA – Italian National Institute for Environmental Protection and Research
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Typography:
Daria Mazzella
ISPRA – Publishing Department

Administration:
Olimpia Girolamo
ISPRA – Publishing Department

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ISPRA – Communication Service

nam tibi de summa caeli ratione deumque
disserere incipiam et rerum primordia pandam,
unde omnis natura creet res, auctet alatque,
quove eadem rursum natura perempta resolvat.[1]

Titi Lucretii Cari – De rerum natura
(Liber I, 54-57)

[1] I shall present to you the supreme doctrine of the heavens and of the gods, and I shall reveal the beginning principles of things, from which nature produces all things, grows and feeds them, and in which the same nature again transforms things that have been dissolved.

Foreword

The Environmental Data Yearbook is aimed at political decision-makers, public administrations, technicians and the general public, with the scope of providing scientific information on the state of the environment in Italy.
The 2012 edition, drawn up in collaboration with the ARPA-APPA (environmental agencies), is the result of environmental monitoring and systematic collection, processing and communication of statistical data, carried out by the ISPRA in accordance with its institutional duties.
The use of common standards and methodological models, the completeness and reliability of the data and the possibility of multiple versions, namely seven, make the Yearbook a thorough and objective communication tool that is simultaneously suitable for widespread disclosure of environmental knowledge. In terms of protecting the environment, these aspects are necessary and of fundamental importance in encouraging integrated policies for sustainable development and greater awareness by citizens.
Sustainability is a key goal for the European Union, and innovation is the essential element to successfully handle this challenge. New ideas can lead to the creation of technologies, instruments and products that are crucial for gradual improvement of the environmental, social and economic systems.
The increase in the global population and the strong anthropic pressures are leading to an increasingly rapid depletion of the planet's non-renewable resources, while those which are accessible to all are exploited at an excessively high rate that prevents regular regeneration.
Sustainable and competitive economic development must, therefore, be based on the principles of ethics and equity and on a balanced and efficient distribution of resources.
In his recent programmatic statement, Environment Minister Andrea Orlando indicated three priorities in terms of the environment: consumption of soil, water resources and environmental crimes.
The first emergency must be handled by facilitating building redevelopment with regard to new construction and to expansion of the urban fabric.
The second calls for legislation on the protection of water, considered to be a resource belonging to everyone and to be managed in an efficient and economically sustainable manner, as confirmed by the referendum.
In the legislative field of environmental infractions, a revision of the administrative sanctions is required, along with an expansion of the definition of crimes that cause serious damage, making them applicable not only to natural resources but to human health as well.
Firmly wagering on the adoption of a more sustainable energy process, the strategic national and international decisions encourage recourse to the sun, wind, waste and water as new opportunities for protection of the environment and economic growth.
Agriculture and food, electronics, textiles, construction, waste disposal and nature protection are only some of the sectors made more competitive by the Italian green economy, according to the national Green Italy 2012 report.
Together with politics, scientific research and technological innovation, monitoring and reporting activities play a key role in the transition towards a green economy.
The third report published recently by the Organisation for Economic Cooperation and Development (OECD) on Italy's environmental performance indicated how our country has further developed the collection and presentation of data on the environment. In terms of environmental information, the continuity with which reports on the environmental situation and on specific environmental issues are presented was highlighted, as well as how the information is facilitated and made more accessible online, with specific reference to the ISPRA Yearbook and to the many versions drawn up, from the complete version to the abridged one, and from the online database containing the indicator summaries to the topic highlights and multimedia products.

In particular, regular publication of the Yearbook contributes to growth of environmental culture and sensitivity, encouraging behaviour that is conscious and eco-compatible at all levels.
To ensure the availability of information to the reference targets, the contribution of the various technical areas of expertise of the Institutes has proven to be essential. My sincere thanks go out to all of those who worked diligently and in a professional manner on the 2012 edition as well.

Prof. Bernardo DE BERNARDINIS
President, ISPRA

Introduction to the Environmental Data Yearbook

The Environmental Data Yearbook, now in its 11th edition, is the most complete and systematic collection of statistics on the environment published in Italy.
It is the result of experience acquired in the environmental reporting sector first in APAT and then in ISPRA and of the synergetic and painstaking work of selection and dissemination of information carried out by the Institute, in support of the environmental protection and sustainability policies, in collaboration with the environmental protection agencies of the Italian regions and autonomous provinces.
A number of technical and scientific organisations actively participated in preparing this edition as well, co-operating with ISPRA in processing scientific data and information and in verifying their consistency.
As part of the inter-agency activities of Area C - Processing, management and dissemination of environmental information, as defined by the 2010-2012 three-year program approved by the Federal Council, a number of activities aimed at ensuring systematic and harmonised production of environmental information and its subsequent dissemination by the system of agencies were carried out.
With regard to the techniques and methods for processing the data and information, a line of action aimed predominantly at defining the methodological reporting standards was conducted.
A review of the core set of indicators, as already introduced in the prior editions, was carried out this year as well by a specific Work Group. The main objective of this group was the analysis of the indicators and related data provided by the regional yearbooks, for comparison and alignment with the contents of the national yearbook, in order to assess their subsequent integration.
Review and consolidation of the core set of indicators involved:

- evaluation of the validity of each indicator based on the objectives set by the national and international regulations, as well as the national and international reporting obligations/guidelines;
- assessment of the indicator's ability to represent the phenomenon under analysis;
- verification of the availability of enough data to make the indicator significant;
- evaluation of the indicator's relevance and scientific soundness;
- inclusion of new types of indicators (e.g., decoupling indicators, performance indicators, efficiency indicators, adaptation indicators, sustainability indicators, composite indicators, etc.);
- development of indicators of the impact on climate change;
- selection of a set of indicators that satisfies the requirements of the INSPIRE Directive (and EC Regulation 1205/2008);
- repositioning of some indicators among the various areas of interest for a more consistent distribution.

Furthermore, in order to ensure integration of the sources of data and information, as well as greater transversality, the process to involve the Agencies System and the other public institutions and technical/scientific organisations continued. Their participation was particularly notable during methodological consolidation, development of the environmental indicators, in the overall referencing phase and in the planning of contributions relative to specific regional factors.
In order to disclose environmental information and knowledge to a increasingly wider public and increase citizens' awareness in terms of the environment, the 2012 edition of the Yearbook comprises seven products (Full version, Key Topics, Key topics light, Yearbook in Figures, Yearbook indicators database, Multimedia version and Newsletter), described below.
The full version of the Yearbook is organised by indicator fact sheet, useful in providing a detailed and analytical summary of the main environmental topics. The document is subdivided into four sections, with the indicators organised according to the DPSIR model (Section A – General elements; Section B – Production sectors; Section C – Environmental conditions; Section D – Protection and prevention). Sections B, C and D contain 21 topics.

Each topic is associated to the SINAnet topics (i.e., for the Atmosphere: Emissions, Air quality, Climate).
The overview, which represents an introduction to the fact sheets, contains information on the indicators and on their depiction via tables and figures, as well as on the updating frequency.
The structure of the fact sheets (metadata section), broken down into the fields Description, Quality of Information, Objectives set by law, State and Trends, and Comments on the tables and figures, has been simplified compared to that used in the Yearbook Database, through selection of essential information with respect to the indicator.
The introduction to the Topics section provides a general and brief overview of the topic, illustrating the characterising elements, from the physical point of view as well as in terms of the main phenomena or issues of environmental interest. The introduction to the SINAnet topic briefly describes the issues that make up the topic. Both were already significantly simplified and reduced in the prior edition, in order to facilitate reading and use of the contents.
Statistical information on the perception and level of knowledge of European and Italian citizens with respect to the environment and the relative issues was presented in the last two editions of the Environmental Data Yearbook, mainly using as the source of data European and national surveys that measure the opinions, attitudes and behaviours of the population (households and/or citizens) with respect to environmental issues. For this edition, due to more limited availability of data, we decided to focus the monitoring on two issues that have been the subject of recent European surveys (water resources and air quality), adding the chapter *European and Italian perceptions of water resources and air quality*.
Changes this year also include the introduction of two new chapters: *Environmental evaluation and authorisation* and *Environmental certification*, to replace the chapter *Environmental evaluation and certification*. The issues discussed in the former (*Environmental evaluation and authorisation*) are: Evaluation of environmental impact, Strategic environmental evaluation, Integrated environmental authorisation (preliminary analyses), Integrated environmental authorisation (controls). The latter (*Environmental certification*) examines the voluntary tools used to encourage production that respects the environment and ecologically aware consumption.
For the first, the *Agriculture* chapter (Aquaculture topic) includes the indicator “Levels of nitrogen and phosphorous from aquaculture systems in a marine environment”.
An indicator on the activities of the ISPRA National Bird Ringing Centre was added to the *Biosphere* chapter. In the *Tourism* chapter, a new indicator provides information on the tourism sector’s contribution to the production of waste.
The chapter *Hydrosphere* presents seven new indicators on the issues of Quality of water bodies and Pollution of water bodies: “Quality index of the biological components of rivers – macrophytes”; “Quality index of the chemical/physical components of rivers - LIMeco”; “Quality index of the chemical/physical components of lakes - LTLeco”; “Quality index of the chemical condition of rivers and lakes - SQA”; “Summary index on pollution of underground water from nitrates (NO_3 Status)”; “Summary index on pollution of surface waters from nitrates (NO_3 Status)”; “Percentage of filtered waste water”.
In the chapter *Environmental planning tools*, the indicator “Progress of regional planning and VAS applications” was renamed “Plans with VAS application at the state and regional level”; furthermore, the indicator “Water protection plans” was included.
Finally, under *Environment and well-being*, the Pollen issue was introduced, the indicator “Potentially lost years of life attributable to car accidents” was removed and three new indicators were added: “Exposure of the population to air pollutants outdoors - $PM_{2.5}$”, “Pollen season” and “Allergic pollen index”.

The 2012 edition, available in its full version in electronic format (PDF) on the sites www.isprambiente.it and http://annuario.isprambiente.it/, is also available through the following products:

- *Key Topics* **–** presents a possible organisation of the information regarding priority environmental issues which are the subject of specific prevention and redevelopment measures. Available in electronic format (PDF) in both Italian and English;
- *Key topics light* – concise version of the Key Topics. Available in electronic format (PDF) in both Italian and English;
- *Environmental data yearbook in figures* – Statistics brochure (in Italian and English) containing the most representative graphs on environmental issues and statistical information or brief highlights. Available in electronic format (PDF);
- *Database* – Tool for online consultation of the indicator fact sheets and preparation of reports (http://annuario.isprambiente.it/);
- *Multimedia* – Tool able to disseminate the Yearbook data and information in a simple and timely manner, thanks to the use of videos, graphical animation and web applications. The video on the Environmental Data Yearbook 2012 (in Italian) is available at www.isprambiente.it;
- Comic – version of an environmental topic of the Yearbook. Available in electronic format (PDF).

The volume *Key Topics* contains an integration of the data elements of the Yearbook related to environmental issues that currently call for priority intervention by the environmental protection policies.

The majority of the topics covered correspond to the issues discussed in the European Union's sixth Environment Action Programme.

The contents discussed regard the following issues:

Climate change and energy; *Biodiversity and actions on the ecosystems*; *Air quality*; *Inland water quality*; *The sea and coastal environment*; *Exposure to physical agents*; *Nuclear activities and environmental radioactivity*; *Environmental hazard*; *Soil and land*; *Waste cycle*; *Use of resources and material flows*; *Tools for environmental knowledge and awareness and market interface*.

The following were examined for each topic, based on the DPSIR model: 1) the existing condition (state/impact), 2) the causes that contributed to generating it (drivers/pressures) and 3) the solutions undertaken or planned (responses).

Based on the availability of data and following comparisons made at the European and regional level, new performance and impact indicators were introduced.

Among the changes, a box with contributions by the ARPA/APPA and illustrating a specific aspect (critical points or good practices) of their territory on a particular topic is inserted after each point of the DPSIR model (1 Existing conditions, 2 Causes, 3 Solutions).

For example, a number of specific regional characteristics are indicated with respect to the most relevant topics.

The Friuli-Venezia Giulia ARPA produced "Il Friuli-Venezia Giulia nel clima che cambia" (Friuli-Venezia Giulia in the changing climate) for *Climate change and energy*.

The Tuscan ARPA provided its contribution on the Pelagos Sanctuary (project GIONHA – *Governance and Integrated Observation of Marine Natural Habitat*) under the topic *Biodiversity and activities involving ecosystems*, on the toxic drums near Gorgona Island under the topic *The sea and coastal environment*, on monitoring of the "La Spezia-Acciaiolo" power line for *Exposure to physical agents*, and on the SISBON (*Sistema Informativo Siti interessati da procedimento di BONifica* – Information System for Sites impacted by Reclamation Procedures) for *Environmental hazard*.

The Friuli-Venezia Giulia, Emilia-Romagna, Marche, Abruzzo and Lazio Agencies highlighted specific regional situations under the topic *Air quality*.

Calabria's ARPA produced "Attività di controllo on-line degli scarichi delle acque reflue urbane nelle aree costiere" (On-line monitoring of urban waste water disposal in the coastal areas) under the topic *Inland water quality*, and "La tettonica della Calabria e le concentrazioni di radon nel

suolo” (Calabria’s tectonic plate and the radon concentrations in the soil) under *Environmental hazard*.
The regional information provided by the Valle d'Aosta ARPA regards an analysis of cryoconite, for *Nuclear activities and environmental radioactivity*, while that of the Piedmont ARPA discusses the regional situation on the flow of special waste in the Piedmont region, under the topic *Waste cycle*.
In *Key topics (light)*, with a view to providing the public with complete and timely environmental information, the environmental issues analysed under Key topics were described according to the elements of the DPSIR model, using a number of indicators able to represent them accurately, specifically selected based on the following criteria: key indicators required by the regulations or by reporting obligations; completeness of the historical series (national figure); representativeness and maximum communicability; innovations/developments/changes.
The DPSIR diagram on the first page summarises the indicators or groups of indicators that characterise the topic, categorised under four colours:

- Green: present in the Yearbook Database
- Blue: used in the Key Topics
- Orange: present in the Yearbook Database as well as in the Key Topics
- Red: indicators not present

Each chapter consists of six parts: an introduction to the topic, which summarises the most significant information; another five parts that describe the information considered most relevant for each of the DPSIR elements (D=Drivers, factors responsible for the pressures; P=Pressures, effect and development of the anthropic activities on the environment; S=State, quality/quantity of resources; I=Impacts, effect of the changes in state; R=Responses, measures implemented).
The new features introduced include the “Focus” text boxes, which discuss regional situations, objectives to be reached or already achieved, or particularly significant information.
With a view to instantaneous and effective communication, the *Yearbook in figures* contains for each topic graphs accompanied by brief informative notes and complementary statistical data, particularly significant and self-explanatory, corresponding to the criteria of completeness of the historical series with respect the national data and communicability.
The Yearbook Database, designed to facilitate data and metadata processing and make it more functional, is an important communication tool provided to the Institute’s internal and external users. Through the indicator fact sheet, the Database permits targeted searches of the available indicators, referring to all editions of the Yearbook (starting in 2003). The information system allows the creation of summary versions that are personalised or organised according to the information requirements of the individual users.
Furthermore, starting from the prior edition, it is possible to produce additional types of reports from the Database indicators regarding, for example, monitoring of the Environmental Action Strategy for Sustainable Development in Italy (CIPE Resolution 57/2002), the European Sustainable Development Strategy (Monitoring Report 2011) and various issues of key interest, such as Climate Change and Sustainable Production and Consumption.
As far as changes, we highlight the migration onto a CMS (*Content Management System*) open source platform for consultation of the indicator fact sheets and products. On one hand, this makes the site more solid from the point of view of cyber attacks, updates, etc., and on the other allows the portal to be expanded to any type of functionality. For example, Agencies may create their own regional yearbook, which will have the same structure as the Yearbook Database, using a specifically designed module.
The video version of the *Multimedia* product, backed by images, graphics, sound and commentary, presents an important summary of the key contents of the Yearbook, discussing the major problems of greatest interest to the general public. As for the prior editions, methodology based on the DPSIR framework was adopted in order to encode and transmit the statistical data and

environmental indicators.
The *Comic* entitled “The investigations of Inspector SPRA”, which aims to disclose the Yearbook's data and information to a young audience of non-experts, handles only one environmental issue per year, using comic-style language. The topic *Climate change* was selected for the 2012 edition. The narrative structure, also based on the DPSIR model, is that of an investigation conducted by Inspector SPRA and five agents: Mr. D. (the agent investigating the Drivers), Mr. P. (the agent investigating the Pressures), Mr. S. (the agent investigating the State), Mr. I. (the agent investigating the Impacts) and Mrs. R. (the agent investigating the Responses).
Through the base of data collected, the Yearbook *Database* and the *Full version* permit more detailed examination of environmental issues.
Furthermore, the information base of ISPRA’s Environmental Data Yearbook also constitutes the reference for a number of other important publications, such as the OECD Report - Environmental Performance Reviews (EPR), the CNEL document “Relazione annuale al Governo e al Parlamento sulla qualità dei servizi pubblici offerti dalle amministrazioni a cittadini e imprese – Sezione Ambiente” (Annual report to the Government and Parliament on the quality of public services offered by the administrations to citizens and businesses – Environment Section), and the “Strategia di azione ambientale per lo sviluppo sostenibile in Italia” (Environmental action strategy for sustainable development in Italy), in accordance with CIPE Resolution 57/2002.
The Environmental Data Yearbook has proven to be an effective, consistent and timely reporting tool able to reach a number of targets, ranging from policy makers to the general and non-specialised public, thanks to its wide array of products published regularly.
This instrument is fundamental in monitoring and evaluating the effects of environmental policies and to increase the awareness of citizens on the state of the environment in which we live, promoting greater responsibility and awareness with respect to environmental problems and encouraging eco-compatible behaviours.
The 2012 edition saw an intensification of the joint work of the Institute with the regional Agencies. My wish is that this collaboration continues and becomes increasingly stronger, in order to improve the data collection systems, encourage the adoption of common methodological models and reporting standardisation processes and improve the organisation and processing of content on regional situations, introduced this year, which must become more systematic and complete.
I sincerely thank all those who contributed to making this eleventh edition of the Yearbook possible.

Stefano LAPORTA
ISPRA General Director

Contributions and thanks

General considerations

In carrying out one of its most important institutional functions, namely the coordination of data collection, management of information and environmental reporting, ISPRA constantly develops its considerable and qualified supply of knowledge and translates it into thematic and inter-thematic reports, such as the Environmental Data Yearbook, now at its eleventh edition, designated for a vast range of users.
Compared to the other publications, the Yearbook, given the thoroughness of environmental topics presented, stands out as the result of the complex synergies among almost all of the Institute's technical disciplines.
The volume of information produced and the complexity of the analyses in this edition of the Yearbook have entailed the commitment of a significant number of experts on various topics and reporting analysts.
In citing the main contributors to the publication, special mention goes to the following Departments:

- *State of the Environment and Environmental Metrology; Marine and Inland Waters Protection; Land Resources and Soil Protection; Nature Protection; Nuclear, Technological and Industrial Risk; Library, Documentation and Information*, and to the following Inter-Departmental Services: *Environmental Emergencies; Environmental Information; Guidance, Coordination and Control of Inspection Activities; and Environmental Certification*;
- *Monitoring of Environmental Quality, Prevention and Mitigation of Impacts, Defence of Habitats and Biodiversity, Sustainable Use of Resources;*
- *Former* INFS.

Equally important were the contributions of the ARPA/APPA agencies and the many technical-scientific bodies.

Planning and coordination of the overall production of the work was handled by the Environmental Statistics and Yearbook Project Special Service managed by Mariaconcetta GIUNTA. Coordination of the Environmental Data Yearbook – Key Topics was handled by Silvia IACCARINO (ASA). Coordination of the Environmental Data Yearbook – Full version was handled by Paola SESTILI (ASA).

Specific contributions to the document Key Topics

I. Purpose and structure of the document
Author: Patrizia VALENTINI

II. Socio-economic framework
Coordination: Paola SESTILI
Authors: Giovanni FINOCCHIARO, Cristina FRIZZA, Alessandra GALOSI, Silvia IACCARINO, Luca SEGAZZI, Paola SESTILI, Patrizia VALENTINI

III. European and Italian perceptions of water resources and air quality
Authors: Giovanni FINOCCHIARO
Contributor: Patrizia VALENTINI

Chapter 1. Climate change and energy
Coordination: Domenico GAUDIOSO, Alessandra GALOSI
Authors: Federica ALDIGHIERI, Chiara ARCARESE, Antonio CAPUTO, Franco DESIATO, Domenico GAUDIOSO, Francesca GIORDANO, Luca ONORATO (ARPA Liguria), Walter PERCONTI

Chapter 2. Biodiversity and activities involving ecosystems
Coordination: Claudio PICCINI (*general*) with the contribution of Lorenzo CICCARESE (*agriculture and forests*), Leonardo TUNESI (*marine environment*), Piero GENOVESI (*fauna*) and Giovanni FINOCCHIARO
Authors: Valter BELLUCCI, Silvia BRINI, Antonio BRUNORI (Comunicambiente), Anna CHIESURA, Lorenzo CICCARESE, Anna Stefania ERCOLE, Giovanni FINOCCHIARO, Diego FLORIAN (University of Padua), Piero GENOVESI, Mario GUIDO (ISMEA), Silvia LIVI, Stefano LUCCI, Marzia MIRABILE, Claudio PICCINI, Roberto SANNINO, Leonardo TUNESI

Chapter 3. Air quality
Coordination: Anna Maria CARICCHIA, Alessandra GALOSI
Authors: Antonella BERNETTI, Patrizia BONANNI, Anna Maria CARICCHIA, Giorgio CATTANI, Mariacarmela CUSANO, Riccardo DE LAURETIS, Antonella DE SANTIS, Alessandro DI MENNO di BUCCHIANICO, Cristina FRIZZA, Alessandra GAETA, Alessandra GALOSI, Giuseppe GANDOLFO, Gianluca LEONE, Emanuele PESCHI, Cristina SARTI, Jessica TUSCANO
With contributions from:
Antonio CAPUTO, Eleonora DI CRISTOFARO, Andrea GAGNA, Barbara GONELLA, Daniela ROMANO, Ernesto TAURINO, Marina VITULLO

Chapter 4. Inland water quality
Coordination: Serena BERNABEI, Silvia IACCARINO
Authors: Serena BERNABEI, Andrea BIANCO, Silvia IACCARINO, Marilena INSOLVIBILE, Marco MARCACCIO (ARPA Emilia-Romagna)

Chapter 5. The sea and coastal environment
Coordination: Angela BARBANO, Silvia IACCARINO
Authors: Giovanni ARENA, Angela BARBANO, Patrizia BORRELLO, Marco CASAIOLI, Matteo CONTI, Filippo D'ASCOLA, Massimo DALÙ, Roberta DE ANGELIS, Silvia IACCARINO, Roberto INGHILESI, Loretta LATTANZI, Erika MAGALETTI, Stefano MARIANI, Sara MORUCCI, Gabriele NARDONE, Luisa NICOLETTI, Arianna ORASI, Antonio PALMA, Marco PICONE, Massimo SCOPELLITI (MATTM), Cecilia SILVESTRI, Laura SINAPI, Emanuela SPADA

Chapter 6. Exposure to physical agents
Coordination: Salvatore CURCURUTO, Cristina FRIZZA e Matteo SALOMONE
Authors: Salvatore CURCURUTO, Cristina FRIZZA, Maria LOGORELLI, Francesca SACCHETTI, Rosalba SILVAGGIO

Chapter 7. Nuclear activities and environmental radioactivity
Coordination: Lamberto MATTEOCCI, Luciano BOLOGNA, (*nuclear activities*) Giancarlo TORRI, Giuseppe MENNA (*environmental radioactivity*), Silvia IACCARINO (*general*)
Authors: Luciano BOLOGNA, Patrizia CAPORALI, Mario DIONISI, Sonia FONTANI, Lamberto MATTEOCCI, Giuseppe MENNA, Giorgio PALMIERI, Carmelina SALIERNO, Giancarlo TORRI, Sandro TRIVELLONI, Joanne WELLS

Chapter 8. Environmental hazard
Coordination: Eutizio VITTORI (*Natural hazards)* with contribution from Valerio

COMERCI, Gaetano BATTISTELLA (*Integrated Environmental Authorisation*), Laura D'APRILE (*Contaminated sites)*, Paola SESTILI (*general*)
Authors for *Natural hazards*: Anna Maria BLUMETTI, Valerio COMERCI, Angelo CORAZZA (PCM-DPC), Luca GUERRIERI, Carla IADANZA, Francesco LEONE (PCM-DPC), Mauro LUCARINI, Alessandro TRIGILA, Eutizio VITTORI
Author for *Integrated Environmental Authorisation:* Gaetano BATTISTELLA
Author for *Contaminated sites:* Laura D'APRILE

Chapter 9. Soil and land
Coordination: Fiorenzo FUMANTI, Paola SESTILI
Authors: Marco DI LEGINIO, Fiorenzo FUMANTI, Anna LUISE
With contributions from:
Federico ARANEO, Eugenia BARTOLUCCI, Nicoletta CALACE, Roberta CARTA, Carlo DACQUINO, Laura D'APRILE, Paolo GIANDON, Maria Cristina GIOVAGNOLI, Carlo JACOMINI, Maria LETTIERI, Ines MARINOSCI, Lucio MARTARELLI, Michele MUNAFÒ, Luca SALVATI, Ialina VINCI
Authors (*Box*: *Land consumption)*: Ines MARINOSCI, Michele MUNAFÒ, Luca SALVATI

Chapter 10. Waste cycle
Coordination: Rosanna LARAIA, Cristina FRIZZA
Authors: Gabriella ARAGONA, Andrea LANZ, Rosanna LARAIA

Chapter 11. Use of resources and material flows
Coordination: Cristina FRIZZA
Authors: Aldo FEMIA (ISTAT), Renato MARRA CAMPANALE

Chapter 12.
Tools for environmental knowledge and awareness and market interface

Coordination: Massimo DIACO (*Introduction, The dissemination of environmental information, Strategies and tools for environmental training and education geared towards sustainability)*, Stefania MINESTRINI and Vincenzo PARRINI (*Tools for improving environmental performance)*, Patrizia VALENTINI (*General, The dissemination of environmental information)*
Authors of *Introduction*: Silvia BONAVENTURA, Fabrizio CIOCCA, Massimo DIACO, Nadia SBREGLIA
Authors of *The distribution of environmental information:* Andrea CERASE (University of Rome "La Sapienza"), Alessandra GALOSI, Daniela GENTA, Marialucia MONGELLI (ARPA Puglia), Waldemaro MORGESE (AIB President – Puglia section), Anna Laura SASO, Patrizia VALENTINI, Andrea VISINTAINER
Authors of *Strategies and tools for environmental training and education geared towards sustainability:* Maria Alessia ALESSANDRO, Daniela ANTONIETTI, Stefania CALICCHIA, Patrizia POLIDORI
Authors of *Tools for improving environmental performance*: Gianluca CESAREI, Barbara D'ALESSANDRO, Stefania MINESTRINI, Vincenzo PARRINI, Valeria TROPEA, Silvia UBALDINI

Editing
The editing phases of the Yearbook products were handled by a work group coordinated by Mariaconcetta GIUNTA, with the contribution of Silvia IACCARINO and Paola SESTILI, and consisting of: Giovanni FINOCCHIARO (processing and statistical validation of the data), Cristina FRIZZA (processing and statistical validation of the data),

Alessandra GALOSI (processing and statistical validation of the data), Elisabetta GIOVANNINI (secretary, mailing list, text editing), Silvia IACCARINO (coordination and overall technical revision of “Key topics” and validation of the data), Alessandra MUCCI (text editing), Matteo SALOMONE (processing and statistical validation of the data, multimedia elaboration and newsletter), Luca SEGAZZI (processing and validation of the data), Paola SESTILI (coordination and overall technical revision of the full version of the Yearbook and processing and statistical validation of the data), Valeria STRADAIOLI (text editing), Patrizia VALENTINI (communication project, multimedia elaboration and newsletter). The Database of Yearbook Indicators is managed by Raffaele MORELLI.
The Group also handled preparation of specific techniques and the relative guidelines for filling out the indicator fact sheet and the Yearbook Indicators Database, as well as integration of the contents of the work, processing and statistical validation of the data published, and overall technical review of both the information contents and the methodological/editing techniques used.

Information content – Unit Coordinators
The work to prepare the information contained in the Environmental Data Yearbook was carried out by a task force coordinated by Mariaconcetta GIUNTA.

Environmental issues	**Topic coordinator**	**Statistical coordinator**
Yearbook guide	Silvia IACCARINO	
Spatial coverage of indicators	Cristina FRIZZA	
Socio-economic framework	Luca SEGAZZI	Paola SESTILI
European and Italian perceptions of water resources and air quality	Giovanni FINOCCHIARO	
AGRICULTURE, FORESTRY and AQUACULTURE	Lorenzo CICCARESE Stefano LUCCI Giovanna MARINO (Aquaculture)	Alessandra GALOSI Luca SEGAZZI
ENERGY	Domenico GAUDIOSO	Alessandra GALOSI
TRANSPORT	Mario CONTALDI	Paola SESTILI
TOURISM	Silvia IACCARINO	Giovanni FINOCCHIARO
INDUSTRY	Antonino LETIZIA	Paola SESTILI
ATMOSPHERE	Riccardo DE LAURETIS with the contribution of Renato MARRA CAMPANALE (Emissions) Anna Maria CARICCHIA (Air quality) Franco DESIATO (Climate)	Cristina FRIZZA Alessandra GALOSI
BIOSPHERE	Claudio PICCINI Leonardo TUNESI (Marine Protected Areas and Protected Species)	Giovanni FINOCCHIARO

Environmental issues	**Topic coordinator**	**Statistical coordinator**
HYDROSPHERE	Angela BARBANO (Coasts) Marco CORDELLA (Venice Lagoon) Serena BERNABEI (Inland water) Gabriele NARDONE (Physical state of the sea) Marina PENNA (Marine and transition waters)	Silvia IACCARINO
GEOSPHERE	Fiorenzo FUMANTI with the collaboration of Marco DI LEGINIO and Anna LUISE (Desertification)	Paola SESTILI
WASTE	Rosanna LARAIA	Cristina FRIZZA
NUCLEAR ACTIVITIES AND ENVIRONMENTAL RADIOACTIVITY	Lamberto MATTEOCCI and Luciano BOLOGNA (Nuclear activities) Giancarlo TORRI and Giuseppe MENNA (Environmental radioactivity)	Silvia IACCARINO
NON-IONISING RADIATION	Salvatore CURCURUTO	Matteo SALOMONE
NOISE	Salvatore CURCURUTO	Cristina FRIZZA
NATURAL HAZARD	Eutizio VITTORI with the contribution of Valerio COMERCI	Luca SEGAZZI
ANTHROPOGENIC HAZARD	Laura D'APRILE (Contaminated sites)	Matteo SALOMONE
ENVIRONMENTAL ASSESSMENT AND AUTHORISATION	Anna CACCIUNI (VIA) Gaetano BATTISTELLA (AIA inquiries) Antonino LETIZIA (AIA inspections)	Luca SEGAZZI
ENVIRONMENTAL CERTIFICATION	Vincenzo PARRINI (Emas) Stefania MINESTRINI (Ecolabel)	Patrizia VALENTINI
ENVIRONMENTAL PLANNING TOOLS	Patrizia FIORLETTI (SEA) Patrizia BONANNI (Air) Angela BARBANO (Coasts) Saverio VENTURELLI (Waters) Salvatore CURCURUTO (Noise) Eutizio VITTORI (Natural risk) Claudio PICCINI (Biosphere)	Cristina FRIZZA
PROMOTION and DISSEMINATION of ENVIRONMENTAL CULTURE	Massimo DIACO Patrizia VALENTINI (Environmental information)	Alessandra GALOSI
ENVIRONMENT and WELL-BEING	Jessica TUSCANO (Environment & health) Vincenzo DE GIRONIMO (Pollens)	Patrizia VALENTINI

Coordinators were also identified for the phases of implementation not directly connected with the information contents of the Yearbook, as shown below:

Related activity	**Interface**	**AMB-ASA interface**
ISPRA web site	Stefano DE PAOLIS	Matteo SALOMONE
SINAnet databases	Michele MUNAFÒ	
Printing	Renata MONTESANTI Daria MAZZELLA	Matteo SALOMONE
Graphics/Photography	Franco IOZZOLI Paolo ORLANDI	Matteo SALOMONE
Communication	Claudia DELFINI	Patrizia VALENTINI

Authors of information content

The specific contributors (authors and collaborators for the individual topics) are listed at the beginning of each chapter of the full version.

Contributions of the Environmental Agency System

The System contributed in various phases: initially, in formulating the methodologies and collecting the data; secondly, in acting as referee, identifying and, where necessary, resolving any discrepancies produced by such an elaborate and complex information management process; and lastly, from this edition, in preparing contributions illustrating specific aspects (critical aspects or good practices) of the territory, included in the Key Topics document under the paragraph "Specific regional characteristics".

The role of interface between ISPRA and each ARPA/APPA was carried out by the Referees Network established as part of the inter-agency activities of the 2010-2012 Program for Activity Area C, "Processing – Management – Dissemination of Environmental Information":
Carlo ZAMPONI (ABRUZZO), Bruno BOVE (BASILICATA), Helmuth SCHWARZ (APPA BOLZANO), Claudia MORABITO (CALABRIA), Marino CARELLI (CAMPANIA), Roberto MALLEGNI (EMILIA-ROMAGNA), Sergio SICHENZE, Nicola SKERT (FRIULI-VENEZIA GIULIA), Alessandro D. DI GIOSA (LAZIO), Gino VESTRI (LIGURIA), Enrico ZINI (LOMBARDY), Federica ALLEGREZZA (MARCHE), Maria Giovanna VITULIANO (MOLISE), Pina NAPPI (PIEDMONT), Maria SERINELLI (PUGLIA), MASSIMO CAPPAI (SARDINIA), Marilù ARMATO (SICILY), Chiara DEFRANCESCO (APPA TRENTO) Marco CHINI (TUSCANY), Paolo STRANIERI (UMBRIA), Marco CAPPIO BORLINO (VALLE D'AOSTA), Francesca MENEGHINI (VENETO).

Authors of Specific Regional Characteristics under "Key Topics"

Chapter 1. Climate change and energy
Marco GANI, Stefano MICHELETTI (ARPA Friuli-Venezia Giulia)

Chapter 2. Biodiversity and activities involving ecosystems
Maddalena BAVAZZANO**,** Gaetano LICITRA, Fabrizio SERENA (ARPA Tuscany)

Chapter 3. Air quality
Sebastiano BIANCO, Carlo COLANGELI, Luciana DI CROCE, Sinibaldo DI TOMMASO (ARTA Abruzzo)
Marco DESERTI, Vanes POLUZZI (ARPA Emilia-Romagna), Lucia RAMPONI (Emilia-Romagna Region)
Fulvio STEL (ARPA Friuli-Venezia Giulia)
Alessandro D. DI GIOSA, Roberto SOZZI (ARPA Lazio)
Federica ALLEGREZZA (ARPA Marche)
Monica ANGELUCCI, Marco VECCHIOCATTIVI (ARPA Umbria)

Chapter 4. Inland water quality
Nicola SKERT (ARPA Friuli-Venezia Giulia)
Luciano MINUTOLO (ARPA Calabria)

Chapter 5. The sea and coastal environment
Luisella MILANI (ARPA Friuli-Venezia Giulia)
Marcello CECCANTI, Stefano ROSSI (ARPA Tuscany)

Chapter 6. Exposure to physical agents
Luca PIANI, Massimo TELESCA (ARPA Friuli-Venezia Giulia)
Barbara BRACCI, Nicola COLONNA (ARPA Tuscany)
Henri DIEMOZ (ARPA Valle d'Aosta)

Chapter 7. Nuclear activities and environmental radioactivity
Lorenzo CARNESALE, Luciana DI CROCE, Sergio PALERMI (ARTA Abruzzo)
Maria Clivia LOSANA, MAURO MAGNONI (ARPA Piedmont)
Massimo FAURE RAGANI (ARPA Valle d'Aosta)

Chapter 8. Environmental hazard
Michele FOLINO GALLO, Salvatore PROCOPIO (ARPA Calabria)
Glauco SPANGHERO (ARPA Friuli-Venezia Giulia)
Marco BAZZANI, Barbara SANDRI (ARPA Tuscany)

Chapter 9. Soil and land
Laura CATALANO (ARPA Friuli-Venezia Giulia)

Chapter 10. Waste cycle
Clemente MIGLIORINO (ARPA Calabria)
Alberto GROSSO (ARPA Campania)
Renzo BARBERIS, Alessandra LACCISAGLIA (ARPA Piedmont)
Emanuela BRUNO, Francesca DI GIOIA, Claudia Marcella PLACENTINO, Adriana PRIMICINO (ARPA Puglia)
Francesco CINTI, Alessandra SANTUCCI (ARPA Umbria)
Giovanna MANASSERO (ARPA Valle d'Aosta)

For their contributions as Referees, we thank the following:

ARPA/APPA	EXPERTS
ARTA Abruzzo	Giovanni DESIDERIO, Marco GIANSANTE, Giovanna MARTELLA
ARPA Calabria	Michele FOLINO GALLO, Clemente MIGLIORINO, Luisella

ARPA/APPA	EXPERTS
	MILANI, Salvatore PROCOPIO, Antonino VOTANO
ARPA Campania	Domenico FEDELE, Pietro FUNARO, Rita IORIO, Annamaria MATRONE, Luigi MONTANINO, Andrea TAFURO
ARPA Emilia-Romagna	Roberto MALLEGNI
ARPA Friuli-Venezia Giulia	Laura GALIZIA, Marco GANI, Paola GIACOMICH, Concettina GIOVANI, Luisella MILANI, Beatrice MIORINI, Luca PIANI, Fulvio STEL
ARPA Lazio	Andrea BOLIGNANO, Giorgio CATENACCI, Roberto SOZZI
ARPA Liguria	Sonia ALBANESE, Monica BEGGIATO, Rosella BERTOLOTTO, Walter RAINERI, Massimo VALLE
ARPA Lombardy	Silvana ANGIUS, Rossella AZZONI, Dario BELLINGERI, Orietta CAZZULI, Luca DEI CAS, Nicoletta DOTTI, Pietro GENONI, Guido LANZANI, Matteo LOMBARDI, Gregorio MANNUCCI, Alessandra NEGRIOLLI, Massimo PALEARI, Emma PORRO, Laura TREMOLADA, Mauro Giovanni VALENTINI
ARPA Marche	Federica ALLEGREZZA, Patrizia AMMAZZALORSO, Milena BRANDINELLI, Patrizia CAMPAGNOLI, Tristano LEONI, Mirti LOMABARDI, Massimo MARIANI, Corrado PANTALONE
ARPA Piedmont	Laura ANGLESIO, Renzo BARBERIS, Elisa BIANCHI, Barbara CAGNAZZI, Maurizio DITONNO Gabriele FABIETTI, Paolo FALLETTI, Mauro GROSA, Alessandra LACCISAGLIA, Mauro MAGNONI, Tommaso NICCOLI, Elena PENSI, Laura PORZIO, Elio SESIA, Giovanni TEPPA, Salvatore TONTI
ARPA Puglia	Lorenzo ANGIULI, Enrico BARBONE, Emanuela BRUNO, Luigi CARRINO, Maria Cristina DE MATTIA, Francesca DI GIOIA, Roberto GIUA, Domenico GRAMEGNA, Anna GUARNIERI CALÒ CARDUCCI, Filomena LACARBONARA, Vito LA GHEZZA, Emanuela LATERZA, Patrizia LAVARRA, Micaela MENEGOTTO, Tiziana MICCIANTUONO, Martino MINARDI, Marialucia MONGELLI, Alessandra NOCIONI, Tiziano PASTORE, Vito PERRINO, Claudia Marcella PLACENTINO, Adriana PRIMICINO, Simona SASSO, Maria SERINELLI, Gabriella TREVISI, Adriana TRISOLINI, Nicola UNGARO, Ettore VALENTINI, Barbara VALENZANO
ARPA Sardinia	Clara RONI, Alessandro SERCI
ARPA Sicily	Anna ABITA, Salvatore CALDARA, Antonio CONTI, Giuseppe CUFFARI, Antonino GRANATA, Vincenzo INFANTINO, Vincenzo RUVOLO, Hariberth SCAFFIDI ABBATE
ARPA Tuscany	Bianca Patrizia ANDREINI, Camillo BERTI, Claudio BONDI, Susanna CAVALERI, Alessandro FRANCHI, Fabio FRANCIA, Stefano MENICHETTI, Marzia ONORARI, Diego PALAZZUOLI, Barbara SANDRI, Marco TALLURI
ARPA Umbria	Cecilia RICCI, Paolo STRANIERI
ARPA Valle d'Aosta	Valeria BOTTURA, Daniela GERBAZ, Sara ISABEL, Fulvio SIMONETTO, Christian TIBONE, Claudia TORRICONE
ARPA Veneto	Elena AVANZI, Luigi BERTI, Maria CARTA, Paolo GIANDON, Beatrice MORETTI, Paolo PARATI, Italo SACCARDO, Paola VAZZOLER, Annarita ZOGNO
APPA Trento	Marco NIRO

Contributions by subjects outside of the Agency System

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We once again express our heartfelt thanks to all those who contributed to making the 2012 edition of the Yearbook possible.

The long but important list of those who in one way or another provided their contribution demonstrates, if such a thing were necessary, the complex work behind the creation of this volume, which is an essential reference for those who use environmental data and information during the course of their activities or just to keep abreast of the environmental conditions in our Country.

It is also clear that in order to achieve these objectives, we must further expand the network of cooperation with organisations and institutions, without which it would not be possible to provide an adequate body of knowledge to satisfy current demands.

This thank you goes out to everyone, even those who contributed but were not expressly mentioned. We may have inadvertently missed some names, and to those individuals we offer our most sincere apologies.

As in the previous editions, we invite all of our readers to send us any comments and suggestions so that we may, also on the strength of such contributions, continue our ongoing improvement in the development of the Yearbook.

Mariaconcetta GIUNTA
Head of the Environmental Statistics
and Yearbook Project Special Service

TABLE OF CONTENTS

I. Purpose of the document

Purpose

The publication presents a detailed outline of the state of the environment in Italy, especially highlighting some of the issues indicated by the European Union as “priority political intervention fields.”

Unlike the full version of the Yearbook, which analyzes the phenomena using individual indicator sheets, this version proposes a fully considered interpretation of environmental indicators, offering a possible organization of the data and information based on the DPSIR (Driving forces – Pressures – States – Impacts – Responses) model.

Developed by the European Environment Agency (EEA), the model places in a cause/effect relationship the pressures exerted upon the environmental matrix, the state of this matrix, the impacts on it, and the responses implemented or to be implemented in the future.
In particular, the DPSIR method is based on the circular nature of the relationships and influences between human activities, environmental conditions, and response measures to the critical areas identified: human activities (D) generate factors of pressure (P) that are responsible for a given environmental condition (S) with consequences on people and on ecosystems (I), which can be contained with appropriate countermeasures (R).

In order to make the document easier for the general public to use and to foster more immediate communication, particular attention has been given to the text’s clear yet rigorous language, and to the graphics, which are accompanied by notes and explanatory comments. Moreover, there is also a glossary of the key terms related to the issue that is illustrated.

Document organization

The volume is organized in 12 chapters: 11 of them each address a specific environmental issue. The twelfth is dedicated to the instruments of environmental awareness.
The content dealt with regards the following themes: *Climate changes and energy*; *Biodiversity and activity on ecosystems*; *Air quality*; *Inland water quality*; *The sea and the coastal environment*; *Exposure to physical agents*; *Nuclear activities and environmental radioactivity*; *Environmental hazard*; *Land and soil*; *Waste*; *Instruments for environmental knowledge and awareness, and interface with the market*.
Noteworthy is the inclusion of the chapter *The perception of Italian and European citizens regarding water resources and air quality issues* substituting the two introductory chapters proposed in the last two editions of the Environmental Data Yearbook. These presented statistical information on perceptions and the degree of knowledge of European and Italian citizens with regard to the environment and its problems, chiefly using as data sources European and national investigations aimed precisely at measuring opinions, attitudes, and behaviours of the population (families and/or citizens) in the matter of environmental issues. In this edition, based on a scanter availability of data, the choice was made to limit the monitoring to two issues that were the object of recent European investigations (water resources and air quality).
Each problem is described based on the information and the data present in the indicator sheets in the Environmental Data Yearbook, examining three points of the DPSIR scheme: 1) the existing condition (State/Impact), 2) the causes that contributed to generating it (Driving forces/Pressures), 3) the solutions undertaken or planned (Responses).
An important new element introduced starting this year is the inclusion at the end of each point of a text box written by ARPA/APPA, aimed at illustrating a special aspect (critical elements or good practises) of its own territory.
It is stressed that not all the contributions that were received proved to be meaningful as concerns scientific importance and the content's pertinence to the specific regional features. However, for this first edition, which involves the System more directly, the choice was at any rate made to fully include the Agencies' contributions.
The regional elements that were provided regarded the following issues:
Climate changes and energy (ARPA Liguria, ARPA Friuli-Venezia Giulia); *Biodiversity and activity on ecosystems* (ARPA Tuscany); *Air quality* (ARPA Friuli-Venezia Giulia, ARPA Emilia-Romagna, ARPA Marche, ARTA Abruzzo, ARPA Lazio); *Inland water quality* (ARPA Friuli-Venezia Giulia, ARPA Calabria); *The sea and the coastal environment* (ARPA Friuli-Venezia Giulia, ARPA Tuscany); *Exposure to physical agents* (ARPA Friuli-Venezia Giulia, ARPA Aosta Valley, ARPA Tuscany); *Nuclear activities and environmental radioactivity* (ARPA Piedmont, ARPA Aosta Valley, ARTA Abruzzo); *Environmental hazard* (ARPA Friuli-Venezia Giulia, ARPA Tuscany, ARPA Calabria), *Land and soil* (ARPA Friuli-Venezia Giulia); *The waste cycle* (ARPA Aosta Valley, ARPA Campania, ARPA Calabria, ARPA Piedmont, ARPA Apulia).
The user may consult the chapters on a number of levels or in a number of modes of reading: the full text deals with the material comprehensively on a national level; the highlights in the margin underscore key information and allow the issues to be easily identified; the graphics and figures represent the scientific data and the individual phenomenon in particular; the text boxes circumscribe the issue to the regional situations.
At the end of each chapter, a glossary of terms and definitions collects and explains the vocabulary most specific to and indicative of the subject, highlighted in orange in order to help the reader identify it in the text.
In appendix to the document is a useful description of the Yearbook Database, an information technology system that allows the information base available to ISPRA to be collected and managed, as well as consulted by the various kinds of users.

II Socio-Economic Framework

Key features of Italy

Italy is a peninsula located in southern Europe, at the centre of the Mediterranean Sea. Its territory holds mountain chains of the Alps and the Apennines, a few major rivers, with the longest being the Po, and many lakes (the largest is Lake Garda), plus numerous islands, including the major islands of Sicily and Sardinia and 70 other smaller islands. Italy covers a total surface area of 301,336 km^2 (not including the Republic of San Marino and the Vatican City state). Its maximum length is 1,200 kilometres (from Vetta d'Italia to Capo delle Correnti). The terrain is primarily hilly and mountainous at respective percentages of 41.6% and 35.2%. Its extensive coastlines total approximately 8,300 kilometres in length. All these features ensure that Italy presents a highly diversified landscape.

47 Italian cities and cultural sites are included on the UNESCO Worldwide Heritage List.

Climatic conditions are generally temperate, though with regional variations. Summers are hot in the northern Regions and occasionally rainy, while the central Regions can present significant humidity and the southern Regions are subject to torrid heat. Winters in the cities of northern Italy feature cold temperatures, humidity and fog, whereas temperatures in the south are much more comfortable (10-20°C).

Italy possesses approximately 40% of the world's art treasures. It is currently the country with the largest number of officially recognised world heritage sites (47 cities and cultural sites included on the UNESCO Worldwide Heritage List).

II.1 Key factors in the development of Italian society

Following the reunification of Italy, the census taken in 1861 showed that Italians residing in Italy numbered 26 million. Over time, Italy doubled its population, with a impressive increase occurring in the immediate aftermath of the Second World War (1945-1950), when annual growth rates of more than 1% were recorded, especially in urban and suburban areas.

The years of the "Italian Economic Miracle" witness massive migratory flows among the country's Regions.

After world war II the rebuilding of the industrial infrastructure, along with much of the rest of the country, plus the political and economic policies enacted, ushered in major socio-economic changes, transforming Italy from a poor, rural type society to an industrialised one. The years from 1956 to 1963 are known as those of the "Italian Economic Miracle", a period characterised by a steep rise in income. This process of growth fuels massive migratory flows among the country's Regions, with the better employment conditions to be found in urban areas serving as the chief catalyst for an intensive exodus from rural areas to cities, both from the inland mountainous zones of the Alps and the Apennines and from Sicily and Calabria, with the favoured destinations of the migration being Rome, Milan, Turin and Genoa. This exodus to industrial areas is still underway, though it has slowed due to the current depressed state of the economy.

In accordance with the overall framework, the structure of the Italian people also changed over time, in terms of both population and

customs, going from approximately 47 million inhabitants in the 1950's to the roughly 60 million of today. In terms of demographics, this period was characterised by a sharp drop in the birth rate and a gradual ageing of the population.
Indeed, in 2011 there were 144 people aged 65 or older for every 100 people younger than 15 (the ratio had been 97 to 100 in 1992), while the average number of children per women was 1.4, the combined result of figures of 2.07 for resident foreign women and 1.33 for Italian women. There were also noteworthy changes in the demographic indexes for the resident population.

The low birth rates of the eighties and nineties set off a rapid aging of the Italian population, a process that has reached levels among the highest in the world.

Table II.1: Demographic indicators of the resident population[1]

	1961	1971	1981	1991	2001	2011	2030	2065
Ageing ratio[a]	38.9	46.1	61.7	92.5	127.1	144.5	207.1*	257.9*
Age dependency ratio[a]	51.6	55.5	53.1	47.5	48.4	52.3	63.2*	82.8*
Average age of the population (at January 1st)	33.5	34.5	36.1	38.9	41.7	43.5	47.0**	49.7**
Life expectancy at birth (males)	67.2	69	71.1	73.8	77	79.4*	82.8**	87.7**
Life expectancy at birth (females)	72.3	74.9	77.9	80.3	82.8	84.5*	87.7**	91.5**
Average number of children per woman	2.4	2.4	1.6	1.3	1.3	1.4	1.4*	1.6**
Birth rate per 1000 population	18.3	16.8	11.1	9.8	9.4	9.1*	8.1**	8.3**
Death rate per 1000 population	9.1	9.5	9.6	9.6	9.6	9.7*	10.6**	13.9**

* estimates
**projection
Note
[a]: Censuses 1961-2001 and 1st January 2009-2065

Following the Second World War, 42% of the population still worked in the agricultural sector, though the industrial and services sectors (respectively accounting for 32% and 26%) were gaining increasing importance. Industrial development in the sixties modified the distribution of employment among the economic sectors: the percentage of the active population employed in industry reached 41%, while the figure for services was 30%, and the percentage employed in agriculture fell to less than 30%.
By 1981, the trend of the Italian economy towards the services sector had resulted in a further shift of the active population into services, which reached a percentage of approximately 50%.

[1] Source: ISPRA processing of ISTAT data

The economic crisis of recent years has been hard felt by the labour market, bringing to light not only the marked divergences still to be found between the different Regions of Italy, but also the difficulty young people face in entering the job market, plus the large number of people who have given up looking for jobs (employment discouragement), and the low representation of female workers. The economy continues to move towards the services sector: approximately 68% of salaried workers are employed in the services.
In 2011 economic activity in Italy felt the repercussions of the overall domestic and international situations. The major crisis that began in the United States in 2007 caused severe damage in Italy, leaving its economy with one of the lowest growth rates in the world.
In 2011 the variation in the volume of the GDP was +0.4%, while the percentage of the population between the ages of 20 and 64 with jobs was 61.2%, with a marked gender imbalance: 72.6% of men were employed but only 49.9% of women. Divergences between Regions were also significant: in the south, the level of overall employment was less than 50% (47.8).

The distribution of the active population by sector shows that by 2011 approximately 68% was employed in the services. The percentage employed in agriculture fell to less than 4%.

Table II.2: The employed by position, sector of activity and geographical area[2]

Geographical area	Absolute figures (in 1000's)			Percentage variations 2011/2010
	figures in 1,000's			%
	Employees	Self employed	Total	Total
North	93	217	310	-6.5
Central	50	68	117	-4.6
South and the islands	270	153	423	2.7
TOTAL Agriculture	**413**	**438**	**850**	**-1.9**
North	2,732	343	3,075	2.4
Central	682	129	812	-1.7
South and the islands	674	130	804	0.6
TOTAL Industry in strict sense	**4,089**	**603**	**4,692**	**1.4**
North	526	378	904	-2.4
Central	246	145	391	-10.1
South and the islands	365	186	552	-6.2
TOTAL Construction	**1,138**	**709**	**1,847**	**-5.3**
North	5,738	1,897	7,636	0.8
Central	2,625	881	3,506	1.6
South and the islands	3,238	1,199	4,437	0.8
TOTAL Services	**11,601**	**3,978**	**15,579**	**1.0**
North	9,090	2,835	11,925	0.7
Central	3,603	1,223	4,826	-0.1
South and the islands	4,547	1,668	6,216	0.2
TOTAL	**17,240**	**5,727**	**22,967**	**0.4**

[2] Source: ISTAT

Table II.3: Rateal of employment of the population aged 20-64 by sex and geographic area[3]

Geographical area	2005			2011		
	Men	Women	Total	Men	Women	Total
	%					
Northwest	78.9	57.5	68.3	77.9	59.4	68.7
Northeast	80.0	59.3	69.7	79.7	61.5	70.6
Central	76.2	54.0	65.0	75.8	55.2	65.3
Central North	78.4	57.0	67.7	77.8	58.7	68.2
South and the islands	67.5	32.7	49.9	62.7	33.4	47.8
ITALY	74.6	48.4	61.5	72.6	49.9	61.2

The employment rate shows a sharp gender imbalance: 72.6% of the employed are men and 49.95% are women.

II.2 The main driving forces and the resulting environmental pressures and impacts

The key facets of the country's geographic and socioeconomic situation, and especially its demographic dynamics and the behaviour of its economic protagonists (families and businesses), are closely related to the pressures of human origin that threaten the national environment (air, water, soil and nature pollution, waste generation, consumption and deterioration of natural resources).

Socio-demographic considerations

The production activities and the individuals found in a given territory constitute the root causes of pressures on the environment in terms of consumption, waste generation, traffic, emissions etc.. With this in mind, any analysis of the environmental situation must include an analysis of the demographic outlook, which can have noteworthy socioeconomic consequences.

As of 1 January 2012, Italy's resident population numbered 59,394,207 people, 6.8% of whom (4,053,599) were foreigners. The increase registered in the overall population as compared to the figure from the previous census is attributable to the increase in the number of foreign citizens.

The increase in the resident population registered in the 2011 census, as compared to the previous census, is traceable to an increase in the number of foreign residents.

Two out of three foreign residents live in northern Italy (35% in northwest Italy and 27% in the northeast), while 24% live in central Italy and 13% in the south and the islands.

In terms of the total population, 26.5% lives in northwest Italy, 19.3% in northeast Italy, 19.5% in central Italy and 23.5% in southern Italy, with 11.2% of the population living on the country's islands.

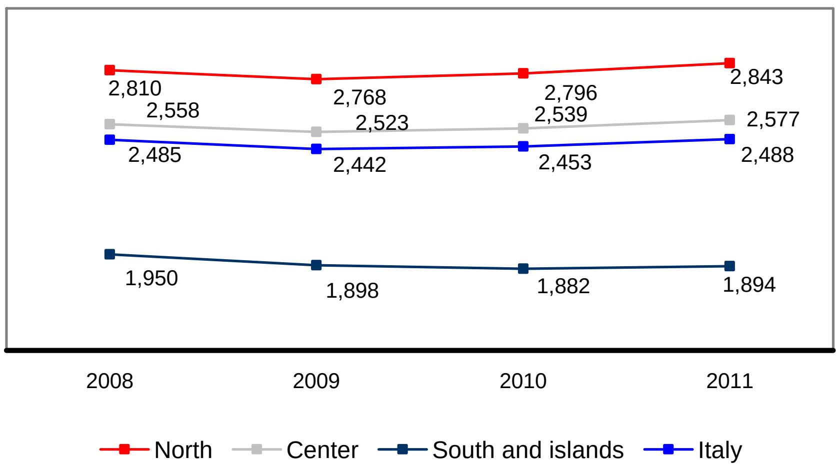
Geographically, noteworthy differences can be observed between the various Regions in terms of both surface area and demographics. The most populous Region is Lombardy, with more than 9.7 million residents, followed by Campania (more than 5.7 million) and Lazio (more than 5.5 million). The Regions that cover the greatest surface area, on the other hand, are Sicily, Piedmont, Sardinia and, in fourth place, Lombardy. The levels and composition of consumption are also affected by demographic changes: in particular, variations in the size of families and in the

[3] Source: ISTAT data processed by ISPRA

characteristics of their members have an influence on the allocation of available budgets.

The number of families residing in Italy, equal to 21.8 million in 2001, currently stands at 24 million, while the average number of family members went from 2.6 to 2.4 during the same period, confirming the trend towards fewer large families and a growing number of families consisting of a single person. The traditional family of a married couple with children is no longer the predominant model. New forms of families are on the rise, including those headed up by a sole parent who is not widowed, by a single person who is not widowed, as well as couples who live together without being married and married couples with families recomposed from earlier marriages. Four out of ten people between the ages of 25 and 34 still live in their families of origin: 45% because they are unable to support themselves independently. It should be noted that 11.1% of the families residing in Italy find themselves in a condition of relative poverty – meaning 8 million and 173 thousand individuals, accounting for 13.6% of the population – while 5.2% are in a state of absolute poverty – meaning 3 million and 415 thousand individuals, or 5.7% of the total population. In southern Italy and the islands, the intensity of relative poverty increased. In 2011, average monthly household expenditure, in current values, was equal to 2,488 euro (compared to 2,453 euro in 2010), varying from a minimum of 1,782 euro (for families consisting of a single person) to a maximum of 3,215 euro (for families of 5 or more people). Compared to the previous year, consumer spending on food, equal to 477 euro, increased by 2.2%. On the average, this represents 19.2% of total monthly household expenditure. In contrast, the percentages of expenditure for clothing and footwear, furnishings, home appliances, services for the home and for leisure time and cultural pursuits decreased, while price increases led to higher percentages of spending on places of residence and transportation. Looking at regional differences, Lombardy once again recorded the highest figure (3,033 euro) and Sicily the lowest (1,637 euro).

In 2011, four out of ten people between the ages of 25 and 34 still lived with their families of origin: 45% because they could not support themselves independently.



In 2011, average monthly household expenditure was equal to 2,488 euro in current values, varying from a minimum of 1,782 euro to a maximum of 3,215 euro.

Figure II.1: Average monthly household expenditure by

geographical area, figures in euro[4]

Economic considerations

In 2011, Italy's GDP remained unchanged in real terms.

The Gross Domestic Product (GDP), which represents the total output of goods and services produced in a country in a given period, valued at market prices, remained unchanged for Italy in 2011, in real terms.

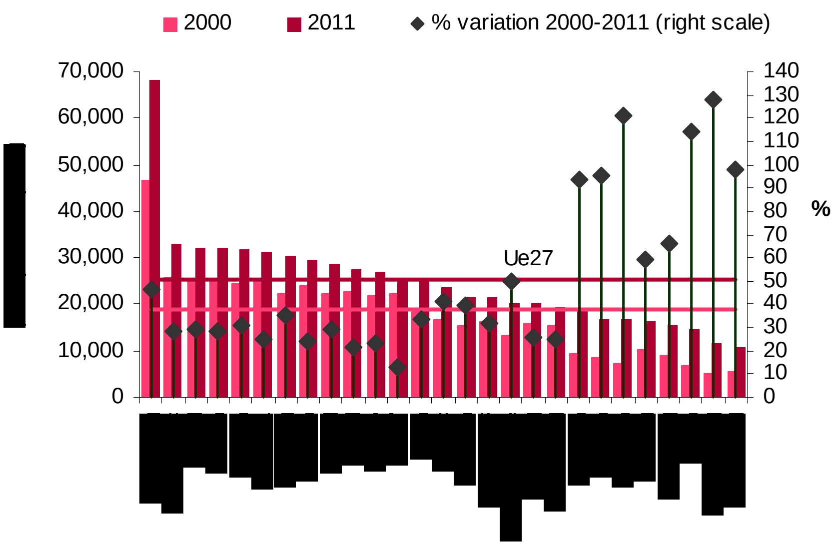
In the European Union, the per capita GDP at PPP[5] differs considerably country by country.

In 2011, the GDP ranged from the 68,400 euro in Luxembourg to Latvia's 14,800 euro.

GDP growth rates have varied significantly among the different European states: healthy growth in Germany, weak in Spain and Italy, extremely negative in the countries subject to programs of fiscal adjustment, such as Greece and Portugal.

Unlike what has occurred in Europe as a whole (EU27), where the countries that start from a lower level of per capita GDP, at PPP, are those that feature the highest grouth rates, the Regions of Italy have not followed this pattern of convergence towards economic growth, seeing that the southern Regions have failed to close the gap with the richer Regions of the north.

In 2011, due to the fact that the level of economic growth recorded in our country was the lowest in the European Union, Italy's per capita GDP (at PPP) stood only 0.4% above the average for the EU27 countries, whereas it had been 18% than the average in 2000.



Unlike the year 2000, when Italy's per capita GDP stood 18% higher than the average per capita GDP for the EU27 countries, in 2011 our country's economic growth rate, the lowest in the European Union, placed the Italian per capita GDP only 0.4% above the average for the EU27 countries.

Legend

* PPP: purchasing power parity

Note:

[a] The figures are updated to 5 November 2012. Any discrepancies with those that appear in other publications or in national or international databanks may depend or rounding-off or on the fact that the latest adjustments in the data have not been taken into account.

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[4] Source: ISTAT

[5] PPP = purchasing power parity

[b] The figures for Greece and Portugal are provisional.

[c] The latest data available for Bulgaria, Poland and Romania regard 2010.

Figure II.2: Per capita GDP in the EU countries[6]

In almost all the countries of Europe, consumption accounted for more than 70% of the domestic GDPs.

With regard to consumption, which constitutes the primary component of aggregate demand[7], figures show that in 2011 all the countries of the EU, except for Ireland and Luxemburg, registered levels of consumption in excess of 70% of their GDP.

The sum total of consumption and investments constitutes domestic demand.

Consumption, in Italy, in 2011 was equal to 82.7% of the GDP, while investments amounted to 19.6%.

It should also be noted that in various countries[8], including Italy, the totals of the percentages of the GDP represented by consumption and investment are higher than 100, indicating that these countries consume and invest more than they produce, and therefore need to draw on foreign markets. A similar situation also exists in southern Italy, whose Regions are forced to import goods and services to sustain high levels of consumption and investment compared to their GDPs.

Within the European area as a whole, average inflation relating to consumption rose in 2011 to 2.7% from the figure of 1.6% for the preceding year. The increase is largely due to sharp price rises for raw materials and to the higher levels of indirect taxation introduced in some countries as elements of programs to reform public finance.

Underlying inflation, measures using an index that excludes food and energy products, remained at a relatively low level (1.4%).

Inflation forecasts over the medium and long term have remained stable, in line with the price stability called for under the Euro System[9].

Exports, driven by trade with emerging markets, have provided support for economic activities, rising above the levels recorded prior to the recession.

Domestic demand, on the other hand has weakened.

Spending on consumer goods has felt the effect of concern over the weak outlook for the employment market and disposable income; investments registered a modest increase, following three years of decline.

As has been the case for more than a decade, in 2011 the productivity of the Italian economy grew at a lower rate than that of Europe's other major economies.

As has been the case for more than a decade, in 2011 the productivity of the Italian economy grew at a lower rate than that of Europe's other major economies.

Contrary to what occurred in the three-year period of 2008-2010, when almost all the different sectors of the economy were affected first by the recession and then by the recovery, in 2011 the performance of the individual sectors varied widely in terms of value added, ranging from the negative results of certain traditional areas of production, which stood in contrast to the more favourable figures for

[6] Source: Eurostat data processed by ISTAT (http://noi-italia.istat.it), *National Accounts*

[7] Eurostat, Database New Cronos

[8] Ibidem

[9] Bank of Italy, Annual Report 2011

sectors of medium-high technological intensity. The enterprise that best dealt with the weak economic outlook were those already geared towards innovation and internationalisation.
Due to the weakening of the international economic cycle, the slowdown in production has been more pronounced, in terms of value added, in the sector of industry in the strict sense (1.2%, compared to 7% in 2010), as opposed to the services (0.8%, compared to 1.4%); the reduction of the construction sector has continued (-3.5%, -5.6% a year in the preceding two years)[10].

The Regions of central Italy showed a greater propensity for services enterprises, while micro-enterprises predominant in southern Italy, medium-size enterprises are more widespread in the northeast, and large-scale is the norm in the northwest.

Figure II.3: Prevalent business sectors and company sizes by region, as compared to the national average (2010)[11]

[10] Bank of Italy, Annual Report on 2011
[11] Source: ISTAT processing (http://noi-italia.istat.it) of ASIA data – Statistical Register of Active Enterprises

With regard to Italy's production structure, based on Eurostat[12] data on structural business statistics and the ISTAT "ASIA" Archive[13] for Italian businesses, it can be observed that the sectoral breakdown of Italy's ISTAT statistics institute, the make-up of the sector in Italy is similar of Germany, even though large-scale industry is prevalent in Germany, as is the case in all the economies of continental Europe.
Within Italy, on the other hand, large-scale service enterprises are more widespread in Lazio, micro-industry is more frequent in Tuscany, and small-scale industry (10-49 employees) is especially popular in the Marche and Umbria Regions.
In southern Italy, micro-enterprises are prevalent, with those engaged in services being particularly widespread in Campania, Calabria, Sicily and Sardinia, while micro industrial concerns are more commonly found in Apulia, Basilicata, Abruzzo and Molise.
In the Regions of northeast Italy, small and medium-size industrial enterprises are the most widespread, while large-scale industry is predominant in the northwest, and especially in Piedmont.

Industry

Industry leads to far-reaching transformations and modifications of the environment in which it is established, due to the emission of pollutants into the air, water and soil, the exploitation of natural resources, the waste generation, the side-effect of increased traffic etc.

The pressure generated by industry manifest themselves in direct relation to the number of industrial sites developed, as well as through other factors, such as the hazardous substances utilised.

The pressures manifest themselves in direct relation to the number of industrial sites developed, as well as through other factors, such as the hazardous substances utilised. In Italia, the number of active enterprises in 2010, meaning the number that engaged in production activities for at least six months of the year under examination, was less than 4.5 million, and they employed a total of approximately 17 million workers. Industrial enterprises (meaning industry in the strict sense) numbered approximately 442 thousand and employed 4.3 million workers, specifically 619,606 independent workers (owners, partners, cooperative members, relatives, in-laws etc.) and 3,689,904 salaried employees. Compared to the third sector (services), industrial enterprises have a larger average size, ranging from a maximum of 21.6 employees per company (the sector of the supply of electric energy, gas, steam and air-conditioning) to 9.4 (manufacturing activities).
Between 2009 and 2010, the number of industrial enterprises registered a decrease of 2.4%, with specific figures including drops in almost all areas of manufacturing activity (-2.8%) as well as mining activities (-1.9%), whereas noteworthy gains were recorded among enterprises that supply electric energy, gas, steam and air conditioning (36.8%). The reduction in employment in all areas of industrial activity proved particularly noteworthy in the manufacturing sector, which showed an overall drop of 3.7% in the number of employees. The highest losses were recorded in enterprises

[12] Eurostat, *Structural Business Statistics* (SBS)
[13] ISTAT, Statistical Register of Active Enterprises (ASIA)

involved in textiles, clothing and accessories, at -6.5%. Negative variations, again in terms of employees, were registered in all the geographic zones: -3.4% Northwest, -3.5% Northeast, -3% Centre, -4.3% South and -3.3% Islands.

Between 2009 and 2010, the number of industrial enterprises registered a decrease of 2.4%.

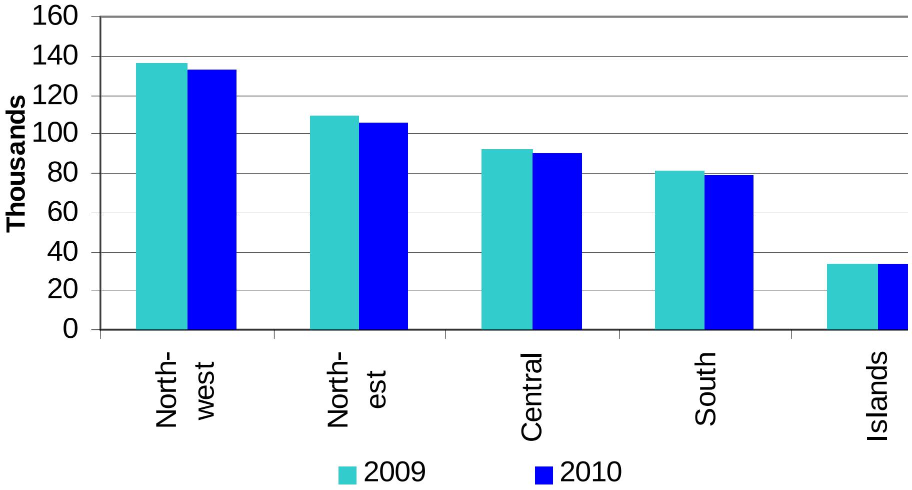


Figure II.4: Industrial enterprises by geographical area[14]

Also of interest is the localisation within the national territory of plants posing Major Accident Hazard (MAH plants), seeing that, on account of the hazardous substances they utilise or the potential accident scenarios they present, they can determine environmentally critical situations brought about by industrial activity.

In Italy, as of 31 January 2012, the number of plants posing major accident hazard (MAH) stood at 1,131.

As of 31 January 2012, the number of MAH plants in Italy stood at 1,131, with 565 classified as such under arts. 6/7 and 566 under art. 8.

The regional distribution shows that 25.2% of the plants are located in Lombardy, while other Regions with a noteworthy presence of MAH plants at risk include Veneto and Emilia Romagna, which account for over 9% of the plants (respectively 108 and 100) and Piedmont, in which 8.6% (98).

These Regions also include a number of areas were such plants are especially concentrated, such as the traditional refining and/or petrochemical hubs of Trecate (Province of Novara), Porto Marghera (Province of Venice), Ferrara e Ravenna, as well as industrial areas in the provinces of Turin, Alessandria, Bologna, Verona and Vicenza.

Chemical and/or petrochemical plants are prevalent within the national territory, along with deposits if liquefied gas (essentially LPG), which, taken altogether, account for approximately

In terms of the types of activities involved, chemical and/or petrochemical plants are prevalent within the national territory, along with deposits of liquefied gas (essentially LPG), which, taken altogether, accounted for approximately 50% of all such plants.

It should also be noted that the Regions of Lombardy, Piedmont, Emilia-Romagna and Veneto were found to hold concentrations of chemical and petrochemical plants.

LPG depots are especially widespread in the southern Regions, in particular in Campania and Sicily, as well as in Lombardy,

[14] Source: ISTAT data processed by ISPRA

Tuscany and Veneto, and in general in the vicinity of urban areas throughout the country, but specifically in the provinces of Naples, Salerno, Brescia, Venice and Catania.

50% of all MAH plants.

In contrast, the refining industry (17 plants in Italy) is distributed rather evenly throughout the country, with the highest concentrations in Sicily and Lombardy, which contain 5 and 3 plants respectively.

Mineral-oil storage facilities are concentrated primarily in the vicinity of the country’s major urban areas and in cities with important industrial ports (Genoa, Naples, Civitavecchia).

Almost all the provinces of Italy have at least one plant that presents a Significant Accident Risk.

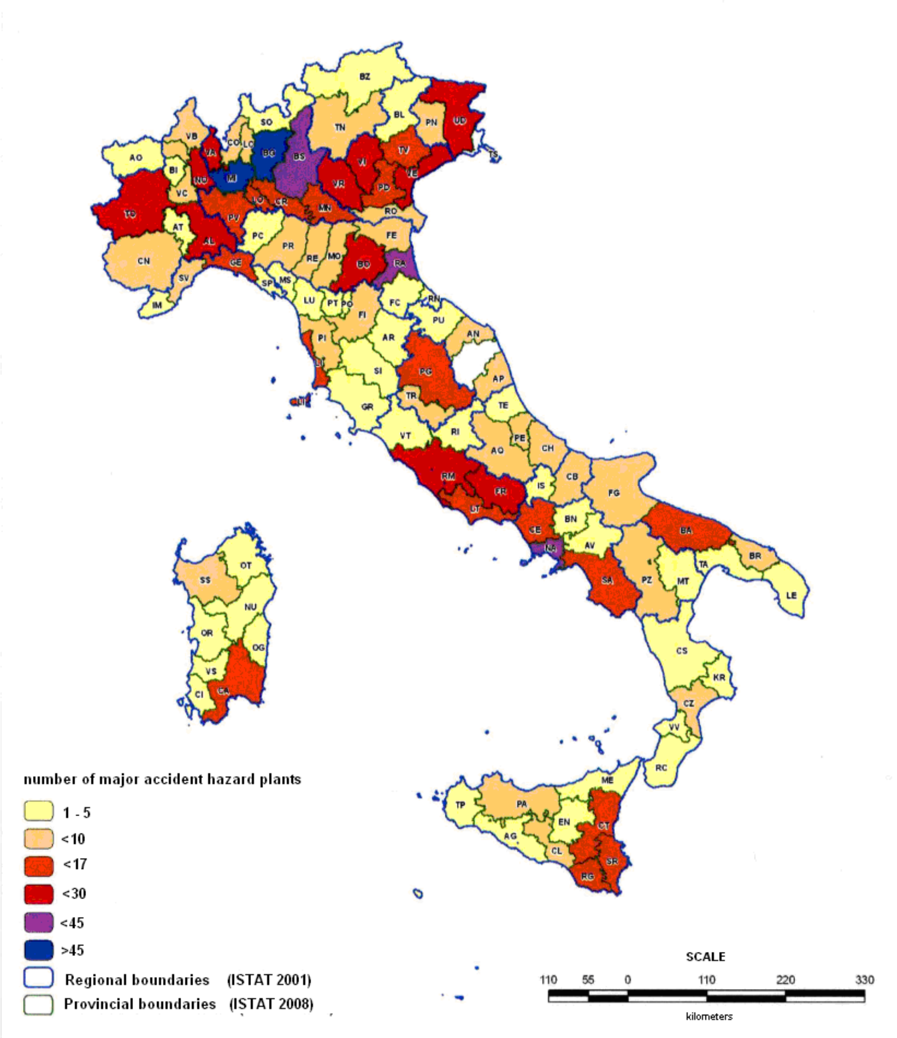


Figure II.5: Distribution by province of plants subject to Legislative Decree 334/99, as subsequently amended[15]

Energy

Italy utilises less energy per unit of product than most of the other industrialised countries. This peculiarity arises from:

- the traditional shortage of primary energy sources (import dependency in 2011 was 80.7%), which has favoured the creation of parsimonious forms of behaviour and infrastructures in terms

Italy utilises less energy per production unit than most of the other industrialised

[15] Source: Ministry of the Environment data processed by ISPRA

of the use of energy, plus a production system that is not excessively energy-intensive;

- the high taxes on energy sources, which push their cost to the final user well beyond the average cost in the EU;
- lower per capita income;
- the relatively mild climate.

countries.

This advantage, which has long been characteristic of our country, has been gradually diminished over the last twenty years.

Still, a comparison with the rest of the European Union shows that energy intensity in Italy remains below the EU average, rating as one of the lowest figures for the 27 countries.

In 2011, gross domestic consumption of energy resources in Italy was equal to 184.20 Mtoe, with more than 81.2% of this demand being satisfied by fossil fuels.

In 2011, gross domestic consumption of energy resources in Italy was equal to 184.20 Mtoe (millions tonnes of oil equivalent), with more than 81.2% of that demand satisfied by fossil fuels (37.5% by oil, 34.7% by natural gasand 9% by coal and other solids), while the remainder was renewable sources (4.7%) and primary electricity (14.1%).

Since 1990, an upward trend in gross domestic energy consumption was recorded, reaching its peak in 2005 (+21% compared to 1990).

Later this trend was reversed, a development accelerated by the economic crisis.

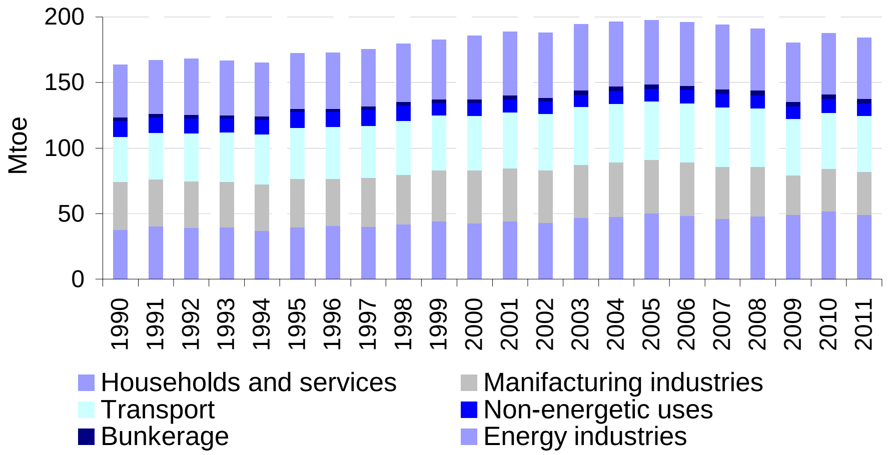
By subtracting the energy dissipated during transformation procedures from the figure for gross domestic consumption, we arrive at the amount that can be made available to final users (approximately 135 Mtoe in 2011).

Civil uses (household and service sector) and transport (passengers and freight) are two areas that each account for more than 30% of the final uses, while the industrial sector uses slightly less than a fourth, while the remainder is employed in the agricultural sector, for non-energetic uses and in the form of stocks of coal for international maritime transport (referred to as bunkerage).

During the period 1990-2008, industrial demand for energy rose slightly, slowing over time, both on account of a more efficient use of resources and structural factors, such as the diminished incidence of heavy industry. In the wake of the economic crisis of 2008, the sector registered a marked decline.

Annual growth in the transport sector was much more robust, though here too the national economic situation triggered a retrenchment.

Meanwhile the household and services sector, though subject to noteworthy fluctuations on account of the variable of climate, showed a long-term upward trend, essentially traceable to the contribution of services, for which levels of consumption have doubled since 1990.



The demand for primary energy stood at 184 Mtoe in 2011.

Figure II.6: Final domestic energy consumption by economic sector[16]

The incidence of imported oil and gas with respect to energy supplies creates a situation in which domestic energy prices depend on prices on international markets, and especially the price of crude oil.

The average level of energy prices for final users tends to be higher than that registered in other European countries.

The average level of energy prices to final users tends to be higher than that registered in other European countries.

In the case of electricity, the cost per kWh for the average household user in the first six months of 2012, including taxes, was 14.9% higher than the average cost in the EU27, while the cost for medium-size Italian industrial enterprises was 42.1% higher than the equivalent EU27 cost.

Taxes had an incidence of 47.1% on household utility use in Italy, while the figure for the EU27 was 41.6%, and taxes on industrial users accounted for 60.3% of the cost in Italy and 48.9% in the rest of Europe.

This price differential can be traced to the supply structure for the energy sources, the degree of competition on the market, the adequacy of the infrastructures and the level of the tax burden.

The taxation of energy resources meets the dual need of generating revenues while influencing prices, so as to limit consumption.

The elevated tax burden may have contributed to improving energy intensity in Italy.

Agriculture, forestry, aquaculture

Relations between the environment, agriculture and forestry are extremely complex and often enter into conflict.

On the one hand, farmland is subject to the direct impact of other sector of production (such as the consumption of land) or indirect repercussions arising from alteration of the physical or chemical properties of the atmosphere or the occurrence of extreme weather events.

[16] Source: The Ministry of Economic Development

At the same time, agricultural activities - which, in many cases, have involved the intensified, concentrated or specialised use of land or agricultural practices in recent decades - are considered to be among the primary causes of water pollution, land erosion, pollution or acidification, plus increases in the greenhouse effect, loss of biological diversity, simplification of the landscape and diminished wellbeing of livestock.

Agricultural plays an important role in environmental defence.

And yet there is no question that agriculture, in addition to ensuring elevated production of foodstuffs, timber and fibres, can also play an important role (if properly managed) in the environmental defence of the land, as well as the preservation of the biological diversity of ecosystems, in terms of both species and genes, in addition to reducing the pollution and deterioration of soil and water. Indeed, in recent years, relations between the environment, agriculture and forestry have become even more complex, due to the emergence of major challenges, such as the need to produce more foodstuffs, fibres and wood for a growing population that increasingly concentrates itself in urban centres, to the detriment of a shrinking labour force in rural areas, or the opportunity to supply biomass for the production of energy to a potentially enormous market, as well as the chance to contribute to the development of the world’s poor countries, which depend to a large extent on agriculture.

Faced with the unceasing globalisation and expansion of international trade, Italian agriculture, forestry and aquaculture cannot avoid addressing these challenges, which will make necessary difficult decisions.

On the one hand, there is the need to meet the growing demand for both “conventional” and “new” products (including bio-combustibles) at elevated levels of quality, while, at the same time, systems of management and production must increasingly take into account considerations of environmental defence and sustainability.

In recent decades Italy has registered a noteworthy reduction in both its agricultural enterprises and (though to a lesser extent) its UAA.

In recent decades, together with a stagnation in demographic growth and in the demand for agricultural products, as well as an exodus of inhabitants from rural areas and an increase in the per-unit productivity of the land, Italy has also witnessed a noteworthy decrease in the number of agricultural enterprises.

The data gathered for the 2010 Agricultural Census shows that there were 1,620,884 agricultural and animal husbandry enterprises in operation (-32.4% compared to 2000), and that the Utilised Agricultural Area totalled 12,856,048 hectares (-2.5% compared to 2000).

While the number of agricultural enterprises has fallen, the size of the average enterprise has grown from 5.5 hectares of UAA in 2000 to 7.9 hectares in 2010.

The most significant decrease was recorded among enterprises with less than 1 hectare of UAA, whose number fell by more than 50% during the decade in question.

More than half the enterprises

More than half of the enterprises (54.6%) are concentrated in the following 5 Regions: Apulia, Sicily, Calabria, Campania and Veneto.

(54.6%) are concentrated in 5 Regions.

Table II.4: Agricultural enterprises and Utilised Agricultural Area (UAA) by region[17]

Region/ Autonomous province	Enterprises			UAA		
	2010	2000	2010/2000	2010	2000	2010/2000
	number		%	hectares		%
Piedmont	67,148	106,240	-36.8	1,010,780	1,068,766	-5.4
Val d'Aosta	3,554	5,925	- 40	55596	71,109	-21.8
Liguria	20,208	36,987	-45.4	43,784	63,781	-31.4
Lombardy	54,333	70,993	-23.5	986,826	1,039,537	-5.1
Trent-Alto Adige	36,693	51,188	-28.3	377,755	414,092	-8.8
Bolzano / Bozen	*20,247*	*23,043*	*-12.1*	*240,535*	*267,380*	*-10*
Trent	*16,446*	*28,145*	*-41.6*	*137,219*	*146,712*	*-6.5*
Veneto	119,384	176,686	-32.4	811,440	850,979	-4.6
Friuli-Venetia Giulia	22,316	33,076	-32.5	218,443	237,937	-8.2
Emilia-Romagna	73,466	106,102	-30.8	1,064,214	1,129,280	-5.8
Tuscany	72,686	121,177	-40	754,345	855,601	-11.8
Umbria	36,244	51,696	-29.9	326,877	366,393	-10.8
Marche	44,866	60,707	-26.1	471,828	492,459	-4.2
Lazio	98,216	189,505	-48.2	638,602	720,748	-11.4
Abruzzo	66,837	76,629	-12.8	453,629	431,031	5.2
Molise	26,272	31,536	-16.7	197,517	214,601	-8
Campania	136,872	234,335	-41.6	549,532	585,997	-6.2
Apulia	271,754	336,694	-19.3	1,285,290	1,247,577	3
Basilicata	51,756	75,929	-31.8	519,127	537,516	-3.4
Calabria	137,790	174,391	-21	549,254	554,794	-1
Sicily	219,677	349,036	-37.1	1,387,521	1,279,707	8.4
Sardinia	60,812	107,442	-43.4	1,153,691	1,019,955	13.1
Italy	**1,620,884**	**2,396,274**	**-32.4**	**12,856,048**	**13,181,859**	**-2.5**
Northwest	***145,243***	***220,145***	***-34***	***2,096,985***	***2,243,193***	***-6.5***
Northeast	***251,859***	***367,052***	***-31.4***	***2,471,852***	***2,632,288***	***-6.1***
Central	***252,012***	***423,085***	***-40.4***	***2,191,651***	***2,435,200***	***-10***
South	***691,281***	***929,514***	***-25.6***	***3,554,349***	***3,571,517***	***-0.5***
Islands	***280,489***	***456,478***	***-38.6***	***2,541,211***	***2,299,662***	***10.5***

The UAA is used for the following purposes, in descending order of importance: crops, permanent meadows and pastureland, growing of timber, family gardens.
The number of animal husbandry enterprises has also fallen, though their average size has increased.
Almost 60% of the animal husbandry enterprises raise cattle. Roughly 70% of the livestock is found in the Regions of the north, such as Lombardy, Veneto and Piedmont.

The main use of UAA is for crops. Almost 60 % of the animal husbandry enterprises raise cattle. Aquaculture is a growth sector.

In Emilia-Romagna,

[17] Source: ISTAT 6° and 5° General Agricultural Census

Aquaculture is a growth sector that presents multiple instances of interaction with the environment, and can constitute a factor of significant pressure, modifying the quality of the water, the use of water resources and biodiversity.

Veneto and Apulia systems for raising trout and shellfish are the most widespread.

All the Regions that have coastal zones, with the exception of Basilicata and Tuscany, produce both fish and shellfish. The most important Regions for the growing of shellfish are Emilia-Romagna, Veneto, Apulia and Sardinia.

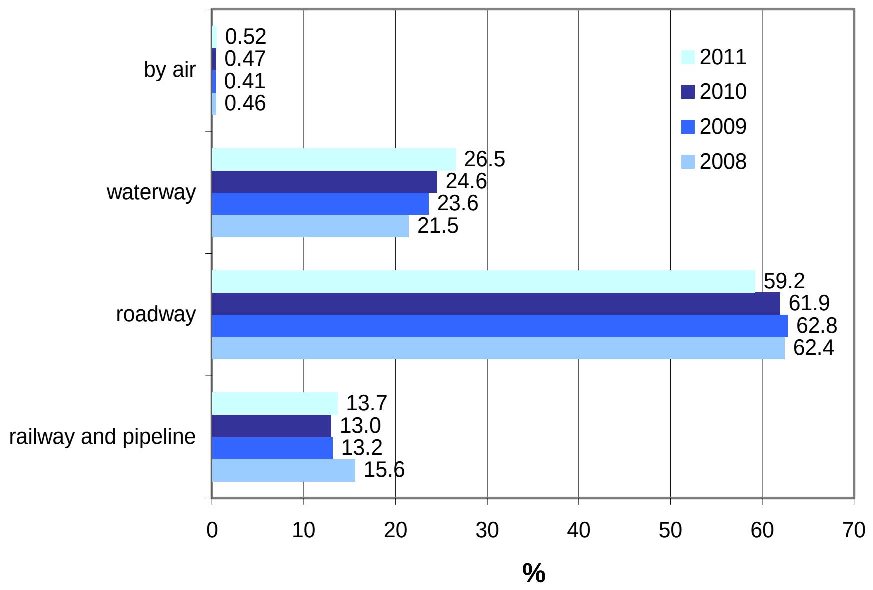
Trout and shellfish breeding systems are the most widely used.

Transportation and mobility

An estimate of domestic freight traffic in Italy for 2011, via all the different modes of transport, produces a final figures of roughly 200 billion tonnes-km, pointing to an overall decrease of 15.7%.

An estimate of the domestic freight traffic in Italy for 2011, via all the different modes of transport produces a final figure of roughly 200 billion tonnes-km[18] (approximately 274.9 billion tonnes-km if motor-vehicle transport, by foreign carriers in Italy is also taken into account), pointing to, despite a trend characterised by fluctuation, an overall decrease of 15.7%. This in contrast to the station for passenger transport, which remained steady between 2005 and 2008, before rising in 2009 (+4%) and then falling from 2010 on. Taken as a whole, the sector fell by 2% between 2005 and 2011. An analysis of the data for freight traffic by mode of transport confirms the absolute preponderance of roadway transport, which accounted for 59.2% of the total tonnes-km of freight transported in 2011, though it still registered a decrease of 6.4% between 2005 and 2011 in favour of maritime transport (6.8). The percentages accounted for by the remaining modes of transport, again for 2011, were: 26.5% by waterway; 13.7% by railway and pipeline; 0.52% for air transport, which continues to cover a minimal portion of domestic freight transport, given that it is focussed primarily on international transport (Figure II.7)

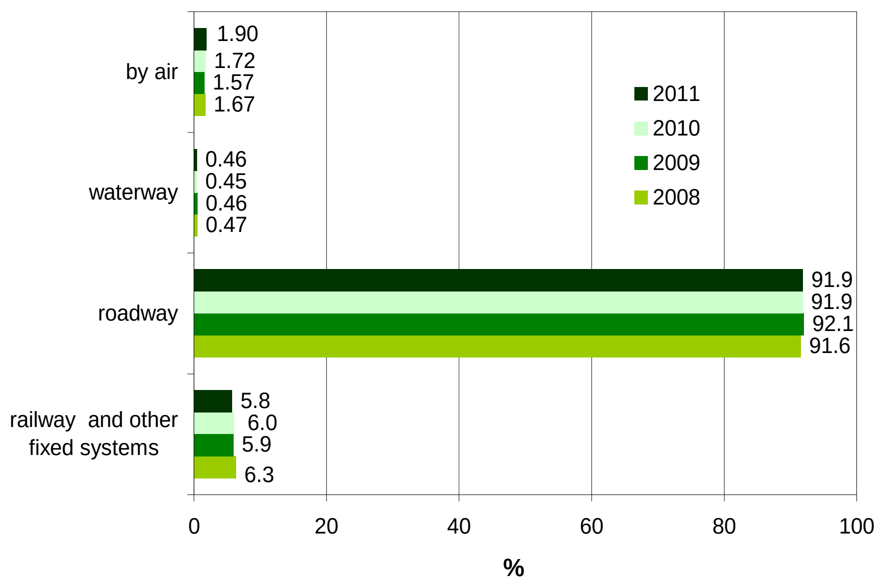
[18] Motor vehicle transport of no less than 50 km was considered, not including that performed by foreign carriers



As in previous years, the figures for 2011 again confirmed the absolute predominance of roadway freight transport (59.2%).

Figure II.7: Percentage breakdown of domestic freight traffic by mode of transport[19]

Taking a detailed look at domestic passenger transport, which neared 883 billion passenger-km in 2011, it can be affirmed that, despite registering a decrease of almost 6% during the years 2009-2011, the percentage break-down by mode of transport remains almost unchanged, with the roadway mode showing a clear-cut predominance, at 91.9%, over the other modes. The percentages registered by the other modes were: 5.8% for transport by rail and other fixed systems; 1.9% for air transport and only 0.46% for transport by waterway (Figure II.8).



The roadway mode also registers a dominant position for domestic passenger transport in 2011, accounting for 91.9%.

Legend

Estimates are given for the "Air" and "Water" modes of transport, in all the years, as well as for the overall figures for 2011

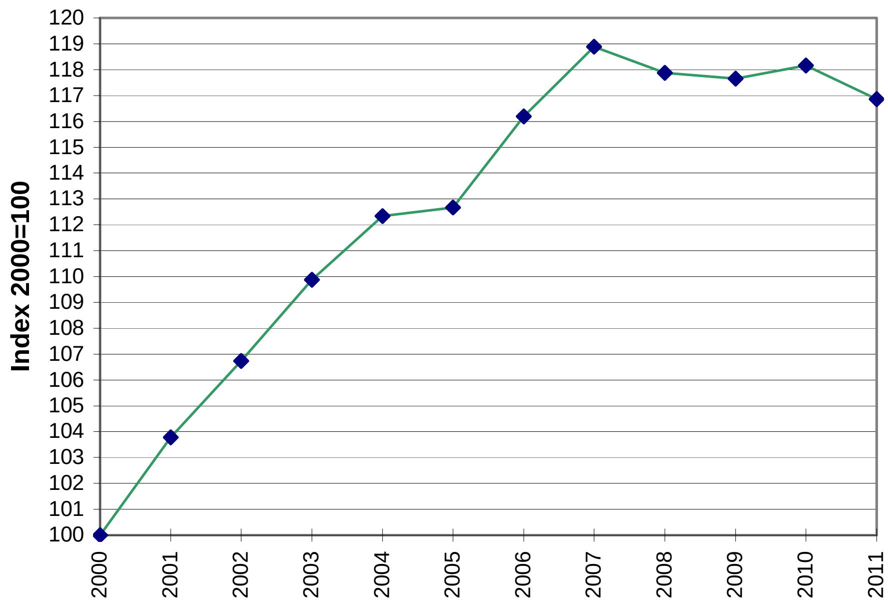
[19] Source: CNT 2010-2011 data processed by ISPRA

Figure II.8: Percentage distribution of domestic passenger traffic by mode of transport [20]

An analysis of traffic for the various modes of traffic points to a number of different situations. In the case of airport traffic in the years 2005 to 2011, studied in terms of the number of aircraft movements for commercial air transport (domestic and international), the trend was marked by fluctuations.

Airport traffic continued to grow in 2011 as well, but at a lesser rate than the previous year (+1.2%).

After peaking in 2007 (1,532,987 movements), airport traffic fell until 2009 (-9.8%), after which it began to rise once again, growing by 3.7% in 2010 and continuing the upward trend in 2011, though at a lower rate (+1.2% compared to 2010)[21].
Vehicle traffic, analysed over the long-term period of 2000-2011 (Figure II.9), increased by approximately 17% in terms of the kilometres travelled by light and heavy vehicles on Italian highways.
This marked growth continued until 2007, at which point the level of traffic remained steady, at around 83 billion vehicle-km, through 2010, followed by a slight decrease (-1%) in 2011[22].



In the years 2000-2011, vehicle traffic, in terms of the kilometres travelled by light and heavy vehicles on Italian highways, increased by approximately 17%. The growth trend persisted until 2007, when it levelled off through 2010, showing a slight decrease from 2011 (-1%).

Figure II.9: Roadway traffic trend registered on the privately managed highway network (2000-2010)[23]

In terms of railway traffic, in 2011 passenger trains accounting for 320.6 million trains-km travelled on the Italian State Railway Network (+2.5% compared to 2005), while there were approximately 41.6 million trains-km of freight transport as well (-31.5% compared to 2005). The year 2009 saw a sharp drop in freight traffic by rail, which fell by 26.7% compared to 2008, due to the economic crisis, a downward trend that continued in 2010, though at a lesser rate (-4%),

[20] Source: CNT 2010-2011 data processed by ISPRA
[21] ENAC data
[22] AISCAT data
[23] Source: AISCAT data processed by ISPRA

with growth resuming from 2011 (+2%).

In the interests of procuring a more complete overview of the topic of "transport and mobility", it is important that any analysis include the pressures that arise in Italy from problems relating to traffic, such as those involving the country's resources and infrastructures. As of 31 December 2010, the size of Italy's primary roadway network (not including municipal roads) had reached 186,419 kilometres, which broke down into 6,668 km of highways, 20,856 km of other roads of national importance and 158,895 km of regional and provincial roads, for an overall increase of approximately 11.1% compared to the year 2000.

Among the statistical information relevant to roadway traffic, are the data provided by AISCAT (The Italian Association of Private Managers of Public Highways and Tunnels) on the volumes of traffic registered on the privately managed highway network subject to continual recording of traffic (5,523.4 km in length as of 31 December 2011), results that show an average daily volume of vehicles on the road for 201 of 40.8 million (down from 41.3 million in 2010), of which 31.5 million were light vehicles (77.2%) and 9.3 million were heavy (22.8%). In terms of the railway network, its total length as of 2010 was approximately 20,392 km, for an increase of 975 km compared to 2000. During the same period, the electrified network and the portion with double tracks were extended by respective figures of 12.3% and 25.3%.

The available data point to a significant presence of port structures within the national territory as well. As of 31 December 2011, there were 270 ports (11 more than in 2010), for an overall wharf length, in terms of the docking points in the ports, of more than 463 kilometres (+11.2 km than in 2010), making for an average of approximately 233 metres per docking point and more than 1.7 kilometres per port.

In terms of maritime transport, 1,992 dockings were registered in 2011, for an increase of 78% compared to 2001.

In 2011 there were 1,992 docking points (+78% compared to 2001).

As for the airport infrastructures distributed throughout the national territory, in 2011 there were 46 airports open only to commercial traffic, making for a distribution of 1 airport every 1.32 million residents.[24]

Tourism

Tourism constitutes an increasingly important element in the lives of people who are willing to travel for both private and professional reasons.

Tourism and the environment are closely connected. Europe is the destination for 51.3% of all international arrivals.

The environment, natural attraction and cultural heritage are all necessary ingredients in the supply and demand of tourism, meaning that they should be safeguarded both through strategic planning and efforts of governance designed to preserve the attractive allure exercised by the tourist destinations while, at the same time, ensuring that the forms of tourism developed prove respectful of the environment and sustainable.

Tourist arrivals

[24] ENAC data

On the international level, the year 2011 saw confirmation, following a period of crisis, of the increase in arrivals already registered the previous year (+4.6%); Europe, where the largest worldwide tourist flow is to be found (51.3% of all international arrivals), showed an increase of 6.1%. Tourist arrivals and presences registered in Italy in 2011 for the sum total of the country's hospitality establishments rose at respective rates of 5% and 3%. The average stay (3.7 days) fell slightly compared to last year, confirming the trend of the last few years towards shorter stays. Climate is one of the main factors that drive the seasonal nature of tourist demand, determining both the length and the quality of operations while playing an important role in the choice of the destination and the amounts spent. In 2011, the seasonal concentration of the tourist flows continued to occur in the third quarter (with 50% of the presences).

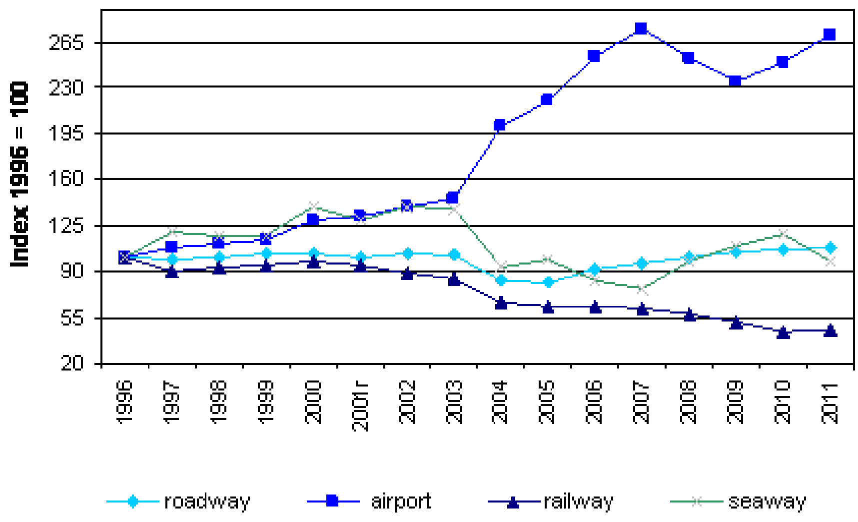
and presences in Italy for 2011 showed respective increases of 5% and 3%.

The climate is one of the main elements driving the seasonal nature of tourism: 50% of the presences registered in 2011 occurred in the third quarter.

The economic crisis has negatively impacted on the overall number of trips taken by Italians, with a decrease of 16.6% having been registered. Nonetheless, 62.9% of these trips were taken by car. The tendency of Italians to travel by plain persists (16.2% of the trips), thanks to the economical and widespread nature of the means of transport, plus in part, the change in people's approach to taking vacations (short breaks). With regard to the means of transport utilised by foreigners to visit Italy, an increase of 3% in the tourist flows passing through border crossings was registered, attributable primarily to air transport (+8.6%) and rail travel (+3.7%) (Figure II.10). Foreigners also continue to chose the automobile as the most frequently used means of transport (65%).

The car is the means of transport most frequently used by Italians to take trips (62.9%).

The car continues to be the main means of transport chosen by foreign visitors (65%).



Legend
r: The figures for 2001 on crossings of the frontier by road and air were revised following a refinement of the research methodology.

Figure II.10: Changes in the number of foreign visitors entering Italy through border crossings[25]

Tourism inevitably brings change; the demand for environmental and

Tourism places a

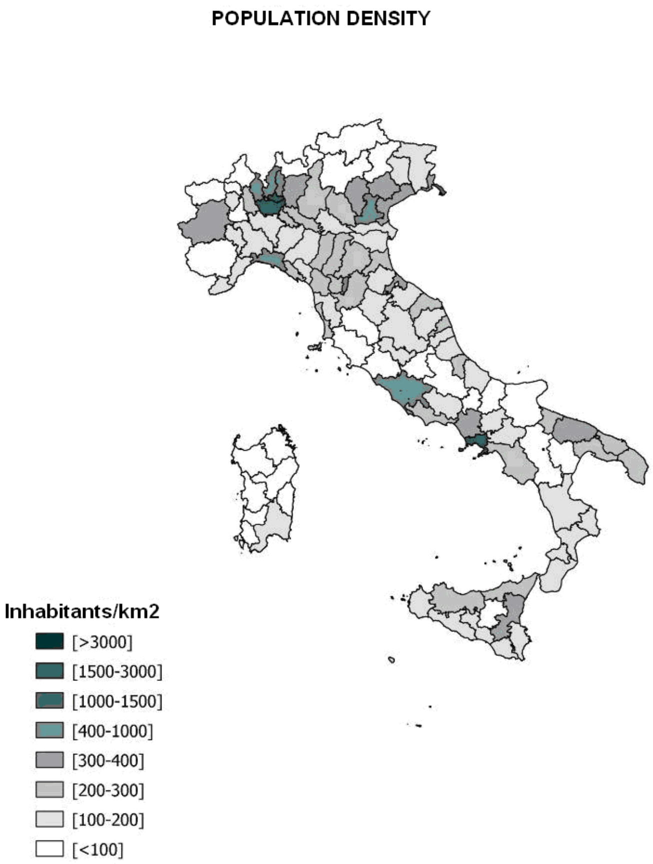
[25] Source: Bank of Italy data processed by ISPRA

cultural resources and the desire to encounter new experiences can alter social and environmental balances.

number of different pressures on the environment.

The factors responsible for the pressures placed on the environment can have a variety of effects, though numerous constants can be observed: large numbers of visitors, seasonal concentrations, the use of the more polluting means of transportation etc.. Furthermore, there is an increasingly noticeable characteristic of tourism in large cities: in addition to the problems for which residents are responsible, consideration must be given to those arising from the fact that these locations are becoming increasingly popular tourist destinations. The arrival of tourist flows radically modifies the inhabited density of certain Italian provinces: Florence, Venice, Rimini and Rome have respective inhabited densities, under normal conditions (taking into account only the resident population), of 277, 343, 374 and 743 inhab./km^2, whereas these figures register noteworthy increases with the arrival of the tourists. In the case of Florence, for example, whose population density is roughly the same as that of provinces such as Livorno, Lodi or Novara, when the tourists are added in, the density (1,544 inhab./km^2) climbs to almost double the normal residential density of Rome (Figure II.11).

Tourist flows radically modify population density, as in the cases of Rimini, Florence or Venice, which reach noteworthy levels with the addition of the tourists.



The map for "inhabitant density" distributes Italy's provinces into eight categories of habitant density; the "total density" map distributes the provinces into the same eight categories, but based on the "total" density (population + arrivals)/surface area of territory.

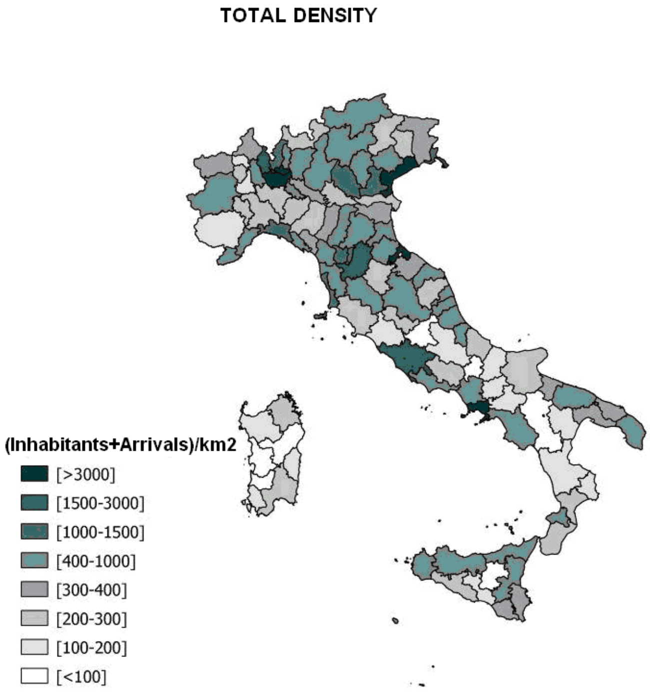


Figure II.11: Changes in the population densities of Italian provinces as result of the tourism flows (2011)[26]

[26] Source: ISTAT data processed by ISPRA

III. European and Italian perceptions of water resources and air quality

Introduction

Information and communication concerning the environment represent important tools for political decision-makers, operators and ordinary citizens, for gaining knowledge and enhancing participation.
Numerous institutional or other stakeholders are increasingly promoting an environmental culture, in order to make scientific and technical knowledge available to citizens improving their awareness of and focus on the sustainability of their lifestyles and behaviour, both individual or collective.
The last two editions of the Environmental Data Yearbook have presented statistical information on the perceptions and levels of awareness of citizens of Europe and Italy with regard to the environment and its problems, using as the primary sources for the data European and national surveys designed precisely to gauge the opinions, attitudes and behaviour of the population (families and/or individual citizens) in terms of environmental concerns.
In this edition, based on a more limited set of available data, it was decided to focus the monitoring on two topics addressed in recent European surveys: water resources and air quality.

III.1. Water resources

It is widely acknowledged that the quality and the quantity of water available in Europe is an important issue for both citizens and institutions.
In 2000, the European Union adopted the Water Framework Directive (WFD), and progress has been made in adopting an integrated approach to the fresh-water management, with the goal of achieving the status of "good" for all waters in the European Community by 2015[1].
Twenty-three out of twenty-seven EU Member States have adopted the River Basin Management Plants as required by the WFD[2].

In terms of the quality of European waters, a series of improvements have been observed in recent years, in particular as regards levels of phosphates and organic pollution in fresh-water, and there has been a noteworthy improvement of bathing waters.
But despite these signs of progress, water quality and quantity remain a cause of concern. In many countries, for example, the nitrates levels in groundwater are above threshold levels. Based on current figures, there is a risk that a large part of the fresh-water systems will not qualify as "good water" by 2015[3].

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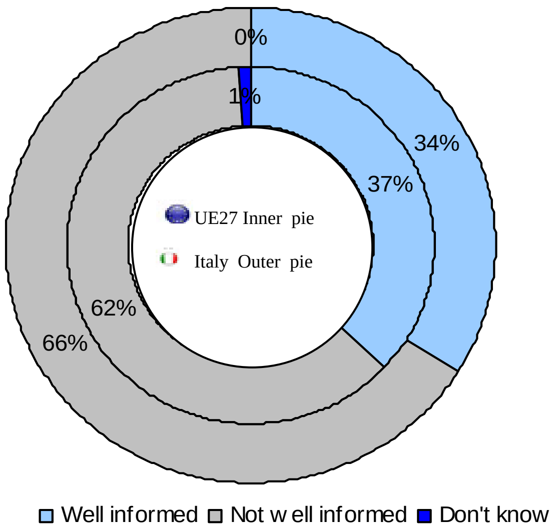
[1] http://ec.europa.eu/environment/water/water-framework/objectives/status_en.htm
[2] http://ec.europa.eu/environment/water/participation/map_mc/map.htm
[3] http://www.eea.europa.eu/soer/europe/freshwater-quality

A recent ISPRA report that processed the 2010 figures supplied by the ARPA/APPA, as well as by the autonomous provincial governments of Italy and its regional governments, on the contamination of surface and groundwaters by plant protection products confirms that high levels of contamination are widespread throughout Italy[4]. Specifically, 55% of the monitoring points for Italian surface water were contaminated, while concentrations of pesticides exceeded the limits set under the law in 34% of the cases. In terms of groundwaters, 28% of the points were contaminated and 12% presented concentrations in excess of the limits.
The research context described above includes the *Flash Eurobarometer* survey on water[5], carried out in 2012 by the European Commission to gauge how well informed Europeans felt they were about problems linked to waters. The survey also analysed their attitudes to water issues. With regard to groundwater, lakes, rivers and coastal waters, the survey showed that most Europeans consider water quality to be a serious problem and do not feel that they are adequately informed. Furthermore, although the majority of citizens have already taken "individual actions" to reduce their water use, they thought that more should be done to tackle water use.
On the specific question of the level of available information and the seriousness of the issues, it was found that only 37% of all Europeans and 34% of Italians feel themselves to be well informed on the different concerns pertinent to groundwater, lakes, rivers and coastal waters (Figure III.1).



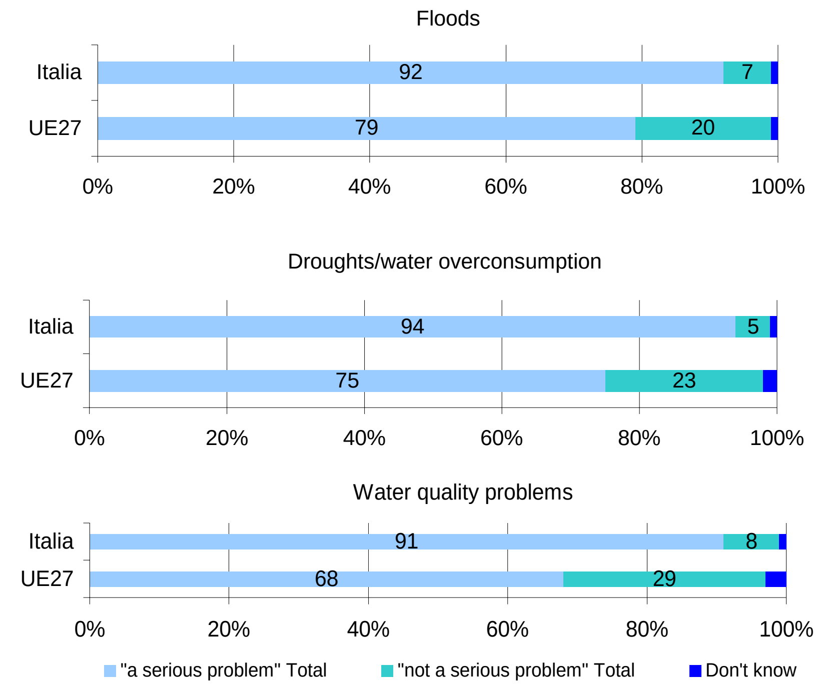
Only 37% of all Europeans and 34% of Italians feel that they are well informed on problems regarding groundwaters, lakes, rivers and coastal waters.

Figure III.1: Responses to the question: "How informed do you feel about problems facing groundwater, lakes, rivers and coastal waters in your country?"[6]

[4] ISPRA (2013). Rapporto Nazionale Pesticidi nelle Acque. ISPRA Report 175/2013
[5] European Community, *Attitudes of Europeans towards Water,* Flash Eurobarometer 344
[6] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Water,* Flash Eurobarometer 344

Water quality is considered a serious problem for their individual countries by 68% of the Europeans interviewed and by no fewer then 91% of the Italian respondents. One out of three European (31%), and 53% of the Italians, think that the problem is very serious. One out of five Europeans (22%), on the other hand, say it is not a very serious problem. Questions regarding floods, droughts and overconsumption of water are also considered to be serious, and at even higher percentages. Detailed data on these last topics (Figure III.2) once again show Italians as being more attentive and/or aware than Europeans as a whole.

Water quality is considered to be a serious problem for their individual countries by 68% of the Europeans interviewed and by a good 91% of the Italians.



Higher percentages of Europeans and Italians consider floods, droughts and water overconsumption a serious problem.

Figure III.2: Responses to the question: "Which of the following problems would you say is a serious concern in your country?"[7]

Those respondents who consider water quality a serious problem are more likely to say the same of drought, water overconsumption and floods.

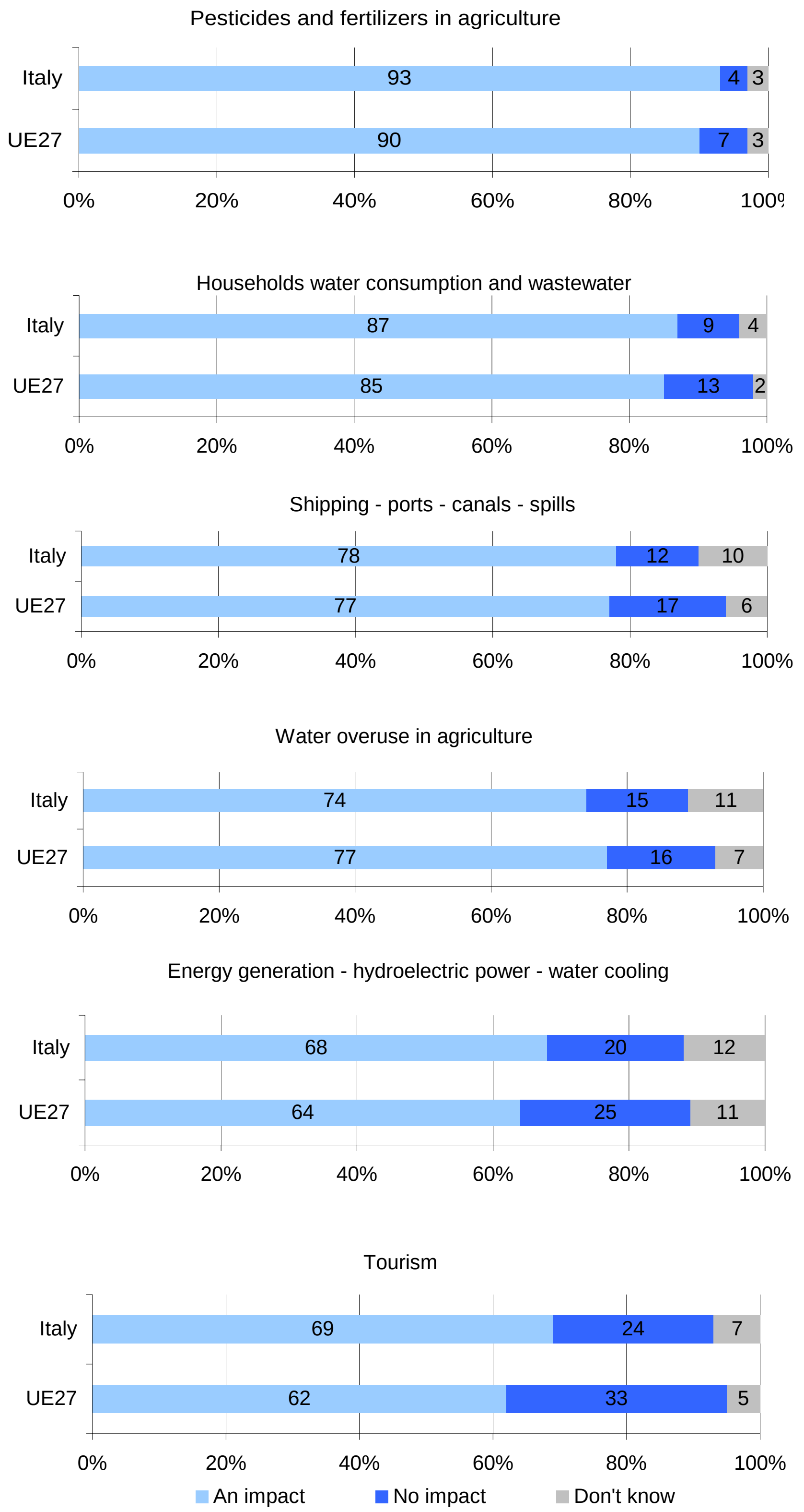
The European survey also identified the factors held to have the greatest impact on the state of water, in terms of both quality and quantity.

As many as eight in ten European consider pesticides and fertilisers used in agriculture (90%), with water consumption and household wastewater (85%), have greatest impact on water quality and quantity in Europe. For 77% the factors to be pointed to are navigation operations (ports, canals, spills) and the excess use of water in agriculture; while more than six in ten Europeans interviewed consider energy (generation, hydroelectric power, water cooling) and tourism the greatest impact factors.

In Italy, these percentages (Figure III.3) are always slightly higher, but with the same proportions between different forms of impact.

As many as eight in ten of European consider pesticides and fertilisers used in agriculture (90%), plus water consumption and household wastewater (85%), have greatest impact on water quality and quantity in Europe.

[7] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Water*, Flash Eurobarometer 344



90% of Europeans hold that the pesticides and fertilisers used in agriculture have the greatest impact on the quality and the quantity of water in Europe. Next, at 85%, come the consumption of water and household wastewater, while 77% cite navigation operations (ports, canals, spills) and the excess use of water in agriculture.

Figure III.3: Responses to the question:"Can you tell me how much impact you think each of the following has on the status (quality and quantity) of water in your country?"[8]

[8] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Water*, Flash Eurobarometer 344

The survey also identified what are considered the main threats to the water environment.

Specifically, 84% of Europeans identified chemical pollution as the main threat. Climate changes were pointed to by 55%, followed by charges to the water ecosystems (49%).

At least four out of ten Europeans holds floods (46%), the water shortage (45%) and the algae growth (41%) to be the most alarming dangers.

For three out of ten (30%), on the other hand, the leading factors of risk are infrastructures, such as dams, canals and physical changes in general.

84% of Europeans believe that chemical pollution is a threat to the water environment.

In all 27 countries of the European Union, chemical pollution is considered the primary threat to the water environment.

Climate change, on the other hand, is ranked among the first three threats in 23 countries, while all the other factors are ranked less frequently in the first three positions, such as: flooding and the growth of algae, ranked among the first three threats in only 9 EU countries, shortage of water in seven, changes in the water ecosystem in six.

For 82% of Italians, the main threat to the water environment is chemical pollution, followed by climate change (50%), changes to water ecosystems (48%), floods (47%), water shortages (41%), algae growth (33%) and infrastructures (26%).

Italians also consider chemical pollution to be the primary threat to the aquatic environment.

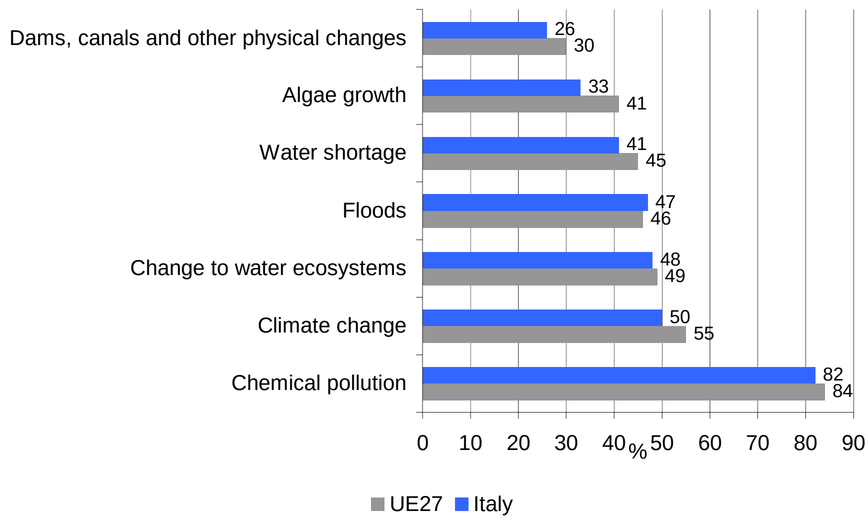
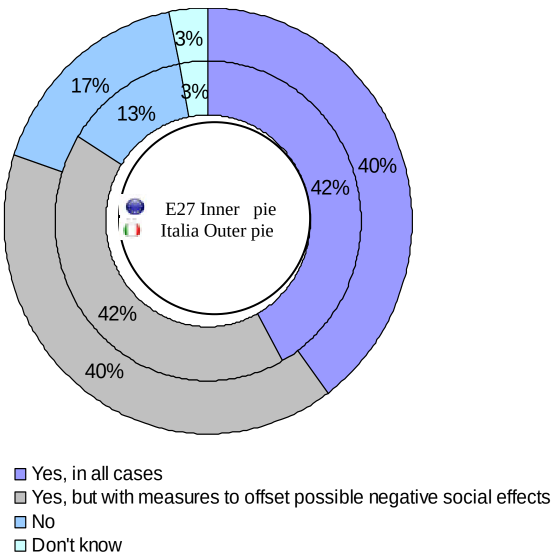


Figure III.4: Responses to the question: "Please tell me which of the following threats you believe is the greatest danger to the water environment?"[9] (Possibility of multiple responses)

In the opinion of both Italian citizens and Europeans as a whole, chemical pollution in general is the primary threat to the water environment.

[9] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Water*, Flash Eurobarometer 344

More than eight out of ten Europeans agree that water users should be charged for the value of water they use. The respondents are equally divided between those who believe that the payment should be charged in all cases and those who feel that measures should be taken to offset any negative social repercussions of fees for water. 13%, on the other hand, are opposed to paying for water on the basis of the volume used. Italians responded to the proposed options in the same proportions as Europeans, though a slightly higher number were opposed to paying for water based on the volume used (17%).



13% of all Europeans and 17% of Italians make up the minority that opposes paying for water on the basis of the volume used.

Figure III.5: Responses to the question: "Think or not that all water users should be charged for the volume of water they use?"[10]

The respondents were asked for an opinion not only on whether the "price" of water should be based on its consumption, but also on whether or not this "cost" should reflect the environmental impact caused by the consumption of the water. On this second point, only slightly more than six out of ten respondents (both Europeans and Italians) agree that the price of water should reflect the environmental impact of its use (61%), meaning that water should be more expensive when its use has a greater environmental impact.

61% of European and Italian citizens believe that the price of water should reflect the environmental impact of its use.

88% of European and Italian citizens believe that the recycling of non-drinking water should be widespread, assuming there are no risks to health. The majority of those interviewed in all countries agree with this idea, with the results ranging from 94% in Malta and Denmark to 65% in Lithuania. In answer to the question, "What kind of water do you usually drink?", almost half the Europeans (49%) said they drink tap water, a third (34%) responded mineral water, and 15% stated that they drink both. The citizens of Denmark, Sweden

88% of European and Italian citizens agree that the recycling of non-drinking water should be widespread, assuming there are no risks to health.

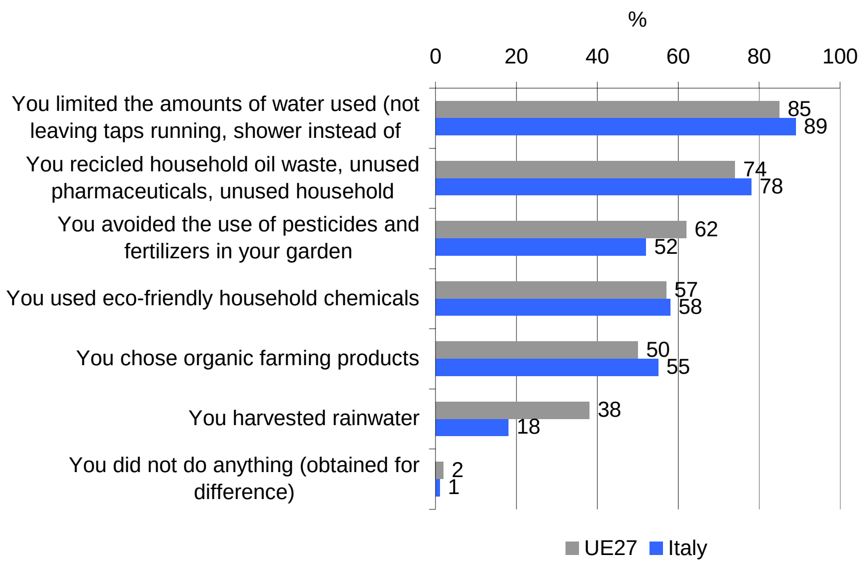
[10] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Water*, Flash Eurobarometer 344

and Finland consume the largest amounts of tap water, which, for almost 90% in all three countries, is the type of water most frequently consumed. Less than 5% declare that they normally drink mineral water. In contrast, only 21% of the citizens of Luxembourg and 21% of Cypriots state that they usually drink tap water.

In the case of Italians, 39% state that they normally drink tap water, 46% says mineral water, and 15% indicate both types of water. The surveys asked citizens if they have taken some kind of individual action in the past two years to reduce water problems and become more water-efficient. Almost all of those interviewed (98% of Europeans and 99% of Italians) say they were doing “something” on their own to reduce the related problems and become more efficient users of water resources.

A full 46% of Italians declare that they regularly drink mineral water.

For example, 85% of Europeans and 89% of Italians say that they have limited the amount of water used by turning off taps, using water-saving appliances ad so on; 74% of Europeans and 78% of Italians recycle household oil waste and chemical waste (unused pharmaceutical products, unused household chemical products, paints, solvents, batteries) (Figure III.6)



85% of the Europeans and 89% of the Italians declare that they limit the quantities of water they use (not leaving faucets open, showering instead of taking baths, installing water-saving devices etc.).

Figure III.6: Response to the question: “There are different ways to reduce waste and become more water efficient. In order to reduce these problems have you done any of the following in the last two years?”[11]

Despite these individual initiatives, more than half the respondents in Europe as a whole (61%) and in Italy (67%) do not believe that households are doing enough to use water efficiently. Furthermore, more than half of both the Europeans and the Italians hold that efforts by industrial concerns (65% EU and 73% Italy) and by the agricultural sector (51% EU and 53% Italy).

More than 60% of Europeans and Italians do not believe that households are doing enough to use water efficiently.

[11] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Water*, Flash Eurobarometer 344

In 19 countries out of 27, the most effective way of tackling water problems is considered to be increasing information on the environmental consequences of water use, an opinion shared by 2/3 of the Europeans (67%).

In no fewer than 19 of the 27 European countries, increasing information on environmental consequences is considered to be the most effective method of tackling water problems.

About information, only 7% of Europeans and 5% of the Italians have heard of the new European strategy for the defence of water resources *"Blueprint to Safeguard Europe's Water Resources"*, and only 11% of Europeans and 16% of Italians are aware of plans for the management of groundwater. Nine Europeans out of ten (89%) have not taken part in consultations for the formulation of a water-basin management plan.

However, 51% of the respondents declared that they would be interested in taking part in an upcoming revision of a plan. In Italy as well, 51% of the respondents said they were interested in future involvement on the issue. Generally speaking, roughly three-quarters (73%) of Europeans answering the survey consider that the EU should propose additional measures to address water problems, and at least half of these respondents want to express their opinions on such measures. At the same time, 12% of the Europeans and 9% of the Italians that the sector does not fall under the responsibility of the EU.

III. 2. Air Quality

As with water resources, the European Commission carried out a survey focussed on the air,quality another major concern for Europeans and a sector in which the European Union has been especially active for more than thirty years. From a regulatory viewpoint, the key objective of the EU is to *"achieve levels of air quality that do not result in unacceptable impacts on, and risks to, human health and the environment"*[12]. The EU has already in place a range of legislation and initiatives to improve air quality, by controlling harmful emissions and implementing measures in the transport, industry and energy sector to protect the environment[13].

Ongoing efforts to improve air quality and air pollution include the survey cited above (*Flash Eurobarometer*[14]), whose objective is to attentively explore the expectations and awareness of the European public with regard to the issue.

In terms of levels of available information and the seriousness of problems relating to the air quality, almost six out of ten Europeans consider that they are not adequately informed on issues of air quality in their countries (59%). In four countries, at least a quarter of the respondents agree that they possess no information at all: Spain (31%), Luxembourg, Cyprus and Latvia (27% each). In Italy, 49% feel they are not sufficiently informed, and 14% say they have no information at all. Three quarters of the Europeans (74%) and the Italians (75%) have not heard of the EU standards of air quality. What is more, 58% of the Europeans and 69% of Italians who have heard of

59% of Europeans and 49% of Italians held themselves not to be well informed on issues of air quality in their countries.

[12] http://ec.europa.eu/environment/air/review_air_policy.htm

[13] http://ec.europa.eu/environment/air/index_en.htm

[14] European Community, *Attitudes of Europeans towards Air Quality,*, Flash Eurobarometer 360

these standards consider them to be insufficient and believe that they should be reinforced. 74% of the Europeans and 81% of Italians had no idea that there was a directive on national limits on emissions (*National Emission Ceilings*), and those who had heard of such limits felt they were insufficient and needed to be reinforced.

With regard to problems of human health tied to the air quality, 87% of Europeans and 97% of Italians think that respiratory diseases are a serious problem, an opinion shared by at least six out of ten of those interviewed in each country, while 92% of European citizens and 95% of Italians, and no fewer than eight out of ten respondents in any of the countries, considered cardiovascular conditions to be a major problem. As for asthma and allergies, 87% of all Europeans think them to be a serious problem, with the level of this response in Italy (94%) proving the highest in any of the European countries. Acidification and eutrophication are also deemed to be major problems by the majority of citizens. In fact, seven out of ten Europeans and 82% of Italians consider acidification a serious problem, while more than three quarters (78%) of Europeans and 87% of Italians said the same for eutrophication.

While 56% of Europeans as a whole felt that the air quality has deteriorated over the last 10 years, 16% think that it had improved. According to 81% of Italians (the highest percentage among the EU27 countries), the air quality in our country has actually deteriorated (Figure III.7).

56% of Europeans as a whole, and no fewer than 81% of Italians, think that the air quality has deteriorated over the last 10 years.

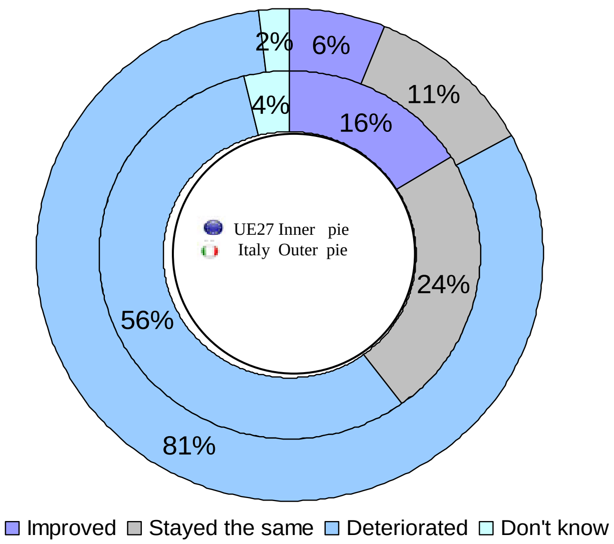


Figure III.7: Responses to the question, "As you see it, what has happened to the quality of our country's air over the last 10 years?"[15]

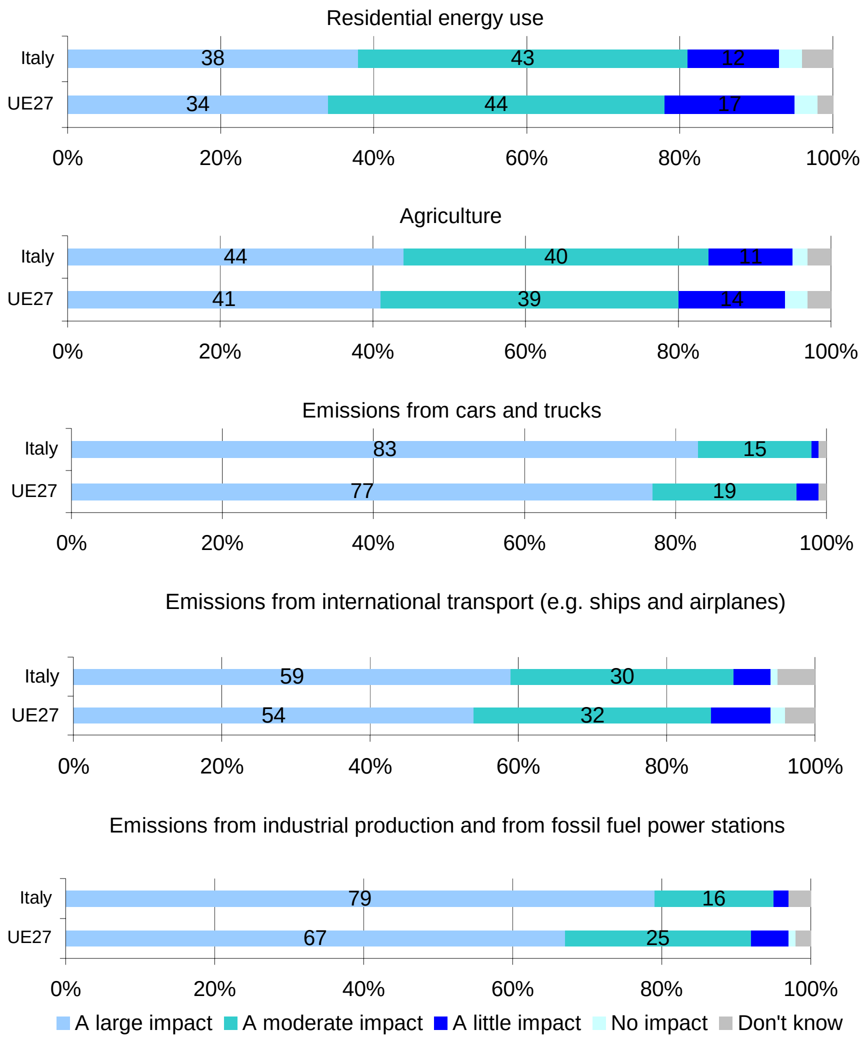
When asked to indicate factors that impact the air quality, more than three quarters (77%) indicated emissions from cars and trucks. Just over two-thirds (67%) say that emissions from industrial production (steel, cement, pulp and paper etc.) and from fossil power stations have a large impact on air quality, while 54% say there is a large

Both European and Italian citizens felt that the atmospheric emissions of automobiles and trucks have the most

[15] Source: ISPRA of data from 360 "*Attitudes of Europeans towards Air Quality*"

impact from emissions from internal transport (such as ships and airplanes). Less than half of all the respondents judged that emissions from agricultural farms, resulting from the burning of fertilisers and farm waste (41%), as well as from the residential energy use (coal and wood for heating of individual households, for example) (34%), played a sizeable role in overall emissions, even though four out of ten Europeans considered those factors to have a moderate impact on the air quality. One European out of five felt that residential energy use has little (17%) or no impact (3%). As can be seen in Figure III.8, the percentages attributable to Italians were always higher with regard to all the potential impacts covered by the question.

significant impact on air quality.



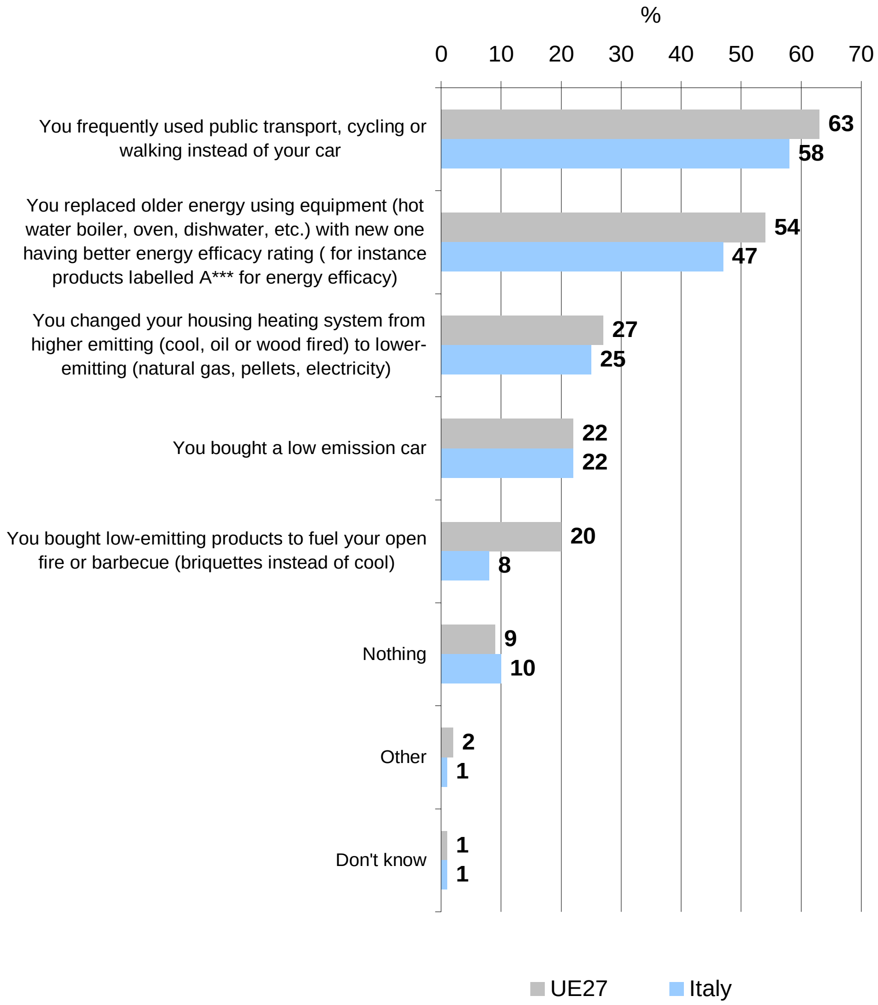
83% of Italian citizens and 77% of Europeans as a whole felt that the atmospheric emissions of automobiles and trucks had the largest impact on air quality.

Figure III.8: Responses to the question: "How much impact do you think each of the following has on air quality in your country? Does it have a large impact, a moderate impact, a little impact or no impact"[16]

[16] Source: European Community, *Attitudes of Europeans towards Air Quality*, Flash Eurobarometer 360

More than six out of ten Europeans (63%), along with 58% of the Italians interviewed, indicated that the actions they've personally taken over the last two years to reduce emissions harmful to the air include the use of public transportation, bicycles or walking, as opposed to driving automobiles.
More than half (54% of Europeans as a whole) stated that they had replaced their energy systems with more recent equipment to improve energy efficiency, while 27% had modernised their heating systems with low-emission installations.
22% had bought a low-emissions car or used low-emissions products to fuel their fireplaces or barbecues (20%).
Figure III.9 show that the percentages registered for Italians were almost always lower than the average European level for each option suggested.

63% of European citizens, along with 58% of Italians, stated that, to reduce emissions harmful to the atmosphere over the last two years, they have chosen more eco-compatible forms of transportation, such as public transit, bicycles and walking.



Replacing automobile travel with more eco-compatible options and getting rid of old, energy-consuming systems for newer, more energy-efficient models are the primary initiatives undertaken by Italian and European citizens in the last two years to reduce emissions harmful to the atmosphere.

Figure III.9: Responses to the question: "There are different ways to reduce harmful emissions to air. In order to reduce these problems have you done any of the following the last two years? (multiple responses possible)"[17]

[17] Source: ISPRA processing of European Community data, *Attitudes of Europeans towards Air Quality*, Flash Eurobarometer 360

The options listed on Figure III.9 demonstrate that most initiatives regard the sectors of transportation and energy.
The survey also investigated opinions on more eco-friendly energy systems for those sectors.

Along these lines, electric cars were considered by Europeans (71%) to have the most ecological fuel system, in terms of air quality, with hybrid electric/gas cars placing second (39%); Italians also rated electric cars first (74%), followed by biofuel models (29%).

All the European countries considered that electric cars offered the most ecological fuel system.
In the opinion of Europeans as a whole, electricity is the most ecological system for heating the home, in terms of preserving the quality of the air, while more Italians say gas, though by a small margin.

In terms of energy sources, Europeans citizens viewed electricity as the most ecological system for heating their homes (50%), followed by wood biomass (46%), and gas plus pellet biomass (both 39%).
In the opinion of Italians, on the other hand, all four systems indicated above were roughly equivalent as preferred sources of energy, with gas scoring 39%, wood biomass and electricity 38% and pellet biomass 37%.

In another question on the energy sector, respondents were asked what options should currently be considered most important for safeguarding the air quality over the next 30 years. The respondents were not as likely to mention non-conventional fossil fuels, such as shale gas (9% Europeans and 3% Italians) and traditional fossil fuels (8% Europeans and 4% Italians).
The majority (70% Europeans and 77% Italians) identified renewable energy sources as being most important (the option most frequently mentioned in all the European countries).
More than a quarter of the Europeans (28%), and slightly less than a quarter of the Italians (21%) indicated energy efficiency.
18% of the Europeans and 11% of the Italians chose the option of nuclear energy, while approximately one out of ten Europeans (12%), and only 7% of the Italians, pointed to the carbon dioxide capture and storage. The Europeans considered that not enough was being done in their respective countries to ensure good air quality. In identifying those who should act, they indicated: government authorities (72%), followed by manufacturers of energy (64%) and families (61%). Roughly half of those interviewed also indicated car manufacturers (53%) and farmers (50%).
A majority of all the respondents placed the primary responsibility on government authorities: this was the opinion of 91% of the respondents in Greece, 87% in Spain, 86% in Italy and Romania, 85% in Lithuania and 83% in Bulgaria. The only exception was Finland, where only 43% provided the same response, while no fewer than 49% thought the government was working well.

The majority of respondents (Europeans and Italians) identified renewable energy sources as today’s most important option for safeguarding the quality of the air over the next 30 years.

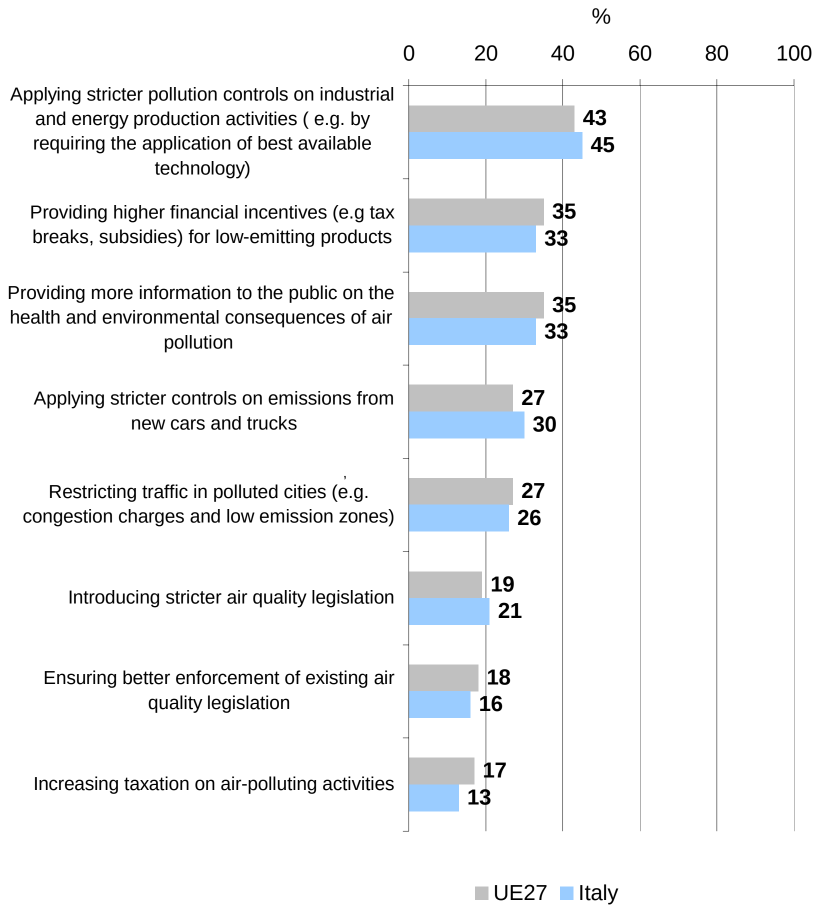
Europeans held that government authorities, in particular, were not doing enough to promote good air quality.

At the same time, 49% of the respondents (Europeans and Italians) believe that the challenges posed by air pollution are best met on the European level, while 23% of Europeans and 18% of Italians would prefer to see them addressed on a national scale, and 24% of Europeans, together with 28% of Italians, voiced their preference for the local level.

49% of the respondents (Europeans and Italians) believe that the challenges posed by air pollution are best addressed on the European level.
The placement of stricter controls on pollution tied to activities of industrial ad energy production is the approach held to be most effective by both Italian and European citizens.

The respondents were also asked to identify what they consider to be the most effective mode for tackling problems involving the air quality: the highest percentages (43% Europeans and 45% Italians) were registered for the option: “Applying stricter pollution controls on industrial and energy production activities (e.g. by requiring use, the application, of the best available technology)”.
Slightly more than a third of Europeans as a whole consider that providing higher financial energy incentives (such as tax breaks, subsidies) for low-emission products, in addition to providing the public with more information on the health and environmental consequences of air pollution, would be the most effective solutions.
Roughly a quarter of all Europeans, on the other hand, favour stricter emissions controls on new cars and trucks, in addition to which they would limit traffic in polluted cities (through traffic taxes and low-emissions areas, for example).

Slightly fewer than one out of five Europeans favoured the introduction of stricter legislation, to ensure more effective enforcement of existing measures, and they supported increased taxation of polluting activities.
The opinions of Italians on the question were almost the same as those expressed by Europeans as a whole (Figure III.10).



The application of tighter controls on pollution tied to activities of industrial and energy production constitutes the option held to be most effective by both Italians and Europeans as a whole.

Figure III.10: Responses to the question: "Which of the following measures do you feel would be most effective in dealing with problems of air quality? (maximum of two responses)"[18]

85% of Europeans, plus 89% of Italians, agreed with the polluter pays principles.

47% of European citizens stated that the European Union should propose additional measures for dealing with problems of air quality in Europe, and that they wanted to be involved.

85% of Europeans agree with the polluter pays principle and at least three quarters of the respondents in each EU country agree, Italians at a level of 89%.

In terms of problems involving the air quality despite the scarce information on the subject, the majority of the Europeans (79%) think that the EU should propose additional measures.
Specifically, 47% of the respondents suggested that they be involved, saying they wanted to express their opinions on the possible solutions; 32% felt that further measures were necessary, but without wishing to express their opinion.

[18] Source: ISPRA of data from 360 "*Attitudes of Europeans towards Air Quality*"

III. 3. Conclusions

Both the surveys point to very similar attitudes on the parts of European citizens as a whole and of Italians.

A lack of adequate information on the survey topics is one basic complaint.

The impacts arising from poor management of the scarce quality of existing conditions are viewed as very serious problems.

It is also felt that all the actors involved, starting with government authorities, should attempt to do more to ensure higher levels of environmental quality, with one option being facilitate the initiatives that citizens seek to enact on their own, in their day-to-day lives, in order to improve the status quo of water resource and air quality.

CHAPTER 1

CLIMATE CHANGE AND ENERGY

Introduction

The *World Energy Outlook* 2012 of the International Energy Agency (IEA) outlines the evolution of the energy system until 2035 and concludes that "taking all new developments and policies into account, the world is still failing to put the global energy system onto a more sustainable path". In the interim scenario foreseen for 2035, called the *New policy scenario*, fossil fuels are dominant in the global energy system and energy-related global emissions are expected to increase from 31.2 GT in 2011 to 37 GT in 2035, causing an increase of over 3.6°C in the average global temperature in the long term. A lower rate of economic growth in the short term would only result in a marginal difference in the long-term climate trend. At present fossil sources still dominate the world energy mix, notwithstanding the development of renewable sources. Furthermore, fossil fuels are supported by subsidies, which, in 2011 in particular, show an increase of about 30% compared to 2010 and are six times greater than the incentives granted for renewable sources.

The *Efficient World* scenario foresees the adoption of policies for dismantling market barriers and permitting investments in energy efficiency. This would make it possible to halve the growth in demand for primary energy foreseen for 2035, with considerable financial return on investments. In that scenario, energy-related emissions of CO_2 would peak before 2020 and drop to 30.5 GT in 2035, leading to an increase of 3°C in the average global temperature in the long term.

A number of international studies show how commitments to reduction of emissions, even if fully implemented, are no longer sufficient to comply with the threshold of 2 °C global warming.

The rapid use of energy-efficient technologies could delay the "point of no return" of CO_2 emissions by five years, with a trajectory of the average global temperature in line with the threshold of 2°C, which is expected in 2017 in the *New Policies Scenario*. In any case, more low carbon technologies will be needed, as well as efficiency, in order to keep the average global temperature from going beyond the threshold of 2°C.

Similar results are reported by other international studies, the UNEP *Emission Gap Report 2012*, for example, which shows how commitments to reducing emissions, even if fully implemented, are no longer sufficient to comply with the global warming threshold of 2°C. In 2020, the emission gap between the emissions in the BaU (*Business as Usual*) scenario and those with a significant probability of remaining below the threshold of 2°C is 14 $GtCO_{2eq}$. It is still technologically possible to fill the emission gap at marginal costs of less than 50-100/t CO_{2eq}; the potential for reducing emissions by 2020 is 17±3 $GtCO_{2eq}$, but promptness of the actions is crucial in order to prevent costs increasing and the point of no return being reached.

In November 2012, the World Bank also called the attention of the international community to the serious consequences of an uncontrolled increase in temperatures, with the report *Turn Down* *the Heat: Why a 4°C Warmer World Must be Avoided*[1], prepared by the *Potsdam Institute for Climate Impact Research* and by *Climate Analytics*.

The study describes the possible impacts of an increase of 4°C in the average global temperature by 2100, which looks probable on the basis of present emission trends: extreme heat waves, reduction in world stocks of food, loss of biodiversity and of ecosystems, rising sea levels by 0.5-1 metre and loss of wealth by nations. The consequences of global warming will affect the population of every country, but they will be more intense in the poorer regions and thwart their efforts at development.

According to this last report, it is still possible to limit global warming, keeping the increase in temperatures below 4°C: in order to achieve this more effective action for reduction of CO_2, in other words development of low carbon technologies, is needed as well as other mitigation actions, accompanied by inevitable adaptation strategies.

Basic climate trends

Global level

Today the warming the global climate system is indisputable, as revealed by observations of the increase in the average global temperature of the atmosphere and the oceans, the melting of the polar ice caps (particularly in the Artic), the reduction in the glaciers at medium latitudes (including the snow cover) and the rising of the average level of the seas. The increase in the average temperature throughout the world and in Europe, observed during the last few decades, is unusual in terms of both extent and rate of variation.

The increase in temperature at the world level and in Europe, observed during the last few decades, is unusual.

According to the Fourth Assessment Report of the IPCC *(Intergovernmental Panel on Climate Change)*, the overall increase in the global average temperature (land-sea system2) in 2005 was 0.7°C compared to the pre-industrial level.

During the last century (1905-2005) the average global temperature increased by 0.74°C, while in the ten-year periods prior to 1950 it increased at a rate of less than 0.06°C per ten years; during the last 50 years, on the other hand, the rate was 0.13°C per ten years and more recently a rate of about 0.25°C per ten years has been reached.

[1] The World Bank, 2012, *Turn Down the Heat" Why a 4°C Warmer World Must be Avoided*

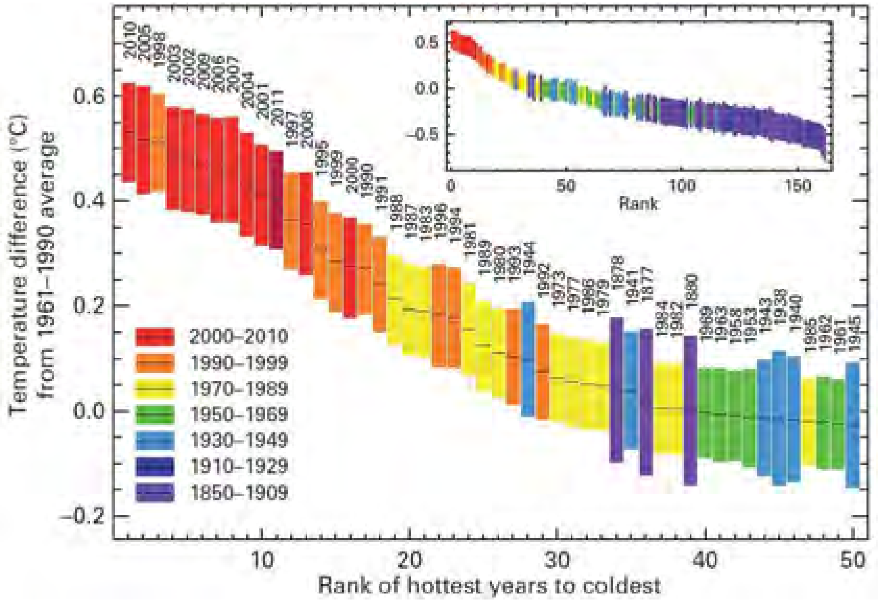
[2] In this document, the term "land-sea" means that the temperature is calculated taking into account both the temperature of the air on land and the surface temperature of the sea, while the term "land only" refers only to the temperature of the air on land

Analyses made by the NOAA (*National Oceanic and Atmospheric Administration)* indicate that the global average temperature anomaly in 2011, compared to the average for the 20th century, was +0.54°C, while the most up to date estimate for 2012 is +0.58°C. The global average temperature anomaly has always been positive since 1977 (Figure 1.1).

The global average temperature anomaly in 2011, compared to the average for the 20th century was 0.54°C. What is more, it has always been positive since 1977.

The ten-year period 2002-2011 was 0.47°C warmer than the reference period 1961-1990. The ranking of the surface global average temperature for the 50 hottest years, published by the World Meteorological Organization, is shown in Figure 1.1; 2011 takes 11th place among the hottest years, whereas 18 of the 21 most recent years take the first 18 places in the ranking.

18 of the 21 most recent years take first place in the ranking of the global average surface temperatures for the 50 hottest years.



Legend
The insert shows the ranking of the global average surface temperatures from 1850 on.
The dimensions of the bar indicate a confidence interval of 95%

Figure 1.1: Ranking of the global average surface temperatures for the 50 hottest years[3]

With regard to precipitation, the evaluations emerging from the 4th IPCC Assessment Report, as well as more recent studies which will represent the base of the 5th Assessment Report, soon to be published, indicate opposite trends (increase or decrease in total annual precipitation) for different parts of the World, in many cases even of slight consistency or statistical significance. On a continental scale, total precipitation has been increasing in Northern Europe since 1950 and has been decreasing in some parts of Southern Europe[4]. Moreover, changing climate variables result in an increase in the frequency, intensity and duration of extreme events, such as floods, drought and heat waves. The frequency of heavy rainfall episodes has increased on most of the land surface, consistent with warming and higher atmospheric water vapour.

Moreover, climate variables result in an increase in the frequency, intensity and duration of extreme events such as floods, drought and heat waves.

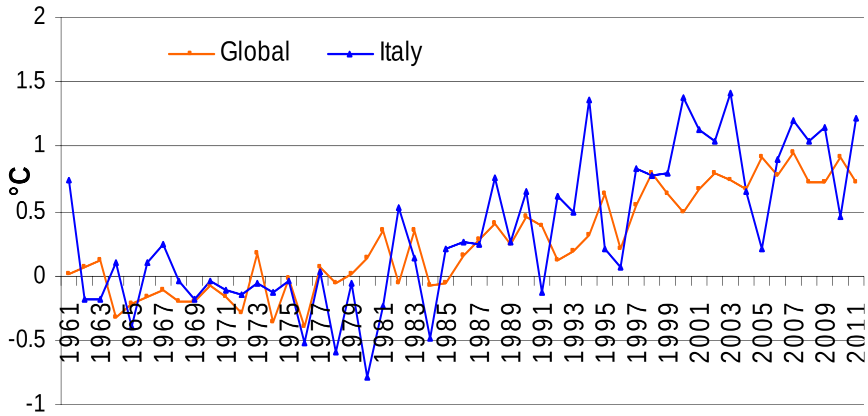
[3] Source: World Meteorological Organization (2012), *WMO statement on the status of global climate in 2011. Report* WMO, no. 1085, Geneva 2012
[4] EEA, 2012, *Climate change impacts and vulnerability in Europe 2012 – An indicator-based report, EEA Report No. 12/2012*

Italy

Temperatures

The climate data and indicators used for evaluating recent climate trends in Italy were produced by the SCIA system (national system for the collection, processing and dissemination of climate data of environmental interest), created by ISPRA and currently updated every year with the time series of observations by the synoptic network (the Meteorological Service of the Air Force and ENAV, the Company responsible for management and control of civilian air traffic - the aviation board), the CRA-CMA (agricultural experimental research council - unit for climatological and meteorological research applied to agriculture, formerly UCEA), many ARPA (regional environmental protection agencies) and the regional agrometeorological services of Marche and Sicily[5].

Estimation of the average temperature variation in Italy is based on the longest and most complete temporal series. Furthermore, the series are tested for homogeneity and corrected if necessary, in order to filter out non-climatic signals, such as changes in the meteorological station instruments or location. Figure 1.2 shows the pattern of the average temperature in Italy compared to the global average for land, from 1961 to 2011.



In 2011 the mean temperature anomaly in Italy with respect to the reference period 1961-1990 was +1.23°C, taking the fourth place in the series from 1961 to date.

Figure 1.2: Time series of mean temperature anomalies. (global and Italian), with respect to 1961-1990 climate normal[6]

During the last 30 years, the Italian mean temperature anomaly was almost always higher than the global for land. In 2011 the value of the mean temperature anomaly in Italy with respect to the reference period 1961-1990 was +1,23°C and comes fourth in the series from 1961 to date[7]. A detailed analysis of the seasonal trends for Northern, Central and Southern Italy shows that the increase of the mean temperature was significant everywhere in autumn since 1970 and in summer since1980, while during the entire period 1961-2006 it was significant in Northern Italy in winter and in the Central-Southern Italy in spring[8].

[5] Desiato F., Lena F. and Toreti A., 2007, *SCIA: a system for a better knowledge of the Italian climate.* Bollettino di Geofisica Teorica ed Applicata, Vol. 48, no. 3 351-358

[6] Source: ISPRA and NCDC/NOAA

[7] ISPRA, *Gli indicatori del clima in Italia nel 2011*, Rapporto Serie Stato dell'Ambiente no. 35/2012, Year VII

[8] Toreti A., Desiato F., Fioravanti G. and Perconti W., 2009, *Seasonal temperatures over Italy and their relationship with low-frequency atmospheric circulation patterns, Climatic Change*, doi 10.1007/s10584-009-9640-0

Extreme temperature events

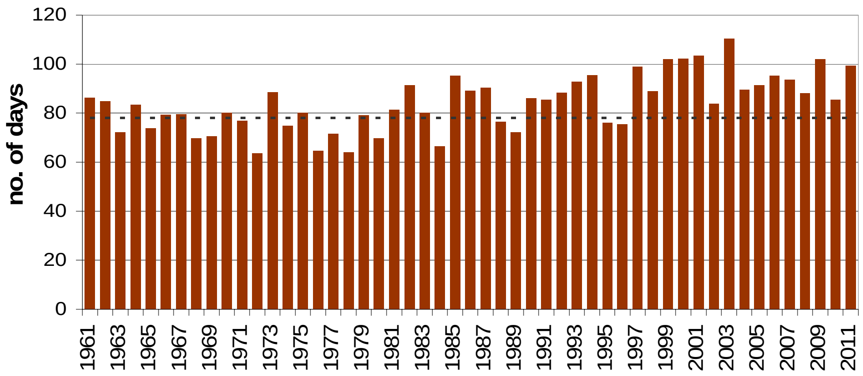
The warming trend can also be seen from the analysis of some extreme temperature indicators.

During the last 15 years, the "summer days"[9] (Figure 1.3) and "tropical nights"[10] (Figure 1.4) have always been more than their climatological averages. In 2011, in particular, the number of summer days took sixth place in the entire series since 1961.

Heat waves are defined as events lasting at least 3 days, when the maximum daily temperature is greater than the 95th percentile of the distribution of the daily maximum temperatures in the thirty-year climatological period 1961-1990. Figure 1.5 displays the average pattern in Italy of the "intensity of heat waves" index, showing the average value (in °C) of the of temperature exceedances over the threshold, accumulated during the course of events.

A trend towards increase over the last 30 years and the exceptional intensity of the heat waves in summer 2003 can clearly be seen.

During the last 15 years, there have always been more "summer days" and "tropical nights" than the climatological averages.



During the past 15 years, the number "summer days", that is to say days with a maximum air temperature of more than 25°C, has always been higher than the climatological averages.

Legend

The dotted line shows the normal average value calculated during the reference period 1961-1990

Note

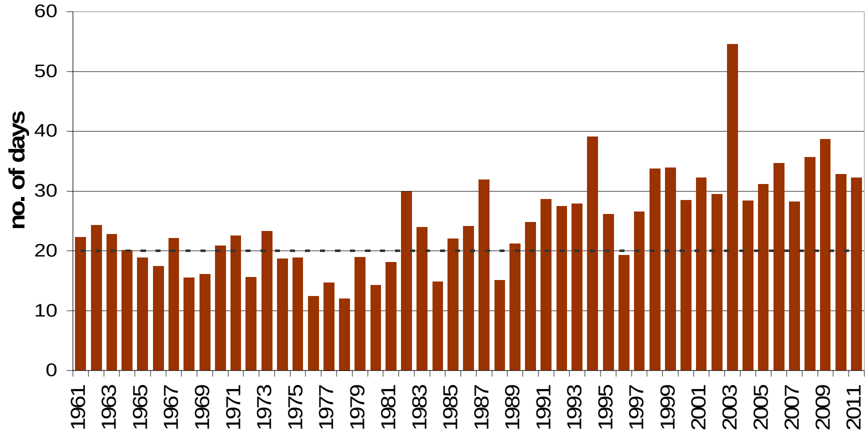
Homogenized time series of 57 stations

Figure 1.3: Annual series of the average number of summer days (maximum temperature > 25°C) (1961-2011)[11]

[9] Number of days with maximum air temperature higher than 25 °C

[10] Number of days with minimum air temperature higher than 20 °C

[11] Source: Data from the stations of the synoptic network and the regional networks processed by ISPRA

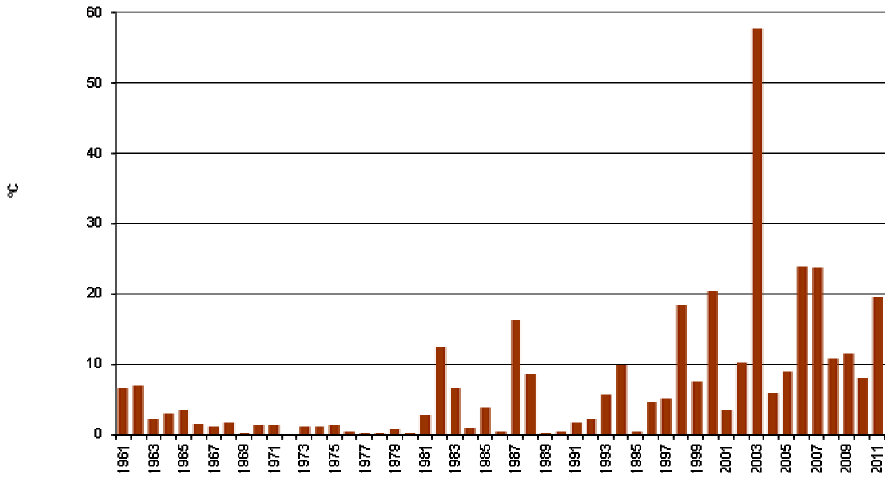


During the last 15 years, the number of "tropical nights", that is to say nights with a minimum air temperature of 20 °C, has always been higher than the climatological average.

Legend
The dotted line shows the normal average value calculated during the reference period 1961-1990

Note
Homogenized time series of 57 stations

Figure 1.4: Annual series of the average number of tropical nights (minimum temperature > 20°C) (1961-2011)[12]



The "intensity of heat waves" index is the average value of the excesses of the maximum daily temperature over a threshold value.

Note
Homogenized time series of 57 stations

Figure 1.5: Average intensity of heat waves (1961 - 2011)[13]

[12] Source: Data from the stations of the synoptic network and the regional networks, processed by ISPRA
[13] Source: Ibidem

Precipitation

With regard to long-term precipitation trends, studies by the CNR (national research council)[14] indicate that "the trends are generally negative, even though only slight and often not very significant from a statistical point of view".

The amount of the reduction in precipitations is in the order of 5% per century; it mainly seems to be due to the spring, the season when the reduction in precipitation is close to 10% per century"[15].

According to studies by the CNR, the long-term precipitation trends are generally negative, even though only slight and often not significant from a statistical point lf view.

Although precipitations time series from 1951 to the present day, available to the SCIA system, are rather inhomogeneous in spatial and temporal coverage, they allow, using the Thiessen or Voronoi method[16], to calculate the cumulative series of annual precipitations for a given geographical area.

Figure 1.6 shows the series of annual anomalies with respect to the the climatological normal 1951-1980, of the mean cumulated precipitation in Northern, Central and Southern Italy.

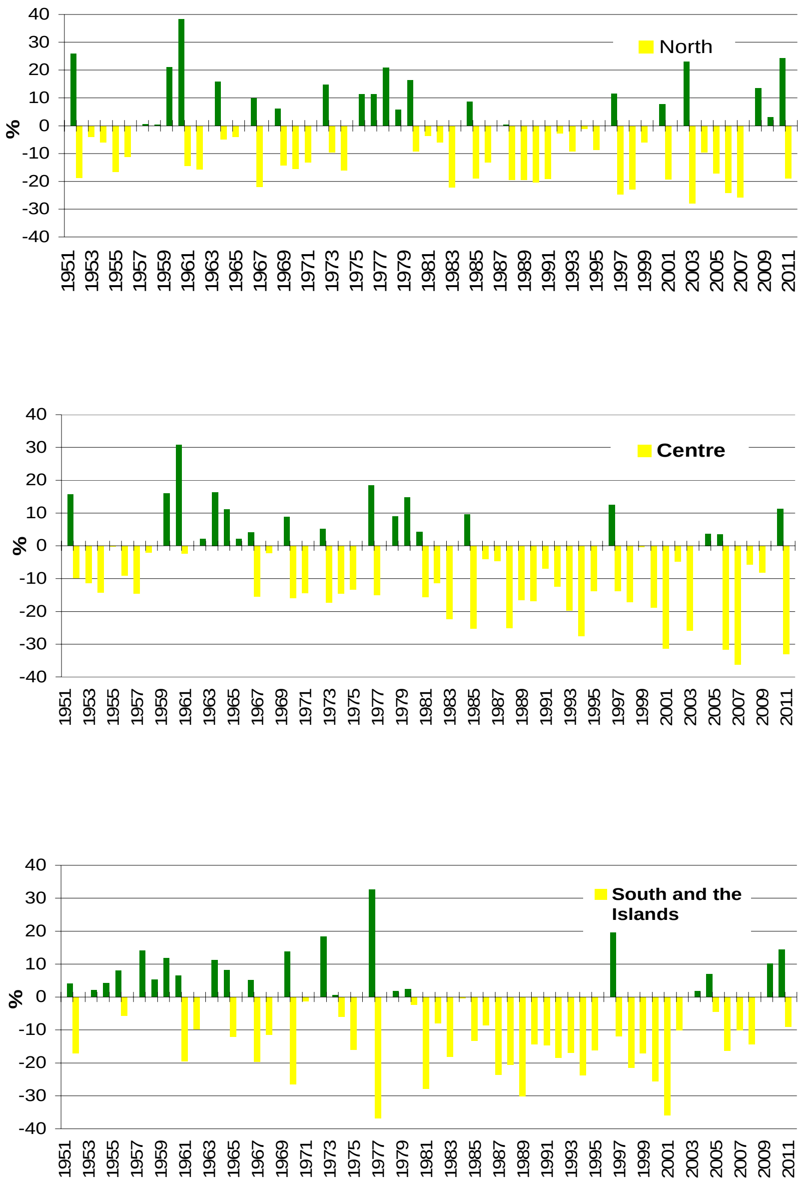
During the last thirty years, precipitations have mostly been lower than the climatological average. In fact, since 1981 they have only been above average for 7 years in the North and for 5 years in the Centre and South.

In 2011 precipitations in Italy were lower than the 1951-1980 climatological average by 19% in the North, 33% in the Centre and 9% in the South.

[14] Brunetti M. et al., 2006, *Temperature and precipitation variability in Italy in the last two centuries from homogenized instrumental time series*, International Journal of Climatology, vol. 26:345-381

[15] Nanni T. and Prodi F., 2008, Energia, no. 1, 2008, pages 66-71

[16] Antonio Mestre Barcelò, 718 WG1., *Report on rainfall spatialisation*, 2002 – Cost 718 Meteorological Applications for Agriculture



During the last thirty years precipitations have mainly been lower than the 1951-1980 climatological average.

Note
Homogenized time series of 57 stations

Figure 1.6: Series of annual anomalies of cumulated precipitations during the period 1951-2011, compared to the 1951-1980 climatological value, in Northern, Central and Southern Italy[17]

[17] Source: Data from the stations of the synoptic network and the regional networks, processed by ISPRA

SPECIFIC REGIONAL CHARACTERISTICS

ARPA Friuli-Venezia Giulia

The *Osservatorio Meteorologico Regionale* (OSMER) - regional meteorological observatory - of the Friuli Venezia Giulia *Agenzia Regionale per la Protezione dell'Ambiente* (ARPA) - Regional Environmental Protection Agency - continues to monitor precipitation and temperature, also for the purpose of evaluating any variations due to climate change.
A recent study made by OSMER[18] shows that, also in Friuli Venezia Giulia, there have been temperature and precipitation variations consistent with the predictions of the literature in a climate change scenario.
An analysis of the data of the 11 meteorological stations in lowland areas managed by the OSMER and in operation since 1991, shows that during the last twenty years (1991-2010) there has been an increase in the annual average temperature.
If we extend the analysis to the 1961-2010 period, in four of these lowland stations (Fossalon, Pordenone, Gorizia and Udine) the increase in the average temperature during the twenty-year period 1992-2010 compared to the reference period 1961-1990 can be quantified as 0.7°C.
The OSMER found that the annual precipitations in 5 stations typical of the different climatic areas (Trieste, Fossalon, Cividale, Udine and Tarvisio) show no significant variations during the twenty-year period 1991-2010, compared to the reference period 1961-1990.
Nevertheless, during the twenty-year period 1991-2010 a reduction in the monthly precipitation was noted during the first 6 months of the year (especially in June), offset by a corresponding increase in precipitation between September and December.
A similar variation was also noted in the average monthly number of rainy days (reduction in the number of rainy days in June and February, increase during the last four months of the year).

Impacts and vulnerability

Global level

The general framework of climate change impacts observed at the global level so far, as it can be described on the basis of the most recent scientific literature, is not significantly different from the one presented in the 2009 edition of the yearbook "*Key Topics*", which is based on the conclusions of the Fourth Assessment Report of the IPCC (2007).

[18] A. Cicogna, M. Gani, S. Micheletti, 2012, Cambiamenti Climatici, Rapporto sullo stato dell'ambiente 2012, ARPA FVG, Forum Editrice Universitaria, , pages 28-53

European level

The Report on *Climate change, impacts and vulnerability in Europe 2012*[19], published by the European Environment Agency (EEA) in March 2013, provides a scientific reference basis regarding impacts of and vulnerability to climate change at the European level.

In March 2013 the EEA published the report on Climate change, impacts and vulnerability in Europe 2012. and vulnerability in Europe 2012, which provides a scientific reference basis regarding impacts of and vulnerability to climate change at the European level.

The main results in the Report can be summed up as follows:

- the ten-year period 2002–2011 was the warmest in Europe, with the average temperatures on land area 1.3° C above the pre-industrial level. Climate projections show that, for the period 2071-2100 the average temperatures on dry land in Europe could increase by between 2.5 and 4°C compared to the period 1961–1990;
- the frequency and duration of heat waves have increased, causing thousands of deaths in the last ten years. Climatic projections show an intensification of heat waves in Europe, which could cause a greater number of deaths if specific adaptation measures are not taken;
- average precipitation is decreasing in Southern Europe and increasing in Northern Europe. Climatic projections indicate that this trend is going to continue in the future. Climate change can cause an increase in fluvial floods resulting from the intensification of the water cycle due to increased temperatures, particularly in Northern Europe;
- drought phenomena are becoming more intense and frequent in Southern Europe. Minimum summer river flows could be reduced markedly in Southern Europe and also in other parts of Europe;
- the Artic region is heating up faster than the rest of Europe; minimum summer extensions of sea ice were recorded in 2007, 2011 and 2012. Melting of the continental glaciers in Greenland has doubled since the nineties;
- the Alpine glaciers have lost about 2/3 of their volume since 1850 and this trend could continue in the future;
- the average global sea level increased by 1.7 mm/year in the 20th century and by 3 mm/year in the last ten years. Climatic projections show a wide range of results but the rise in the average global sea level in the 21st century will probably be higher than in the 20th century (even though the relative sea level on the coasts of Europe varies according to the area), causing an increased risk of coastal flooding;
- climate change also plays a role in the transmission of certain diseases that can have considerable effects on human health;
- a number of changes are taking place in biodiversity: early blooming of plants and of phytoplankton and zooplankton, migration of plants and animals to more northern latitudes or to higher altitudes. Some studies show a potential risk of future extinctions;

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[19] EEA, 2012, *Climate change, impacts and vulnerability in Europe 2012* – An indicator-based report, EEA Report No. 12/2012

- the availability of water resources for agriculture is decreasing in Southern Europe, while it could increase in other areas. The growing season of many crops has lengthened in Europe and this trend could continue in the future together with an expansion of crops located in southern latitudes towards northern latitudes. Climate projections show that the harvest of some crops will decrease in Central and Southern Europe due to heat waves.

Italy

Starting with the last IPCC report, all the most recent studies confirm that the Mediterranean region, and Italy which is part of it, are among the areas most sensitive to climate change. In fact, in this region the effects of climate change can already be seen, which, together with the consequences of anthropic stress on the region and on its resources, make it one of the most vulnerable areas in Europe: particularly in the Alpine areas, which can be regarded as a kind of crossroads between different climatic regimes (polar, Atlantic, Saharan, Mediterranean and continental); the increase in temperature has mainly occurred during the winter, resulting in a reduction of the snow cover depth and duration and a reduction in the extension of glaciers.

The Mediterranean region, and Italy which is part of it, are among the areas most sensitive to climate change.

The potential impacts of climate change and the main vulnerabilities for Italy can be summed up as follows:

- a possible worsening of the existing conditions of strong pressure on water resources, with a consequent reduction in the quality and availability of water, especially in summer in the South and the small islands;
- possible alterations in the hydro-geological regime which could increase the risk of landslides, debris flows and mudflows, rock falls and flash floods. The areas most exposed to hydro-geological risk are the Po valley (with an increase in the risk of flooding) and the Alpine and Apennine areas (with the risk of flash floods);
- possible land degradation and a higher risk of erosion and desertification of the land, with a large part of Southern Italy classified as at risk of desertification and alarming conditions in several areas of the North;
- a greater risk of forest fires and drought for Italian forests, with the Alpine area and the islands (Sicily and Sardinia) being the most critical;
- a higher risk of loss of biodiversity and natural ecosystems, particularly in the Alpine areas and in mountain ecosystems;
- glacial retreat, accompanied by colonisation of the proglacial areas by vegetation;
- a change in the density of high altitude forests, causing in some cases a shift of tree lines toward higher altitude;
- a higher risk of flooding and erosion of coastal areas, due to a higher incidence of extreme weather events and sea level rise (also combined with subsidence phenomena, either of natural or anthropic origin);

- a greater risk of heating of the Mediterranean surface waters, with changes in the coastal biological communities and loss of marine biodiversity;
- possible proliferation of allochthonous species that take advantage of potentially warmer waters (for example: blooming of *Ostreopsis ovata*);
- a potential reduction in agricultural production, particularly wheat growing, but also fruit and vegetables; the growing of olives, citrus fruits, grapes and durum wheat might become possible in Northern Italy, while in the South the growing of maize might deteriorate and be even more affected by the scarcity of water for irrigation;
- potential consequences on human health, especially for the most vulnerable sectors of the population, due to the increase in diseases and deaths related to heat, in cardio-respiratory diseases caused by atmospheric pollution, in accidents, deaths and diseases caused by floods and fires, in allergic ailments and to changes in the emergence and spread of infectious diseases and water- and food-borne diseases;
- potential damage to the Italian economy as a whole, such as: drop in hydroelectric generation due to the reduced availability of water, reduced (or more expensive) winter tourist facilities and less attractiveness for tourists in the summer, drop in productivity of fisheries, effects on urban and rural infrastructures with possible interruptions in or inaccessibility of the transport network and damage to human settlements and socio-economic activities.

Pressures on the climate system

Greenhouse gas emissions in Italy

A large part of the warming observed during the last 50 years is attributable to human activities

Even without ignoring the effects of natural phenomena like the variability and intensity of solar radiation, the vast majority of the scientific community is convinced that "*there are new and more significant factors*" for maintaining that "*a large part of the warming observed during the last 50 years is attributable to human activities*"[20]; these results are amply confirmed by the IPCC Fourth Assessment Report, which confirmed that "*the warming of the climate system is unmistakable*" and with a "*very high level of confidence*" it indicated human activities as the causes of this warming[21].

The average global atmospheric concentration of CO_2, the main greenhouse gas, increased from 280 ppm during the period 1000-1750 to over 390 ppm in 2011 and during the last 40 years there has been an increase of from 1 to 2 ppm a year[22]. CO_2 levels of higher than 400 ppm have been recorded since spring 2013 at various stations of the Global Atmospheric Watch (the World Meteorological Organisation's network for measuring atmospheric concentrations of greenhouse gases) located in the northern hemisphere.

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[20] IPCC, 2001, *Climate Change 2001 – Synthesis Report*

[21] IPCC, 2007, *Climate Change 2007 – WG-I, WG-II, WG-III, Technical summary*

[22] http://oco.jpl.nasa.gov/science/

Between the pre-industrial period and 2011, an increase in annual emissions of carbon dioxide from around zero to about 34.7 billion tonnes was recorded, taking into account only emissions arising from the use of fossil fuels in combustion processes and in cement manufacture. Projections for 2012 show a further increase in global emissions of carbon dioxide to 35.6 billion tonnes[23].

From the pre-industrial period to 2012 projections show an increase in annual emissions of carbon dioxide from about 0 to about 35.6.

According to evaluations on the carbon cycle reported by the IPCC, between 1750 and 2000 fossil fuels equal to about 390 billion tonnes of carbon were extracted from the subsoil and burned and they, in turn, produced about 1,400 billion tonnes of carbon monoxide. 57% of this amount was absorbed by the sea (partly dissolved in the water and partly absorbed by the phytoplankton) and by land vegetation (through chlorophyll photosynthesis and forest sinks). The remaining 43% remained in the air, producing an increase in concentrations of carbon dioxide up to the highest value in the last 650 thousand years and, probably, even the last 20 million years. Similar, or even more marked, patterns are also recorded for other greenhouse gases, like methane, nitrous oxide and fluorocarbons.

The global economic crisis that has been affecting the financial and energy markets since 2008 had limited effects on the pattern of greenhouse gas emissions at the global level in 2011. Even though in 2011 CO_2 emissions caused by the use of fossil fuels in 2011 decreased compared to the previous year in a number of industrialised countries (-6.3% in the United States, -9.1% in the United Kingdom, -6.6% in Germany, -8,8% in Japan, -8.2% in Russia), they continued to increase in the emerging countries (+9.2% in China, +9.8% in India).

At the global level the average annual increase since 2000 was 3.1% and the increase forecast for 2012 is 2.6%. Emissions in 2011, compared to those recorded in 2007, the year the economic crisis started, were 10.5%.

Between 1990 and 2011 greenhouse gas emissions in Italy went from 518.98 to 488.79 Mt CO_2 eq, with a decrease of 5.8%. According to the Kyoto Protocol Italy is supposed to bring its emissions during the period 2008-2012 to levels 6.5% lower than the 1990 assigned amounts, that is to say to 483.26 Mt CO_2eq.

In Italy the trend of greenhouse gas emissions is in line with that in the main industrialised countries. The data in the national greenhouse gas inventory[24] show that emissions went from 518.98 to 488.79 million tonnes of CO_2eq (Mt CO_2eq) during the period 1990-2011, a decrease of 5.8%. According to the Kyoto Protocol, Italy is supposed to bring its emissions during the period 2008-2012 to levels 6.5% lower than the 1990 assigned amounts, that is to say to 483.26 Mt CO_2eq.

At the global level, Italy in 2010 is responsible for not more than 1.32% of the carbon dioxide emissions originating from the use of fossil fuels and takes 14th place among the countries with the highest levels of greenhouse gas emissions[25].

[23] Global Carbon Project , 2012, *Global Carbon budget 2012*
[24] ISPRA, 2012, *Italian Greenhouse Gas Inventory 1990-2011*. National Inventory Report 2013
[25] IEA, 2012, *CO_2 emissions from fuel combustion. Highlights.* (1971-2010 data)

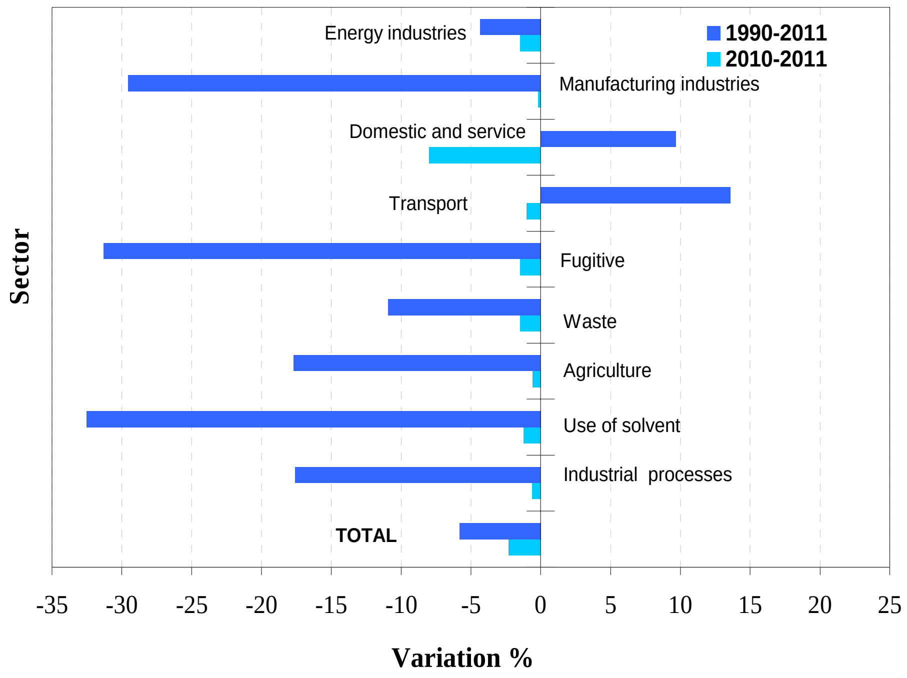
Between 1990 and 2011 total greenhouse gas emissions in Italy decreased by 30.19 Mt CO_2eq. During this period the emissions of nearly every sector were reduced, except for the transport sector and the household and services sector, whose emissions increased by 14.15 Mt CO_2eq and 7.61 Mt CO_2eq respectively.
Fugitive emissions, due to accidental leaks during the extraction and distribution of hydrocarbons, are down by 3.37 Mt CO_2eq and those from the manufacturing industry by 25.7 Mt CO_2eq; there is a reduction of 7.21 Mt CO_2eq in the agricultural sector, for the use of solvents the drop is 0.80 Mt CO_2eq, for industrial processes it is 6.75 Mt CO_2eq and for waste it is 2.14 Mt CO_2eq; lastly, emissions from the energy industries are down by 5.98 Mt CO_2eq.
Since 1990 national emissions have been on the increase, with a turnaround starting in 2005, accelerated by the economic crisis, and an upturn in emissions in 2010 compared to the previous year.

Table 1.1: Greenhouse gas emissions by sector[26]

	1990	**2008**	**2009**	**2010**	**2011**	**2011-2010**
Sector	**Mt CO_2eq**					**Var %**
Energy industries	137.21	156.81	131.8	133.18	131.23	-1.47%
Fugitive emissions	10.78	7.34	7.14	7.52	7.41	-1.49%
Manufacturing industry	86.95	72.47	55.9	61.37	61.25	-0.20%
Transport	104.23	124.58	120.26	119.58	118.38	-1.01%
Household and services	78.57	88	90.1	93.64	86.18	-7.97%
Industrial processes	38.39	35.67	30.74	31.83	31.64	-0.59%
Use of solvents	2.45	1.95	1.83	1.68	1.66	-1.22%
Agriculture	40.74	36.02	34.78	33.72	33.53	-0.57%
Waste	19.66	18.34	18.24	17.79	17.52	-1.49%
TOTAL	**518.98**	**541.18**	**490.78**	**500.31**	**488.79**	**-2,30%**

As a whole, the reduction of emissions in 2011 compared to the previous year was 11.52 Mt CO_2eq (-2.3%) with reductions of different amounts in all the sectors (Figure 1.7).

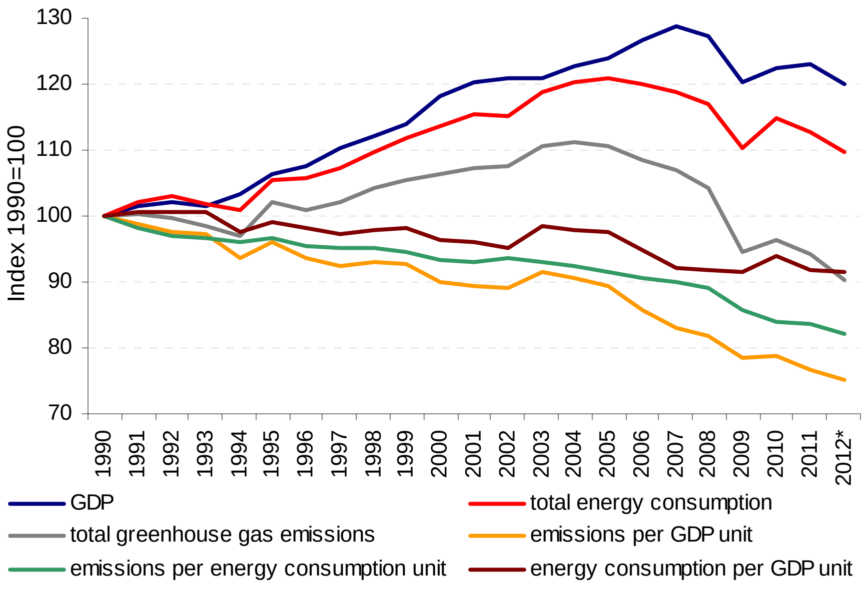
[26] Source: ISPRA



Between 1990 and 2011 there was an increase in emissions from the household and services sector and, above all, from transport.

Figure 1.7: Percentage variation of greenhouse gas emissions by SNAP (*Selected Nomenclature for Air Pollution*) sector for 2011 compared with the preceding year and with 1990[27]

A provisional estimate (updated as of 30 June 2013) of the emissions processed by ISPRA for 2012 gives a value of 464.55 Mt CO_2eq, a reduction of 5% compared to the previous year and 10.5% compared to 1990, amounting to a reduction in absolute terms of 54.43 Mt CO_2eq. The average emissions of greenhouse gas during the period 2008-2012 came to 497.12 Mt CO_2eq.



A comparison (Figure 1.8) between the trend of total greenhouse emissions and that of the main variables of economic growth shows that, during the period 1990-2012, the growth of greenhouse gas emissions was generally slower than that of the economy, highlighting a relative decoupling.

Legend
* Provisional data

Figure 1.8: Trend of the principal economic, energy and emission indicators[28]

[27] Source: ISPRA
[28] Source: Ibidem

A comparison (Figure 1.8) between the trend of total greenhouse emissions and that of the main variables of economic growth (like the GDP, for example) shows that, during the period 1990-2012, the growth of greenhouse gas emissions was generally slower than that of the economy, highlighting a relative decoupling between the two variables, which becomes absolute after 2008[29]. If we analyse the trend of greenhouse gas emissions by unit of energy consumption, we can see an increasingly marked decoupling between the two variables. This decoupling is mainly due to fuels with a higher carbon content being replaced by natural gas for generating and to an increase in renewable sources in industry in recent years.

The trend of greenhouse gas emissions and of energy consumption shows an increasingly marked decoupling mainly due to fuels with a higher carbon content being replaced by natural gas for generating electricity and to the use of renewable sources in industry.

The breakdown was analysed in order to assess the role of the main determining factors underlying the change in greenhouse gas emissions during the period 1990-2012[30]. This technique makes it possible to study the variation of an indicator during a given period of time, in relation to its decisive factors defined *a priori*, on the basis of a conceptual model that explains the dynamics of the parameter being observed. The variation of a parameter is then broken down into the variation of the parameters that cause it.

Atmospheric emissions of greenhouse gas can be expressed as the product of decisive factors according to the following equation:

$$GHG = \frac{GHG}{E} \times \frac{E}{GDP} \times GDP$$

This representation makes it possible to break down the variation in the emissions in relation to the additive contribution of the following factors:

the ratio between emissions of greenhouse gas (GHG) and energy consumption (E) to determine the effect of the use of fuels with a lower carbon content and of renewable sources (carbon intensity);

the ratio between energy consumption (E) and gross domestic product (GDP) to estimate the effect of efficient use of fuels (energy intensity);

the gross domestic product to evaluate the effect of economic growth.

The factorisation makes it possible to evaluate the effect of the variation of a factor while leaving the others unchanged, but it does not enable us to examine the effect of the interaction between the factors considered, in other words their reciprocal dependency.

The 10.5% drop in emissions between 1990 and 2012, amounting to 54.4 Mt CO_2eq, is due to the reduction in carbon intensity and energy intensity, equal to 18.5% and 9.3% respectively, and to economic growth equal to 17.3%.

[29] If the economic variable shows positive growth absolute decoupling is said to occur when the growth rate of the environmental variable is zero or negative; relative decoupling is said to occur when the growth rate of the environmental variable is positive, but less than the growth rate of the economic variable (OECD, 2002)

[30] Ang B.W., 2005. *The LMDI approach to factorisation analysis: a practical guide*. Energy Policy 33, 867–871

The increase in emissions due to the variation in the economic factor during the period between 1990 and 2012 would have been 89.5 Mt CO_2eq if the other factors had remained unchanged.
The reduction due to the use of lower carbon content fuels and renewable sources would have been 95.8 MtCO_2, while the increase in efficiency would have caused a reduction of 48.2 Mt CO_2eq in emissions. These results lead us to conclude that, considering the historic series observed for the different factors, the increase in emissions due to the economic factor was offset by other factors.
Nevertheless, since it is impossible to evaluate the interactive effect of the different factors we cannot definitely say that the reduction noted in emissions occurred independently of the economic crisis, which, starting in 2008, caused a reduction of 6.9% in the gross domestic product compared to 2007.
The equation shown above enables us to test the effects of positive economic growth during the period between 2008 and 2012 and consequently to determine the emissions of greenhouse gas leaving the carbon and energy intensity unchanged.
Considering a growth of 1% a year between 2008 and 2012, lower than the average of 1.5% recorded between 1990 and 2007, emissions of greenhouse gas during the period 2008-2012 would have been 537.8 Mt CO_2eq. Assuming a gross domestic product unchanged until 2012, and stopped at the 2007 level, the average greenhouse gas emissions during the Kyoto period would have been 522.2 Mt CO_2eq, also considering the decreasing trend of the carbon and energy intensity as unchanged.
An analysis of the factorisation shows that the economic crisis, after 2007 and lasting until 2012, caused a drop in the gross domestic product which decisively contributed to the reduction of greenhouse gas emissions.

Greenhouse gas emissions and Kyoto target

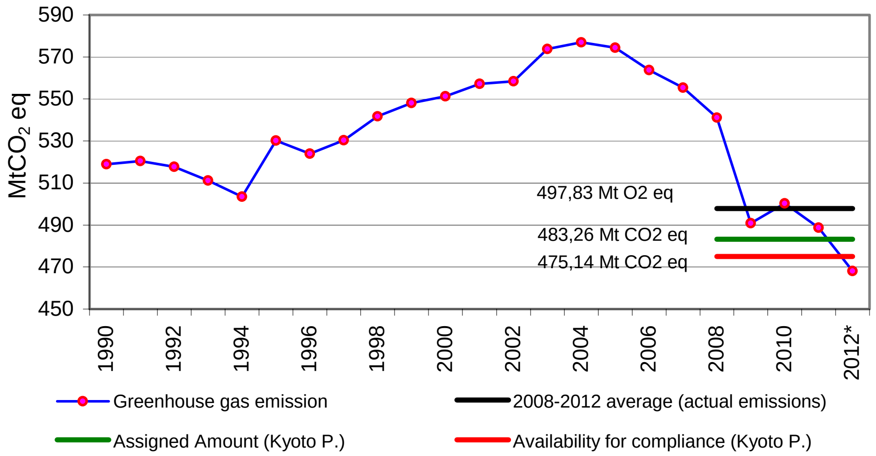
We describe herebelow the specific case of Italy within the accounting system foreseen by the Kyoto Protocol, on the basis of what is set out hereunder in BOX 1. The emission budget initially assigned to Italy for the five-year period 2008-2012 came to 2,416,277,898 AAU (calculated on the basis of the 1990 emissions and on the reduction target). Part of this initial "capital" (1,009,223,343 AAU) was converted into EUA (*European Allowance Units*) and allocated for the operation of the European scheme *Emissions Trading System* (EU ETS). 966.511.739 EU ETC units (including EUA, CER (Certified Emission Reductions) and ERU (Emission Reduction Units)) "came back" (returned by the operators after their emissions had been verified) while 41,822,500 units remained available for the market.
Therefore, as things stand at present, the assigned amount available for verifying Italy's compliance with the commitment made when it ratified the Kyoto Protocol is 2,374,455,398 units[31] (AAU reconverted from EUA, CER and ERU).

[31] Value subject to change

Considering annual average values, approximated to the Mt CO_2eq, the allowed level of emissions (initial yearly assigned quantity) came to 483.26 Mt CO_2eq while in present availability it has become 474.89 Mt CO_2eq. Comparing this allowed level with the average level of emissions released per year during the five-year period 2008-2012 (provisionally estimated at 497.12 Mt CO_2eq) we find that a debt of 22.23 Mt CO_2eq was accumulated every year.

The provisional estimate of the average level of emissions released per year during the five-year period 2008-2012 came to 497.12 Mt CO_2 eq.

Considering the 2012 preliminary estimates, Italy accumulated an annual emission debt of 22 Mt of CO_2 equivalents between 2008 and 2012..



Legend
*Provisional data

Figure 1.9: Total greenhouse gas emissions and level foreseen for compliance with the Kyoto Protocol[32]

In fact, in order to reach compliance in 2015 with the reduction commitment made, Italy will have to acquire approximately 111.2 million more Kyoto units.

It should be noted that the contributions from the use of credits generated by the forestry sector (LULUCF, *Land Use, Land Use Change and Forestry*) and resulting from investments in international projects for clean development (*Clean Development Mechanism* - CDM) have not yet been taken into account in this calculation. With regard to absorption by the forestry sector, the estimates up to 2011 credit 10.2 Mt CO_2eq a year for activities related to art. 3.4 of the Kyoto Protocol (afforestation, reafforestation, deforestation) and 6 Mt CO_2eq a year for activities related to art. 3.3 (forestry management). However, the final figure related to the activities foreseen by art. 3.3 of the Kyoto Protocol will be fixed after the UNFCCC review in 2014, at the end of the Kyoto commitment period. With regard to credits arising from international cooperation projects acquired by the Italian government through the *Italian Carbon Fund*, the estimated figure is 2 Mt CO_2eq per year.

Therefore, concerning the estimates of past years, the distance from the Kyoto Protocol target is presently smaller and capable of allowing Italy to achieve the target with a limited effort by using the credits permitted by the Kyoto Protocol mechanisms and the credits arising from forestry activities.

The distance from the Kyoto Protocol target is presently small and capable of allowing Italy to achieve the target with a limited effort.

[32] Source: ISPRA

As far as the EU27 target for reducing greenhouse gas emissions in 2020 by at least 20% compared to the 1990 levels is concerned, the evaluations contained in the report "*Greenhouse gas emission trends and projections in Europe 2012 - Tracking progress towards Kyoto and 2020 targets*" by the European Environment Agency show that European emissions will continue to decrease slightly until 2020[33]. The projections made by the European Environment Agency indicate that current national measures will make it possible to achieve a 19% reduction in emissions in 2020. The gap of one percentage point from the target of 20% could be closed and even outstripped by 8 points if the Member States implemented all the additional measures currently planned, particularly in the household and transport sectors.

Estimates by the European Environment Agency show that EU27 could attain and outstrip the target of reducing gas emissions by at least 20% in 2020 compared to the 1990 levels provided the Member States implement all the additional measure currently planned.

SPECIAL FOCUS BOX

Accounting methodology for the Kyoto Protocol

Article 3 of the Kyoto Protocol requires each Party to guarantee that its total greenhouse gas emissions (from sources listed in Appendix A) do not exceed the level assigned to it for the commitment period. The target for emissions reduction is fixed on the basis of a reference year, 1990, and is shown in Annex B.

The permitted level of emissions is called the Assigned Amount (AA). The **initial assigned amount** is calculated by applying the target for reduction of the emissions produced during the reference year, multiplied by the five years of the first commitment period (2008-2012). This initial quantity is expressed in units called "Assigned Amount Units" (AAU), each of which represents the right to emit one tonne of carbon dioxide equivalent (tCO_2eq).

The Kyoto Protocol allows the Parties to add or subtract units from the initial assigned amount (thus increasing or decreasing the level of emissions allowed during the commitment period) through forestry activities and by participating in the so-called Kyoto mechanisms (*Emissions Trading, Joint Implementation, Clean Development Mechanism*).

The mechanisms make compliance with their commitments more flexible for the Parties since they can take advantage of reducing emissions wherever it suits them best. In fact, these activities allow the Parties to generate, cancel, acquire or transfer emission rights and consequently to change their assigned amount. These emission rights are referred to collectively as Kyoto Units and are subject to specific regulations depending on the particular type of unit.

Kyoto Units acquired by a Party through the mechanisms are added to the initial assigned amount, while units transferred to other Parties are deducted from the initial assigned amount. There is no limit to acquisition of Kyoto Units by a party but there is a limit to the number of units that can be transferred (determined by the amount of the Commitment Period Reserve - CPR). It should be noted that the

[33] EEA, 2012, *Greenhouse gas emission* trends *and projections in Europe 2012 - Tracking progress towards Kyoto and 2020 targets, Report 6/2012*

total amount assigned for all the Parties remains constant as a whole, since it is redistributed among the various Parties.

The mechanism of *Emissions Trading* between Parties can be applied again at the regional level by developing similar systems that involve other legal entities, as was the case with the European *Emissions Trading System* (EU ETS) between 2008 and 2012. In cases like this the Kyoto Protocol acts as an umbrella underneath which these regional systems operate, since the units circulating in them are subject to the same rules and the same accounting system.

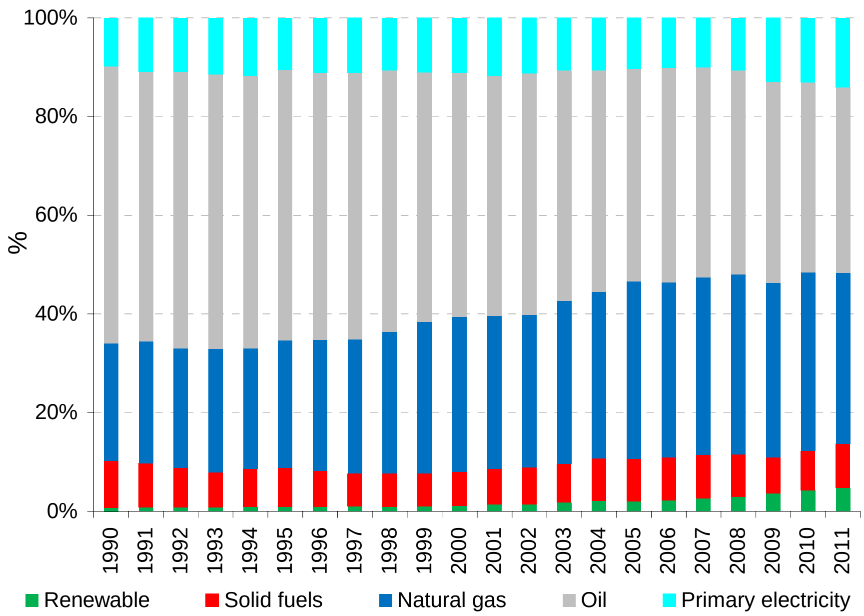
At the end of the commitment period, the compliance of each Party will be evaluated by comparing the total emissions produced with the **Available Assigned Amount.** The available assigned amount is equal to the initial assigned amount plus the Kyoto Units acquired from other Parties by means of the mechanisms or generated following absorptions from forestry sector activities, less the Kyoto Units transferred to other Parties by means of the mechanisms or cancelled following emissions from forestry sector activities.

If in 2015 (after the last UNFCCC review related to the year 2012) the total emissions in the commitment period are less than or equal to the available assigned amount, the Party will be regarded as compliant with its commitment to reduction or limitation of emissions.

Generation and consumption of energy

The trend of energy prices is one of the causes of the changes taking place in supplies. Starting in 1990 there has been a marked increase in the role of natural gas compared to oil products and a trend towards an increase in the contribution of renewable sources, which however still accounted for a very small percentage (4.7%) in 2011, and of cogeneration.

The trend of energy prices is one of the causes of the changes taking place in supplies.



A series of changes in supplies are taking place in the energy sector. In fact consumption of natural gas is increasing compared to oil products and the contribution of renewable sources and cogeneration.

Figure 1.10: Total share of energy consumption by primary source[34]

[34] Source: MSE data processed by ENEA

However, changes in the mix of primary sources have not reduced the high energy dependency of Italy, which shows wide variations around an average value of 82.4%.

However, changes in the mix of primary sources have not reduced Italy's high energy dependency.

It is only in the last few years that there has been a reduction in energy dependency, although the concomitance of the economic crisis does not enable us to interpret the trend from a structural point of view.

In 2011energy dependency was 8.,7%,the lowest value since 1998.

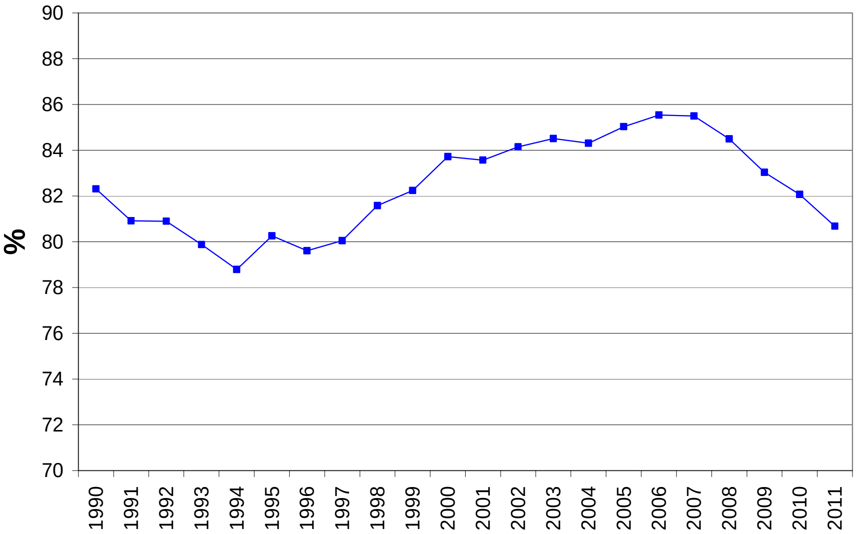


Figure 1.11: Energy dependency in Italy[35]

Starting in 1990 there was a growing trend in gross domestic consumption of energy, reaching a peak in 2005 (+21% compared to 1990). From 2006 there was a turnaround, subsequently accelerated by the economic crisis, with a drop of 8.8% in consumption in 2009 compared to 2005.

In 2011 gross domestic consumption increased by 12.7% compared to 1990.

In 2010 consumption picked up again by 4.1% compared to the minimum reached in 2009. In 2011 it declined again by 1.9% compared to the previous year. As a whole, gross domestic consumption in 2011 increased by 12,7% compared to 1990. Different sectors have shown different trends since 1990; in particular, industry and agriculture show a decline of 10.4% and 3.2% respectively, while the transport and civil sectors increased by 24.1% and 33.4% respectively.

Regarding the distribution of final uses of energy, net of non-energy uses and bunker fuels, the civil sector absorbed 37% of energy in 2011, 21.8% of which were by the household sector and 15.2% the services sector. The transport and industry sectors absorbed 34.3% and 26.2% respectively, while the agriculture and fisheries sector accounted for the remaining 2.4% of the final use of energy.

In Italy, the drop in total energy consumption in recent years, together with the limited growth of the GDP, is at the root of the drop in primary[36] and final[37] energy intensity between 2005 and 2011 (-6.1% and -6,8%) respectively.

In Italy the drop in total energy consumption in recent years, together with the limited growth of the GDP, is at the root of the marked drop in primary and final energy intensity between 2005 and 2011 (-6.1% and -6.8%).

[35]Source: Data by the Ministry of Economic Development, processed by ENEA

[36]Primary energy intensity is defined as the ratio between domestic availability of energy and the Gross Domestic Product (GDP)

[37]Final energy intensity is defined as the ratio between overall final consumption and the GDP

The primary energy intensity value recorded in 2011, amounting to 129.4 Toe per million euro at values linked to 2005, is one of the lowest since 1990, after the one recorded in 2009. An analysis of the total energy intensity of the G20 Countries reveals that, in 2010, Italy, together with the United Kingdom, had the lowest total energy intensity in terms of values adjusted to purchasing power parity, lower than world and OECD averages.

In 2010,Italy, together with the United Kingdom had the lowest total energy intensity of the G20 countries in terms of values adjusted to Purchasing Power Parity, lower than the world and OECD averages.

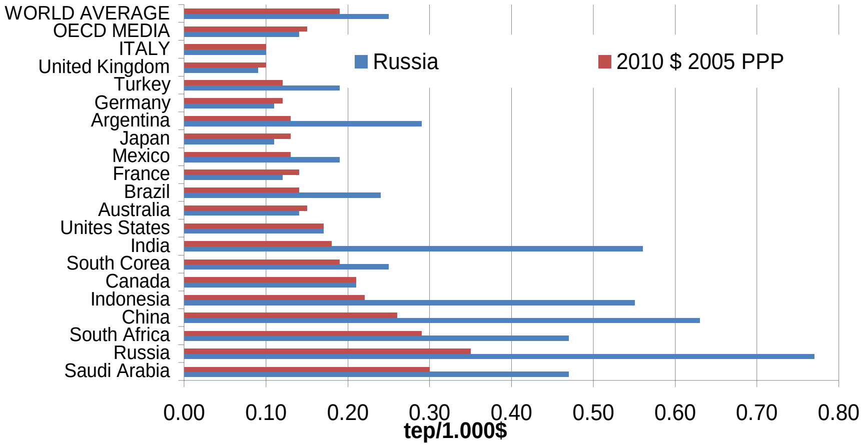


Figure 1.12: Total energy intensity for the G20 countries, referred to $ 2005 and adjusted to Purchasing Power Parity (PPP) (2010)[38]

Between 1994 and 2011, the growth rate in electricity generation was markedly greater than that of total energy consumption. This result indicates the growing role of electricity as an energy carrier in the national energy system.
In the last year there was a slight increase in electricity generation, 0.2% compared to 2010 while there was a reduction of 1.9% in total consumption of energy.

Between 1994 and 2011, the growth rate in electricity generation was markedly greater than that of total energy consumption.

Between 1994 and 2011 the growth rate of electricity generation was greater than that of total energy consumption. This trend shows the growing role of electricity as energy carrier in the national energy system.

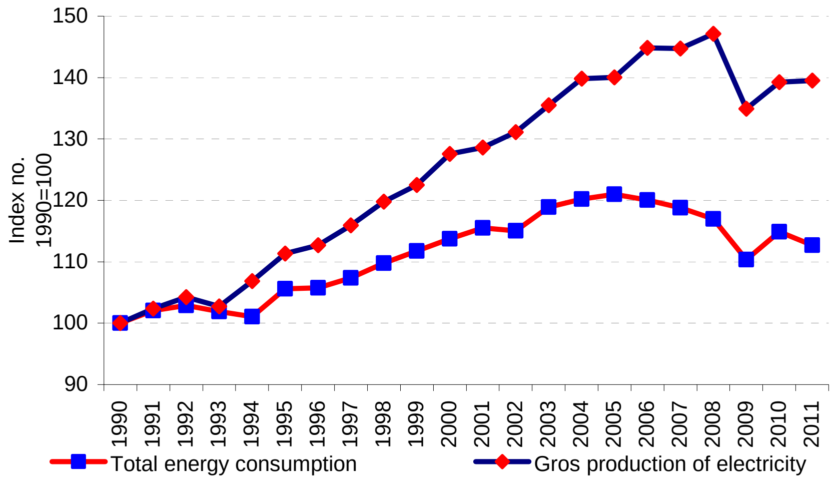
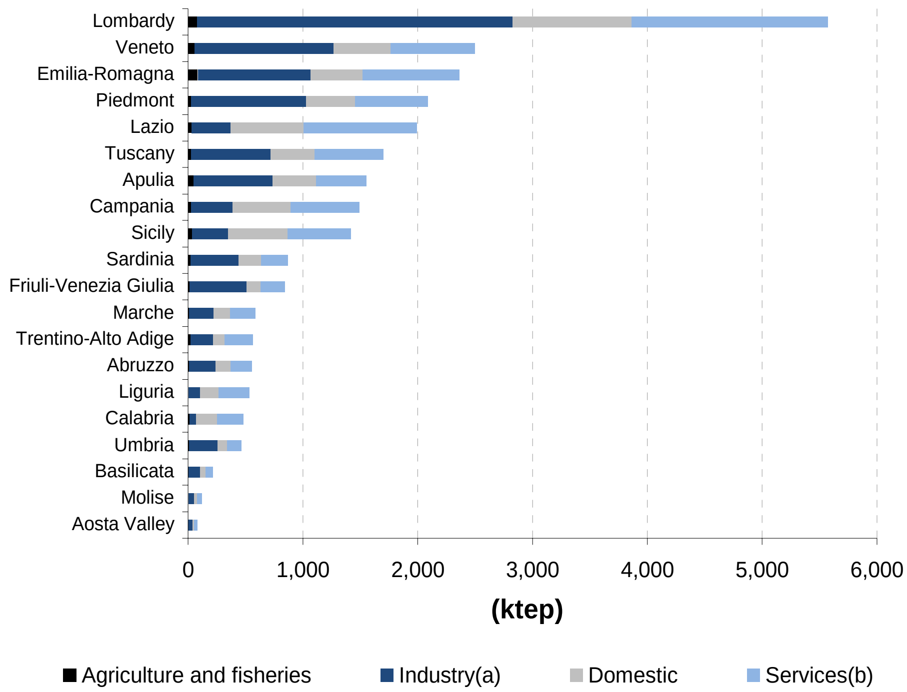


Figure 1.13: Trend of the total energy consumption and electricity generation (1990 = 100)[39]

[38]Source: International Energy Agency (IEA)
[39]Source: Data by the Ministry of Economic Development and TERNA S.p.A. processed by ISPRA TERNA S.p.A.

Final electricity consumption is extremely diverse across the country, as shown by the breakdown of data at regional level. In 2011, Lombardy consumed 21.5% of the national total, followed by Veneto with 9.6%; while Emilia-Romagna and Piedmont accounted for 9.1% and 8% respectively, whereas other regions, like Latium, Tuscany, Campania, Apulia and Sicily, had an average value of around 6.3%. The aforementioned nine regions as a whole consumed 79.6% of the Italian total (Figure 1.14).

Final electricity consumption is extremely diverse across the country, as shown by the breakdown of data at regional level.



With regard to electricity consumption, Lombardy consumed 21.5% of the national total. Nine regions (Lombardy, Veneto, Emilia-Romagna, Piedmont, Latium, Tuscany, Apulia, Campania and Sicily) as a whole consumed 79,6% of the Italian total.

Legend
(a) The "Energy and water" sector is not included;
(b) "Aqueducts" and "Transport" are included

Figure 1.14: Final electricity consumption at the regional level, by sector (2011)[40]

Demand for transport

The Italian transport system has to deal with great variations in the demand for mobility.

During the period 1990-2011, the demand for passenger transport increased by 21.3%, while the demand for domestic goods transport increased by 3.3% compared to 1990.

The demand for passenger transport was at a standstill during the period 2005-2008, followed by an increase in 2009, then there was a decrease during the following years (-5.9% in 2011 compared to 2009) (Figure 1.15).

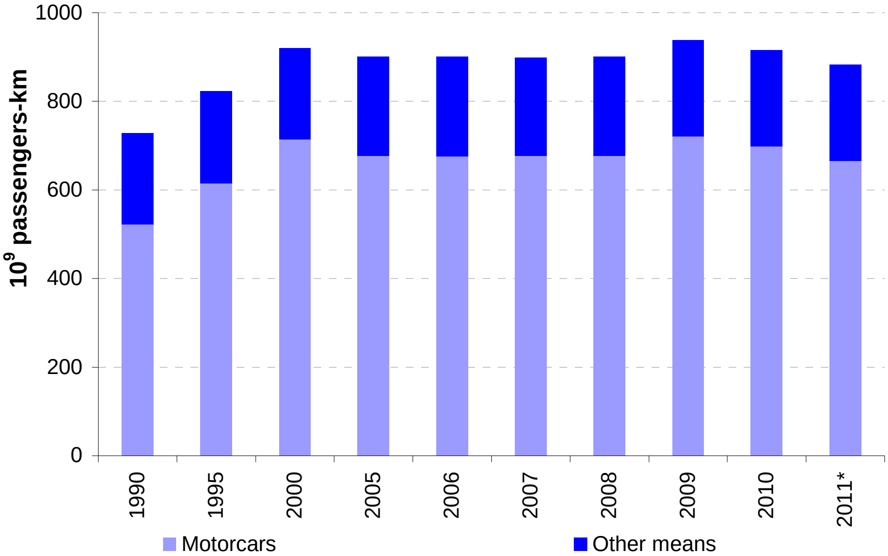
The demand for passenger transport continues to be met mainly by road transport systems, the least efficient from the economic and environmental points of view. In particular, in 2011, road transport by motorcar and motorcycle accounted for 80.2% of the demand for passenger transport.

Italy is one of the European countries with the highest number of

The Italian transport system has to deal with great variations in the demand for mobility. During the period 1990-2011, demand for passenger transport increased by 21.3%, while demand for goods transport increased by 3.3% compared to 1990.

[40]Source: TERNA S.p.A data, processed by ISPRA

motorcars in circulation per resident population, after Luxembourg and Malta, but it has the highest number of vehicles, taking motorcycles and commercial vehicles into account also; at the world level, only the USA has a higher motorization rate, if expressed in vehicles per inhabitant.



During the period 1990-2011 the demand for passenger transport increased by 21.3%. Road transport (motorcars and motorcycles) in 2011 accounted for 80.2% (75.4% for motorcars alone) of the demand for passenger transport.

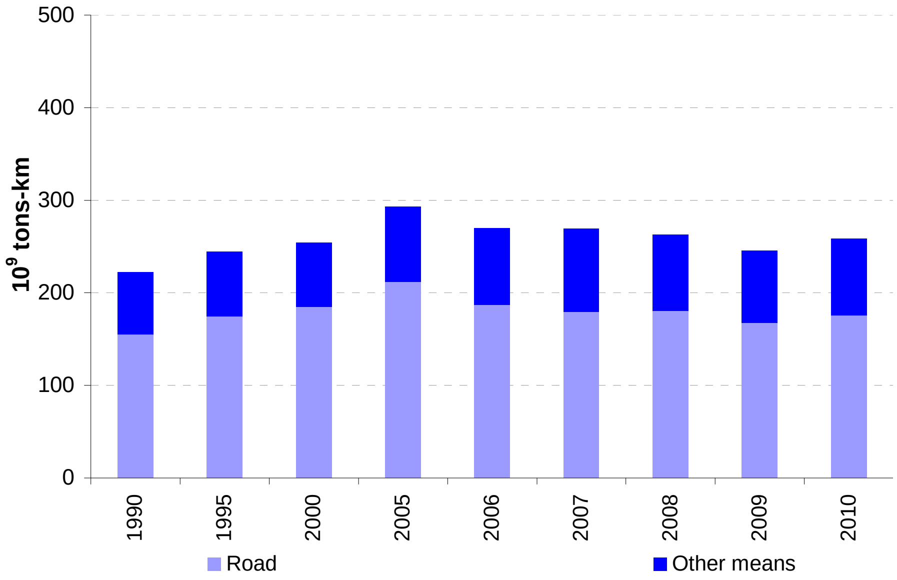
Legend
* Provisional data

Figure 1.15: Trend of the demand for passenger transport[41]

In Italy, the demand for goods transport shows great fluctuations, strictly linked to economic development dynamics. There was an increase of 3.3% between 1990 and 2011.
Starting in 2007 there was a drastic reduction following the effects of the economic and financial crisis (-8.8% in 2009 compared to 2007), whereas in 2010 there was an upturn (+5.3% compared to 2009) followed by a marked drop in 2011 (-11.2%) compared to the previous year.
Goods transport is mainly by road, with a share, fairly constant since 1990, that fluctuates at values close to 70% (66.5% in 2011).
In 2011, goods transport by sea and rail accounted for 21.3% and 7.7% respectively, while air transport accounted for a marginal 0.4%.
In 2011 transport of goods by road decreased by 13.2% compared to the previous year while for “other means” the decrease was 7%.

Goods transport is mainly by road, with a share, fairly constant since 1990, that fluctuates at values close to 70% (66.5% in 2011).

[41] Source: MIT (Min. Infrastructures and Transport) data, processed by ISPRA

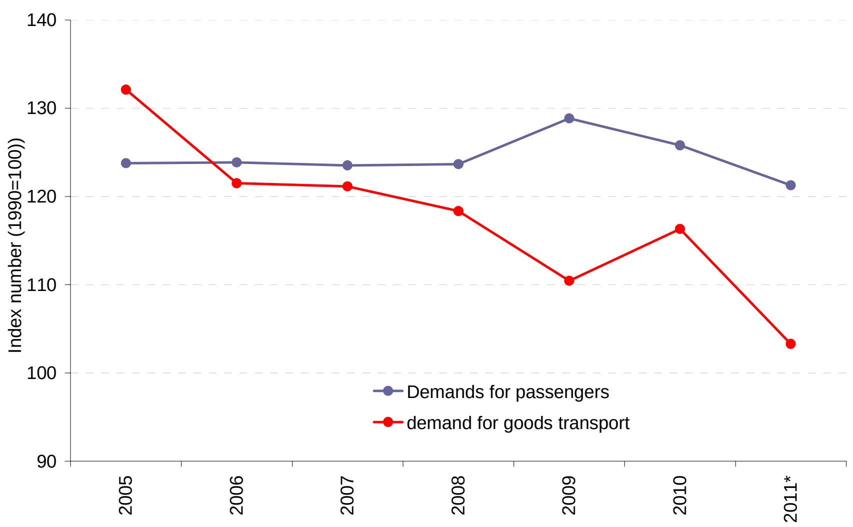


Since 1990 there have been marked fluctuations in demand for transport. The 2011estimates show that goods, transport in Italy is mainly by road (66.5%).Goods transport by sea and rail accounted for 21.3% and 7.7% respectively of total transport.

Legend
* Provisional data

Figure 1.16: Trend of the demand for goods transport[42]

The demands for passenger and goods transport display different dynamics, particularly in recent years.
Where the demand for goods transport is more sensitive to economic dynamics, the demand for passenger transport shows slighter variations.



Demands for passenger and goods transport show different dynamics, particularly in recent years.

Legend
* Provisional data

Figure 1.17: Trend of the demands for passenger and goods transport[43]

[42] Source: MIT data, processed by ISPRA
[43] Source: Ibidem

Response measures: mitigation and adaptation

Response to climate change takes place according to two main approaches: mitigation, which consists of reducing greenhouse gas emissions, and adaptation, which is aimed at minimising the possible negative consequences and preventing any damage caused by climate change. These two approaches complement one another.

Response to climate change takes place according to two main approaches: mitigation (that is to say reduction of greenhouse gas) and adaptation to the climate change that is taking place.

Use of nuclear energy and of renewable sources is an option for reducing greenhouse gas emissions.

As far as energy policies are concerned, the debate has been dominated by the incident that occurred in Japan at the Fukushima nuclear plant on 11 March 2011, following a strong earthquake and consequent seaquake, one of the most serious incidents in the history of the sector after Chernobyl in 1986.

With regard to energy from renewable sources, the publications of the IPCC and the IEA, entirely dedicated to the role of renewable sources and their potential for the development of an economy with low greenhouse gas emissions, are particularly important.

The IPCC reviewed 164 global energy scenarios and their consequences on greenhouse gas emissions. Most scenarios show a significant increase in the share of renewable energy between 2030 and 2050. The scenario with the highest share foresees that 43% of the worlds energy needs could be met by renewable energy in 2030, and 77% in 2050.

In 2008 the share of renewable energy at the world level was 12.9%, mainly represented by biomass (10.2%). Achievement of the targets considered feasible by the IPCC calls for the adoption of measures aimed at fostering the competitiveness of renewable sources over fossil sources, such as monetizing the external costs of energy, removing institutional and regulatory obstacles that prevent or hinder the development of renewable sources, as well as investing in new technologies and infrastructures.

The IEA report stresses the substantial growth recorded at the world level in the sector of renewable sources, in particular wind and solar, nevertheless this contribution is by far outstripped by fossil sources and the use of all renewable sources needs to be doubled in 2020 in order to achieve the sustainability goals.

According to the IEA, the development of an environmentally friendly economy calls for more “aggressive” environmental policies, including elimination of incentives for fossil sources and a transparent and predictable programme of incentives for cleaner and more efficient options.

In the past ten years, coal met 47% of the new demand for electricity at the world level; therefore, in order to meet the targets for reduction of emissions, extensive use of the technology for capture and storage of CO_2 becomes necessary. The application of that technology requires adequate policies as well as support programmes.

In the transport sector, the IEA stresses the importance of electric vehicles for reducing atmospheric emissions of greenhouse gas; this sector needs incentives and the development of suitable infrastructures. However, present sales of electric vehicles are extremely low and

achieving the target of 20 million electric vehicles in circulation in 2020, in the most developed countries, would represent 2% of the vehicle fleet.
Of particular importance with regard to mitigation measures during 2012 is approval of the Directive 2012/27/EC on energy efficiency, which, among other changes introduced, repeals Directive 2006/32/EC as from 5 June 2014 and comes into full effect on 1 January 2017.
The new directive advises Member Countries on how to achieve the energy efficiency target of 20% in 2020. It requests each Member State to fix an indicative national target, which will be monitored by the European Commission.
Each Member State must identify its objectives, taking into account that the energy consumption of the Union in 2020 must not exceed 1,474 Mtoe of primary energy or 1,078 Mtoe of final energy.
By 30 April each year, starting in 2013, Member States must report the progress made in achieving energy efficiency targets. By 30 April 2014, and every three years after that, they have to submit national action plans for energy efficiency that include the measures for improving energy efficiency and the energy savings expected and/or achieved.
The directive also requires the preparation of a long-term strategy for mobilising investments in the restructuring of the national complex of household and commercial buildings, both public and private.
A “model” role will be played by the real-estate sector of public bodies. In fact, every year, starting on 1 January 2014, 3% of the total living area of heated and/or cooled buildings owned by the central government or occupied by it must be restructured to comply with at least the minimum energy performance standards.
Another important element of the directive is the request to the energy companies to reduce their sales of energy to businesses, industries and families by at least 1.5% per year.
On 17 October 2012 the Climate Change Committee approved the 2013 to 2020 emission allocations to each Member State for the sectors not regulated by Directive 2003/87/EC, as foreseen in Decision 406/2009/EC. This Decision fixes a 10% reduction of emissions in 2020 compared to the 2005 European Community levels, sharing out the costs among the Member States; Italy’s target is 13%.
We set out some very important measures taken in Italy during 2012:

- the Ministerial guidelines of 16 February 2012 describe the procedures for obtaining funding from the Kyoto Fund. The Fund was set up by the 2007 Budget Law to fund actions implementing the Kyoto Protocol. The resources, € 600 million euro distributed in three annual installments of € 200 million each, are managed by the *Cassa Depositi e Prestiti* (bank for deposits and loans) (CDP). The Fund is aimed at promoting actions at the regional and national level in the sectors of renewable energy, energy efficiency, and forestry research and management. The Fund is “revolving”, that is to say it is supplied through reimbursements of the disbursements made at a soft rate (0.50% per year) and is aimed at public and private parties who submitted a request for funding before 14 July 2012;

- Ministerial Decree of 15 March 2012 regarding burden sharing, as laid down in Law 13/2009, in other words the sharing of regional commitments for attaining the national target in 2020 of 17% of energy from renewable sources on gross final consumption. As things stand at present, the target assigned to the regions is 14.3%, since the rest of it depends on the tools available to the State. Among the items that contribute to the target of regional gross final consumption of energy from renewable sources (electricity, thermal energy and biofuels), the national target laid down by the national action plan, PAN, for national generation of electricity from renewable sources and consumption of thermal renewable sources was shared out at the regional level only. Consumption of biofuels for transport and the import of renewable energy from Member States and Third Countries do not contribute to the fixing of the share of energy from renewable sources to be shared among the regions and the autonomous provinces, without prejudice to the possibility of "making agreements for statistical transfers with territorial bodies in other Member States and agreements with other Member States", in pursuance of Leg. Dec. 3 March 2011, no. 28. The Ministerial Decree foresees a system of annual monitoring of regional targets and lays down that, pending fixing of the monitoring method, "without prejudice to the national target, a review is to be made of the methodological criteria and the parameters used for sharing the intermediate and final targets among the Regions and the Autonomous Provinces", following which the regional targets can be revised;
- Ministerial Decrees of 5 July for photovoltaic energy (*Quinto Conto Energia* - fifth feed-in scheme) and 6 July on non-photovoltaic renewable sources (hydroelectric, geothermal, wind, biomass and biogas) define the new incentives for these energy sources. The incentives scheme will make it possible to exceed the European targets for renewable energy. The decrees bring the incentives into line with European levels, adjusting them to the trends of the market costs of the technologies (drastically reduced during recent years). A system is introduced for the control and management of the volumes installed and the related overall costs (auctions for big plants and registers for medium-sized ones). The decree on renewable non-photovoltaic sources guarantees transition from the previous system by converting green certificates into incentives; green certificates issued for productions up to 2015 will be taken back. Subsequently the conversion of the green certificates to the rate will be done according to the fixed incentive level laid down in Legislative Decree no. 28 of 2011;
- Decree of the Ministry for Economic Development of 28 December 2012, known as the "*Conto Termico*" (thermal scheme), establishes a system of incentives for the generation of thermal energy from renewable sources (heat pumps, boilers, biomass stoves and fireplaces, solar heating plants, also combined with solar cooling technology for generating cold) and for actions in the field of energy efficiency (insulating walls and roofs, replacing frames and installing sun shields). For the generation of thermal

energy the decree is aimed both at private parties and the Public Administration, while for energy efficiency actions the incentives only apply to the Public Administration. The decree introduces specific incentives for Energy Diagnosis and Energy Certification, if combined. An incentive mechanism is introduced along the lines of the *Conto Energia Fotovoltaico* (photovoltaic feed-in scheme) dedicated to renewable thermal energy. The incentives will be based on the estimated amount of energy the plant will generate and do not apply to plants installed to fulfil the obligation for new or renovated buildings but only to the share in excess of compliance with the obligation. For energy efficiency activities, the incentive is equal to a percentage of the expenditure.

Reduction in energy costs, fully reaching and exceeding all the European targets concerning the environment, greater safety of supply and industrial development in the energy sector. These are the four main aims specified in the new Energy Strategy Document (SEN).

Some of the particularly important indicatives in the energy sector are the National Energy Strategy (SEN) of the Ministry of Economic Development, and the Plan for reduction of emissions in 2020 submitted by the Ministry of the Environment, Land and Sea to the Interministerial Committee for Economic Planning (CIPE) (proposed resolution).

The National Energy Strategy, with a reference point of 2020, concentrates on four main objectives:

- reducing the gap between the cost of energy for consumers and for firms, and aligning wholesale prices at the European level for all energy sources: electricity, gas and fuels;
- reaching and exceeding the environmental targets laid down in the European Climate and Energy Package 2020, with a reduction of about 19% in greenhouse gas emissions, 20% in the incidence of renewable energy on gross final consumption and about 24% in primary consumption in relation to the inertial trend in 2020;
- improving safety of supply, particularly in the gas sector, and reducing dependency on supplies from abroad from 84% to 67%, thanks to energy efficiency, increasing generation from renewable sources, less importation of electricity and greater generation of national resources;
- encouraging sustainable economic growth by developing the energy sector, in particular by a programme of investments until 2020, in both the green and white economies (renewable energy and energy efficiency) and in traditional sectors (electricity and gas grids, regasifiers, storage, development of hydrocarbons). These are private investments, partly supported by incentives, which favour a positive economic return for the country.

The Plan of the Ministry of the Environment for reducing emissions by 2020 includes a series of measures aimed at attaining the environmental targets by 2020. The Plan lists, among its principal priorities:

- creating a Catalogue of technologies, systems and products for decarbonising the Italian economy;
- developing the national sector of “ecosustainable” technologies and promoting renewable sources and energy efficiency, particularly in the sector of public and private building;
- changing the modes of transport of goods and persons, gradually

moving from the road to the railway, and aiming at making the railway more competitive than air transport on national routes;

- introducing a tax on carbon emissions, a carbon tax, with exclusion for the industrial sectors already obliged to purchase permits for the emission of CO_2 by the Emissions Trading European Directive. The income from the carbon tax and from the sale of permits for the emission of CO_2 will be used to support public and private investments for reducing the economy's carbon intensity;
- managing the forests, woodlands and agricultural land in order to "capture" atmospheric carbon, and for generation of biomass for the energy sector and second-generation biofuels.

In April 2013 the European Commission presented the EU Strategy for adaptation to climate change, which is intended to help make Europe more resilient in relation to climate change.

With regard to adaptation, in April 2013 the European Commission adopted the EU Strategy for adaptation to climate change, which is intended to help make Europe more resilient in relation to climate change. The strategy will strengthen preparation for and ability to respond to the impacts of climate change at the local, regional, national and Community levels, and promote the development of a coherent approach and better coordination.

The Strategy concentrates on three main objectives:

- promoting action by Member States. The Commission plans to encourage all the Member States to adopt an adaptation strategy (15 of them have already done so) and will give funding to help them build up their adaptation capacity and take initiatives. The Commission will also support adaptation at the urban level, with the launch of a voluntary commitment based on the Covenant of Mayors;
- encouraging climate proofing at the Community level, further promoting adaptation in vulnerable key sectors like agriculture, fisheries and the cohesion policy, ensuring that infrastructures in Europe are made more resilient, and promoting the use of insurance against catastrophes, whether natural or caused by humans;
- improving information support to decision-making processes, dealing with the gaps in knowledge about adaptation and further developing the European climate adaptation platform (Climate-ADAPT) as a reference tool for information about adaptation in Europe.

From the operations point of view, the EU foresees the integration of responses to climate change (mitigation and adaptation) in sectoral policies and in funding by the EU, in particular as far as concerns the subjects of the sea and of inland waters, silviculture, agriculture, biodiversity, infrastructures and buildings, but also migratory and social matters.

To encourage actions at the local, regional and national levels, guidelines are under preparation for integrating the climate in policies and investments and for using the tools and funds allocated by the Commission for climate change. In Italy, the first step towards starting the process of preparing a National Adaptation Strategy was taken in 2012, with the official task entrusted by the Ministry of the Environment, Land and Sea (MATTM) to the Euro-Mediterranean

Centre for Climate Change (CMCC) of ensuring technical-scientific coordination in the process of drawing up the National Adaptation Strategy. For carrying out the related activities, a technical task force, an institutional task force and a mechanism for participation by the stakeholders have been established. The technical task force, composed of about one hundred experts, has the task of collecting and preparing the scientific information on impacts, vulnerability and adaptation available at the national level. The work, already at an advanced stage, has made it possible to systematize knowledge, experience, and research at the national level on the impacts of climate change, on mitigation and on adaptation. The institutional task force is composed of representatives of all the Ministries, Departments and other institutions relevant for the purposes of the National Adaptation Strategy and its task is to provide political input and confirm the process.

Finally, the stakeholders involvement, ensured through a series of consultations, makes it possible to learn the point of view of the citizens regarding adaptation in Italy and thus, taking that into account, to adapt the strategy to it.

During this first phase of the process the technical task force has to produce the following reports:

- state of scientific knowledge about impacts, vulnerability and adaptation to climate change;
- analysis of the policies and regulations on adaptations existing at the European and national levels;
- elements for a national strategy for adaptation to climate change.

The three documents will be based on a sectoral approach.

The following sectors have been identified:

1. Water resources (quantity and quality)
2. Desertification, land degradation and drought
3. Hydrogeological imbalance
4. Biodiversity and ecosystems
   - *Land ecosystems*
   - *Marine ecosystems*
   - *Inland waters and transition ecosystems*
5. Health
6. Forests
7. Agriculture. Aquaculture and Fisheries
   - *Agriculture and food generation*
   - *Sea fishing*
   - *Aquaculture*
8. Energy (generation and consumption)
9. Coastal areas
10. Tourism
11. Urban settlements
12. Critical infrastructure
    - *Cultural heritage and scenery*
    - *Transport*
13. Special cases
    - *Alpine and Apennine areas*
    - *Po valley hydrographic district.*

The European emissions trading system

In the countries of the European Union, a central role in mitigation strategies has been assigned to the implementation of the European emissions trading system, established on the basis of Directive 2003/87/EC.

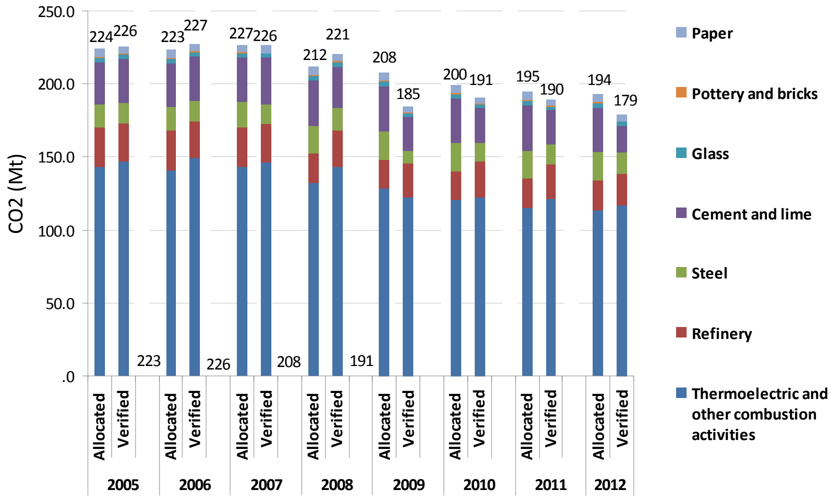
In the countries of the European Union, a central role in mitigation strategies (that is to say the prevention of climate change by reducing greenhouse gas emissions and increasing the absorption of carbon dioxide) has been assigned to the implementation of the European emissions trading system, established on the basis of Directive 2003/87/EC.

This system involves the fixing of a maximum limit (cap) for emissions of carbon dioxide by industrial plants that fall within the field of application of the directive.

Permits for admissible emission are granted to each plant through the National Allocation Plan (PNA). Every permit (European Allowances Unit, EAU) gives the right to emit one tonne of carbon dioxide into the atmosphere during the reference year. Permits for the emission of CO_2 that are allocated but not used may be exchanged among the various operators on the European market. This system is expected to set a competitive type of mechanism in motion, leading to the reduction of emissions by industrial plants. From this point of view, the price at which the emission permits have been exchanged on the European market is a useful indicator of the effectiveness of the system and its ability to send operators a signal that there is scarcity in the total availability of permits. The first period of implementation of the Emissions Trading System (ETS) started on 1 January 2005 and ended on 31 December 2007. In Italy the quotas for the first period were assigned by measure DEC/RAS/74/2006 by the Ministry of the Environment, Land and Sea (MATTM).

By a Decision of 20/2/2008, the National Committee for management and implementation of Directive 2003/87/EC, composed of representatives of the MATTM and the Ministry of Economic Development, assigned the quotas for the second period (2008-2012).

The final data on allocated and verified emissions of carbon dioxide are available for the period between 2005 and 2012 (Figure 1.18).



The first period (2005-2007) ended with higher emissions of carbon dioxide than the allocations (+5.6 Mt CO_2). Between 2008 and 2012, the emissions verified were lower than the emissions allocated (-42.5Mt CO_2), due to the economic crisis, particularly evident during the last two years.

Legend

Allocated: CO_2emission quotas transferred to the plants. For the period 2005-2007 the value includes the quotas resulting from internal transfer operations and not from allocations.
Verified: amount of CO_2actually emitted by the plants

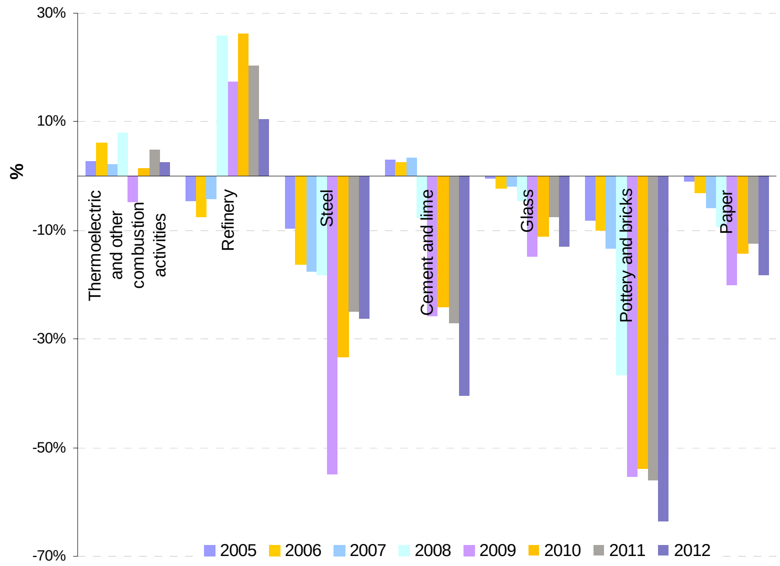
Figure 1.18: Comparison between allocated and verified emissions for the various industrial sectors[44]

The first period ended with higher emissions of carbon dioxide than the allocations (+5.6 Mt CO_2).
In 2008, the first year of the second period (2008-2012), the emissions verified were 8.8 Mt CO_2 higher than the amount of emissions allocated.
The thermal power and refinery sectors emit a greater amount than the quotas allocated, while the other sectors have lower emissions than their allocations.

During the period 2009-2012 the reduction of emissions due to the economic crisis is evident.
The gap between quotas allocated and emissions verified gradually decreased between 2009 and 2011 (23.4 Mt CO_2 in 2009, 8.3 Mt CO_2 in 2010 and 4.9 Mt CO_2 in 2011) and started increasing again in 2012 (14.6 Mt CO_2).
The surplus of quotas allocated compared to the emissions verified concerns every sector, except for the thermal power sector for every year except 2009, the cement and lime sector between 2005 and 2007 and the refinery sector between 2008 and 2012 (Figure 1.19).

The first period (2005-2007) ended with higher CO_2 emissions than the allocations (+5.6 Mt CO_2). In 2008,the first year of the second period, the emissions verified were 8.8 Mt CO_2 higher than the amount of emissions allocated, while during the following years there was a surplus of quotas allocated compared to the emissions verified, due to the economic crisis.

[44] Source: ISPRA



The surplus of quotas allocated compared to the emissions verified concerns every sector, except for the thermal power sector for all the years except 2009, the cement and lime sector during the first period and the refinery sector during the second period.

Figure 1.19: Percentage variation of the allocated emissions of CO_2 compared to the quotas verified for the various industrial sectors[45]

The comparison between emissions verified and emission cap in the various sectors must take into account the emission quotas made available to the various sectors through use of the reserve for new entrants or by another method.

Law no.111 of 19 July 2010 identifies a reimbursement mechanism for plants that have not received CO_2 emission quotas free of charge, due to depletion of the reserve for newcomers foreseen in the Decision assigning the CO_2 quotas for the period 2008-2012, equal to 16.93 $MtCO_2$.

Directive 2003/87/EC defines a "new entrant" as: "*an installation carrying out one or more of the activities indicated in Annex I, which has obtained a greenhouse gas emissions permit or an update of its greenhouse gas emissions permit because of a change in the nature or functioning or an extension of the installations subsequent to notification to the Commission of the national allocation plan*".

In pursuance of Law no. 111 of 19 July 2010, the ETS Committee has therefore fixed the permitted CO_2 quotas for each new entrant during the second period.

The quotas emitted by such installations can be purchased on the market by the operators and subsequently reimbursed.

The monetary amount for the sum of the quotas fixed for each instillation will be established by the Authority for Electricity and Gas (AEEG). The quotas fixed for the period 2008-2012 amount to a total of 57.15 $MtCO_2$.

[45] Source: ISPRA

Table 1.2: Quotas of CO_2 emissions fixed after depletion of the reserve for new entrants, updated by the resolutions in March 2013[46]

Sectors	2008	2009	2010	2011	2012
	KtCO₂				
Thermal power and other combustion activities	36.77	3,457.32	13,265.60	16,798.00	17,803.87
Refinery	0	0	236.51	427.36	273.76
Steel	2.93	64.43	181.67	317.05	151.14
Cement and lime	319.64	319.64	445.31	788.11	827.84
Glass	0	3.84	17.04	243.20	367.26
Ceramics and bricks	0	0	0	0	0.00
Paper	1.84	43.01	167.44	277.45	313.08
TOTAL	**361.18**	**3.888.25**	**14.313.57**	**18.851.17**	**19.736.94**

Fixing the new quotas has further steepened the gap between actual emissions and emission permits assigned to installations on various grounds. Considering the quotas allocated and the quotas fixed, all the sectors show a surplus of emission permits compared to actual emissions between 2008 and 2012, with the sole exception of refineries, for every year, and of thermal power plants, for 2008 only.

Since 2008 all the sectors show a surplus of emission permits compared to actual emissions, with the sole exception of refineries, for every year, and of thermal power plants, for 2008.

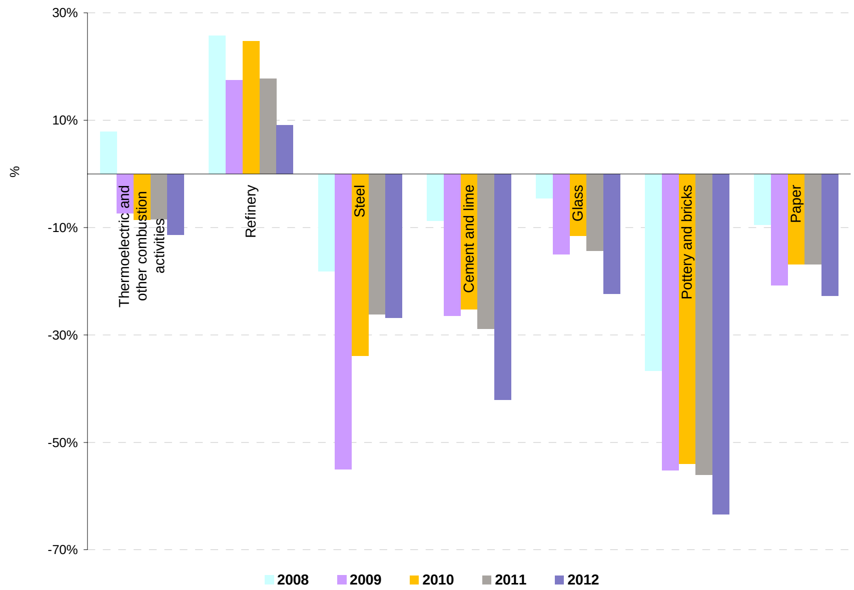


Figure 1.20: Percentage variation of the allocated and fixed emissions of CO_2 compared to the quotas verified for the various industrial sectors[47]

The reduction of emissions due to the economic crisis, as well as fixing further quotas for the installations, makes it difficult to evaluate the environmental effectiveness of the emissions trading system for the period after 2012. In fact, the emissions allocated or the emissions fixed that were not actually issued, represent emission permits that operators can resell or use during the following years when the various industrial sectors have got over the crisis.

The reduction of emissions following the economic crisis makes it difficult to evaluate the environmental effectiveness of the emissions trading system for the period after 2012.

The surplus of permits, already noted for some sectors in Europe[48] could

[46] Source: MATTM
[47] Source: ISPRA

constitute an obstacle to investments in the low-carbon content sectors. By a Decision of 22 October 2010, the European Commission approved the amount of emissions to be allocated in Europe for 2013 (2,039.15 Mt CO_2). The emission permits made available by the economic crisis could actually represent an increase in the post-2012 emission threshold, where they have not been used to offset emissions in excess of the allocations during the period before the economic crisis. On 19 February 2013 the European Parliament's Environment Committee voted for a plan proposed by the European Commission to postpone the allocation of 900 Mt CO_2 , the auction of which, planned for the period 2013-2015, has been put off until 2019-2020. The temporary withdrawal of emission quotas from the market was expected to increase the price of CO_2, which is a stimulus for the green economy sector and which went down by nearly 30 € per tonne in 2008 at values of between 3 € and 4 € during the first few months of 2013.
The Committee's proposal was turned down by the European Parliament on 16 April 2013. In the days following the vote, the price of CO_2 dropped as low as 2.63 € per tonne.

Energy efficiency and saving

With regard to domestic generation of electricity it is reported that an increasing role is being played by cogeneration, which makes it possible to increase the efficiency of converting the energy available in primary sources.

At the national level, it is reported that an increasing role is being played by cogeneration, which makes it possible to increase the efficiency of converting the energy available in the primary sources.

Data for electricity generation show that, since 1997, the need for new electricity by thermal power plants is almost entirely produced in cogeneration (Figure 1.21).
In 2011 there was a downturn in gross thermal power generation compared to the previous year (-1.2%).
The greatest turndown was for cogeneration (-8.9%), while plants that produce only electricity show a 6% increase in generation. During the last year the share of combined generation of electricity and heat was 44.6%, while it was 21% in 1997.
With regard to the mix of primary sources, it is pointed out that the dominant role played by natural gas in thermal power generation has a positive influence on the trend of greenhouse gas emissions.

The increasing role of natural gas in thermal power generation has a positive influence on the trend of greenhouse gas emissions.

This is due, not only to the lower value of the emission factor of natural gas compared to other primary sources but also to the greater efficiency of combined cycles powered by natural gas compared to traditional steam cycles.

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[48] Gaudioso D., Caputo A., Arcarese C., "*A preliminary assessment of CO_2 emissions abatement resulting from the implementation of the EU ETS in Italy*", proceedings of the workshop "eceee 2009 Summer Study", 1–6 June 2009, La Collesur Loup, Côte d'Azur, France, http://www.eceee.org/conference_proceedings/eceee/2009/

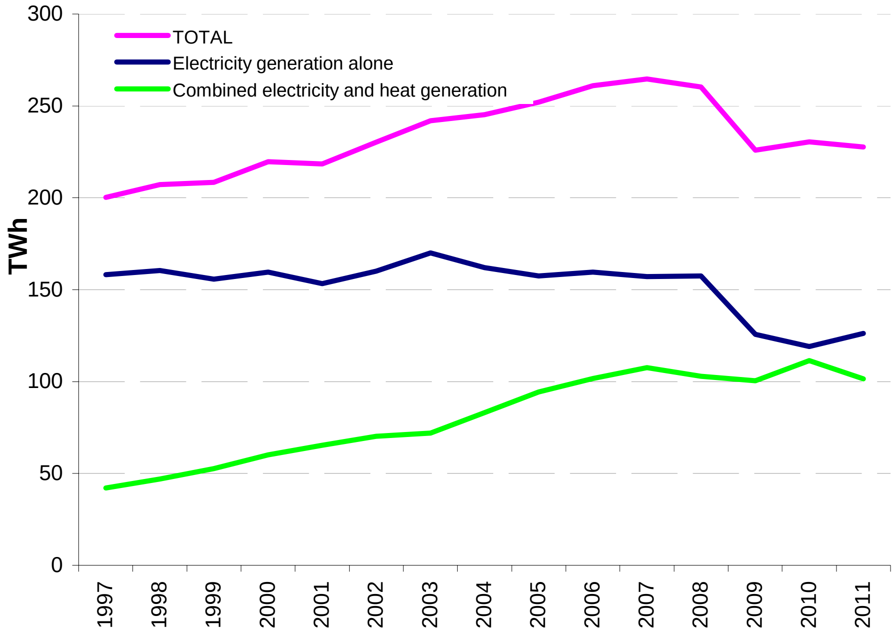


Figure 1.21: Gross generation of thermal power[49]

The generation of electricity alone remained fairly steady until 2008 when there was a sharp drop. Combined generation increased until 2007 after which it fluctuated around an average value. These data show that since 1997 the needs for new thermal power are almost entirely produced in cogeneration.

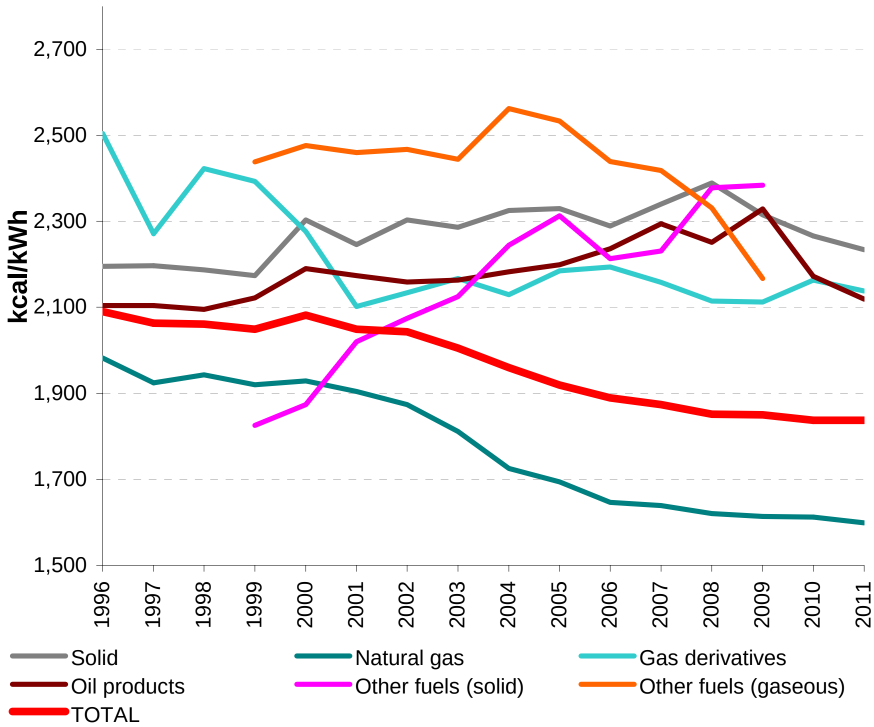
During the period 1996-2011 there was a reduction of 19.3% in average specific consumption of natural gas for gross electricity generation. In 2011 gas derivatives also saw a marked drop in specific consumption, 14.6% compared to 1996. Considering all the fuels used for producing electricity, the average specific consumption went down by 12.1%.

During the period 1996-2011, the average specific consumption of all the fuels used for gross electricity generation went down by 12.1%.

The average specific consumption for electricity generation related to all the fuels, is affected by the use of products less efficient than gaseous fuels, like oil products or solid fuels.

In fact, during the period considered (1996-2011) the average specific consumption of oil products and sold fuel increased by 0.7% and 1.8%, although since 2009 both fuels have been showing a marked reduction in specific consumption, -9% and -3.5% respectively (Figure 1.22).

[49] Source: TERNA S.p.A. data, processed by ISPRA



During the period 1996-2011there was a drop of 19.3% in the average specific consumption of natural gas and 14.6% for gas derivatives. During the same period the average specific consumptions of oil products and solid fuel increased by 0.7% and 1.8% respectively. Generally speaking, the average specific consumption for electricity generation went down by 12.1%.

Figure 1.22: Average specific consumption of fuel in gross electricity generation from fossil sources[50]

The electricity generation sector is one of the main sources of domestic greenhouse gas emissions. Carbon dioxide emissions for electricity generation in 2011 were 118.2 Mt CO_2eq, equal to 90.1% of emissions by energy industries and 24.2% of total domestic emissions. The factors of atmospheric emission of carbon dioxide by electricity generation activities in Italy show a constant reduction in emissions per kWh produced, starting in 1990. The downturn in emissions is due to several factors that contribute to various extents:

- variation in the fuel mix used by the thermal power system, mainly fuels with a low carbon content and greater heating power, like natural gas;
- technological improvement of combustion plants, starting in 2001, and greater efficiency of combined cycles powered by natural gas rather than the traditional steam cycles;
- electricity generation from renewable sources with zero net carbon dioxide emissions.

With regard to the factors of emission from electricity consumption, at the user level the reduction of emission factors is also due to the following factors:

- increase in the ratio between net and gross electricity generation due to a reduction in auxiliary consumption and losses in the transformers of thermal power plants;
- reduction of losses on the grid due to greater efficiency of the grid;
- increase in the amount of electricity imported from abroad.

[50] Source: TERNA S.p.A. data, processed by ISPRA

Table 1.3: Thermal power generation emission factors, total electricity generation and electricity consumption[51]

Year	Gross thermal power generation	Gross electricity generation *	Electricity consumption
	g CO_2/kWh		
1990	708.35	592.01	577.76
1995	691.93	570.66	556.47
2000	649.24	528.35	510.59
2005	568.45	482.54	462.29
2006	560.19	475.48	460.70
2007	545.84	468.84	453.07
2008	538.58	447.34	439.61
2009	528.66	414.43	398.43
2010	520.28	401.34	386.95
2011	519.02	393.10	381.37

Legend
* net of pumping contribution.

Based on Directive 2006/32/EC, the indicative national target for energy saving is 9% by the end of the ninth year of application of the directive (2016).

Directive 2006/32/EC laid down the targets for Member States for efficiency in final uses of energy and energy services. The indicative national target for energy saving is 9% by the end of the ninth year of application of the directive (2016).
In compliance with Law 99/2009, the second Plan of Action for Energy Efficiency (PAEE 2011) was approved by the State-Regions Conference on 27 July 2011. Continuing the first Plan presented by Italy in July 2007, the PAEE 2011 maintains the quantitative target of 9.6% (126,540 GWh/year) for consumption reduction in 2016, gives the results obtained in 2010 and extends the estimates from 2016 to 2020 with a view to associating policies on renewable sources with energy efficiency policies. As a whole, there was a saving of 47,711 GWh, which is 33.8% compared to the expected medium-term results specified in the 2007 Plan (Table 1.4).

Table 1.4: Annual energy saving achieved and expected in 2010 and annual energy saving expected in 2016 and 2020[52]

Measures for improving energy efficiency	Annual energy saving		Savings achieved in 2011 compared to the target for 2016	Expected annual energy saving	
	achieved in 2010	achieved in 2011		2016	2020
	GWh/year		%	GWh/year	
Household	31,427	40,065	66,7	60,027	77,121
Services	5,042	1,987	8,1	24,590	29,698
Industry	8,270	10,143	50,4	20,140	28,678
Transport	2,972	5,400	24,8	21,783	49,175
TOTAL	**47,711**	**57,595**	45,5	**126,540**	**184,672**

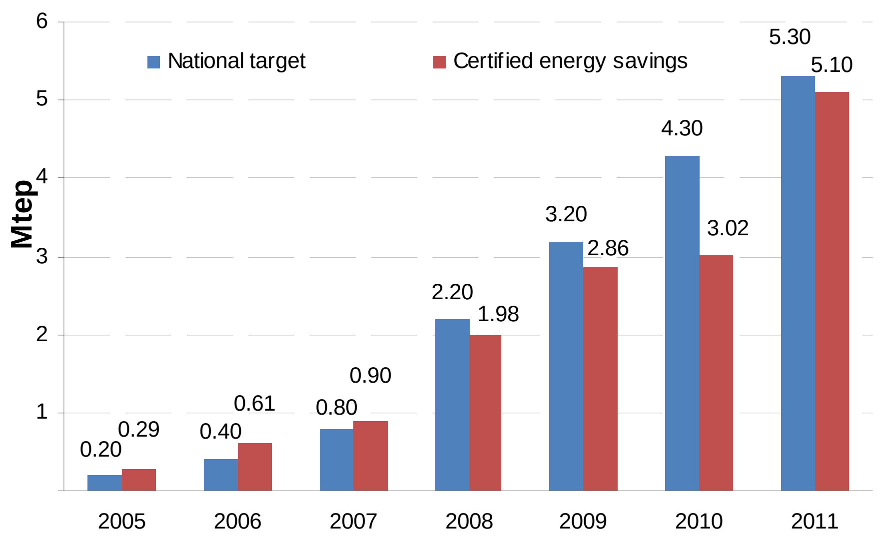
[51] Source: ISPRA
[52] Source: *Piano d'Azione Italiano per l'Efficienza Energetica*, 2011 ENEA, RAEE 2011 - Rapporto Annuale Efficienza Energetica, 2012

The household sector accounts for 69.6% of the savings made in 2011, and in the following years also it continues to be the sector with the highest potential for saving (47.4% in 2016 and 41.8% in 2020).
The industry sector accounts for 17.6% of the savings made.
The savings levels were lower for the services and transport sectors, 3.4% and 9.4% respectively, highlighting the difficulty of attaining the targets fixed in those sectors and the need to introduce new measures, in line with the provisions of the new energy efficiency Directive.
On the basis of the information contained in the PAEE 2011, the measures identified for achieving the target for 2016 will make it possible to save 14% of energy in 2020, compared to the average energy consumption between 2001 and 2005.
Moreover, the energy savings expected in 2016 and 2020 will make it possible to avoid annual emissions of 37.2 Mt CO_2 and 45 Mt CO_2, respectively.

On the basis of the PAAE 2011, the measures identified for achieving the target for 2016 will make it possible to save 14% of energy in 2020, compared to the energy consumption average between 2001 and 2005. Those savings, expected in 2016 and 2020, will make it possible to avoid annual emissions of 3.2 Mt $CO_2$and 45 Mt CO_2 respectively.

Among the tools currently in operation for energy saving, a central role is played by the white certificates system, established by art. 6 of Directive 2006/32/EC, which Italy implemented immediately after the United Kingdom, by the Ministerial Decrees of20 July 2004.
The aim of these decrees, subsequently supplemented by the Ministerial Decree of 21 December 2007, is to achieve a saving of energy that increases year by year until it reaches the level of 6 Mtoe in 2012, by introducing quantitative primary energy saving obligations for distributors of electricity and natural gas.

The aims of the MD of 20 July 2004 and the MD of 21 December 2007is to achieve a saving of energy that increases until it reaches the level of a 6 Mtoe a year in 2012.



During the first three years of operation of the white certificates system, certified energy savings were always greater than the annual targets specified in the decrees, the aim was not achieved during the following three years. The gap between national targets and certified energy savings was reduced in 2011.

Legend
For "national targets" the reference year is the calendar year;
As far as "certified energy savings" are concerned, the first year (2005) refers to the period from 1 January 2005 to 31 May 2006 and for the following years the reference period is from 1 June of the year shown to 31 May the following year.

Figure 1.23: Comparison between national energy saving targets and certified energy savings[53]

[53] Source: AEEG - Authority for Electricity and Gas - data processed by ISPRA *"Il meccanismo dei Titoli di Efficienza Energetica dal 1°giugno al 31 dicembre 2011"*. First Interim Statistical Report related to obligation year 2011, prepared in pursuance of article 8, clause 1, Ministerial Decree 21 decembre 2007

During the first three years of operation of the white certificates system, the energy savings achieved were greater than the annual targets specified in the abovementioned decrees, while the certified savings as a whole were lower than the target of 18.9% between 2008 and 2010. In 2011, after issue of Resolution EEN 9/11 of 27 October 2011 by the Authority for Electricity and Gas, a considerable reduction of the gap between national targets and certified energy savings can be seen.

By applying an emission factor the certified savings can be expressed in terms of greenhouse gas emissions avoided. In particular, if we assume an emission factor of about 2.3 tCO_2/Toe (typical of natural gas), we find that in 2011 the white certificates made it possible to avoid the emission of 11.7 Mt $CO_2$and that since 2005 a total of 34 Mt CO_2have been avoided.

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In nearly all the Member States of the European Union, heating was the main factor of energy use in buildings in 2009, with 68.2% of the total energy consumption in buildings, followed by electricity consumption with 15.2% and water heating with 12.5%; consumption for cooking food accounted for 4.2%.

During the period 1990-2009 efficiency in buildings increased by 24% and the first data for 2010 show a further increase of up to 27%. This trend is partly due to the higher efficiency of heating following the introduction of stricter standards for new buildings and wider use of high efficiency boilers.

During the period 2000-2009, the efficiency of buildings in Europe increased at an average annual rate of 1.43% with considerable differences between Member States. The figure for Italy is 1.22% (Figure 1.24).

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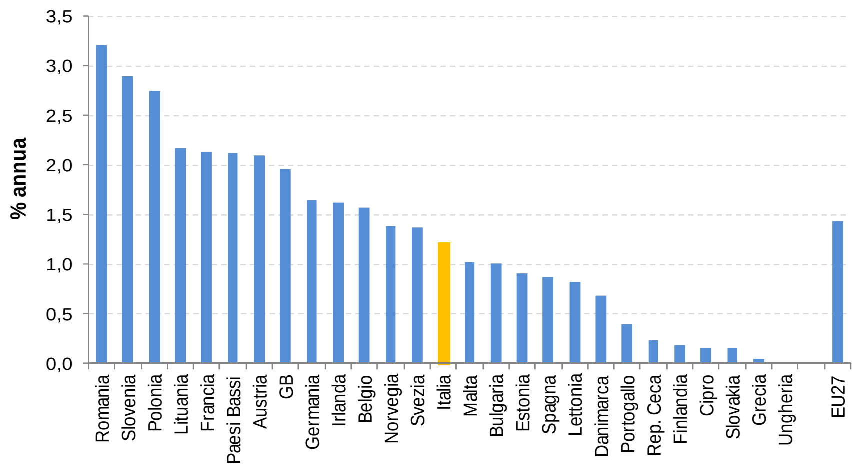


Figure 1.24: Annual percentage increase in the consumption efficiency of buildings during the period 2000-2009[54]

The increase in efficiency in the use of energy in the household sector should be seen in the context of the trend of final consumption, which increased by 7.5% during the period 1990-2009; in the period 2005-2009 alone there was a downturn of 2.6% in consumption,

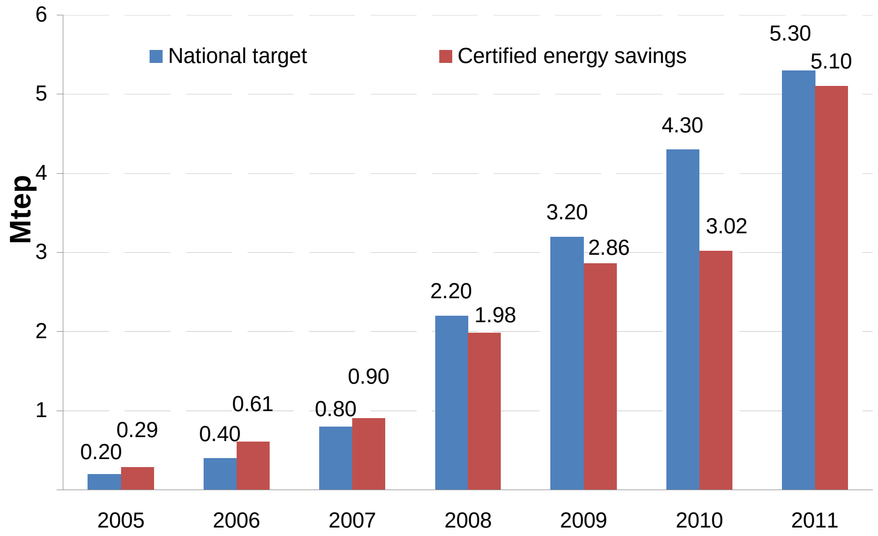
[54] Source: EEA/ODYSSEE data, processed by ISPRA

particularly marked from 2008 on as a result of the economic crisis.
According to the European Environment Agency, the increase in the number of electrical household appliances, the increase in the average sizes of housing units and the spread of central heating of buildings have contributed to an increase in energy consumption in the domestic sector of 0.4% a year between 1990 and 2009, counterbalancing the 60% energy efficiency through technological progress.

For building efficiency in Italy an important roles is played by the stimulus for efficiency improvement effected through the tax deduction incentive mechanism.

As far as building efficiency in the country is concerned, an important role is played by measures like Legislative Decree no. 192 of 19 August 2005, which assimilates Directive 2002/91/EC for increasing the energy efficiency of buildings, or the tax deduction mechanisms introduced with the 2007 budget law (Law 27 December 2006 no. 296).
Leg. Dec. 192/2005, which came into force on 8 October 2005, prescribes minimum energy performances for buildings, introduces changes in the inspection of the installations and in energy certification of buildings. According to the data prepared by ENEA[55] (new technologies, energy and environment agency) the energy savings achieved during the period 2005-2011 thanks to actions taken within the framework of this measure came to 1,987.5 kToe. The savings achieved thanks to that measure between 2006 and 2009 were fairly constant (about 330 kToe/year); 2005, the year the standard came into force, is an exception with savings of 9.4 kToe. The overall energy saving prevented the emission of 4,571 kt CO_2, assuming an emission factor of about 2.3 tCO_2/Toe (typical of natural gas).
With regard to the tax deduction mechanism for the energy improvement of buildings, Law 22 December 2012 no. 214 confirmed the tax deductions of 55% for 2012 and fixed the percentage at 36% as from 2013; however law bill no. 134 of 7 August 2012 extended the tax deduction of 55% until 30 June 2013. This measure consists of the deduction from IRPEF (personal income tax) or IRES (corporate income tax) of 55% of the costs incurred for carrying out energy saving work on existing buildings (new buildings and extensions are excluded). According to calculations by ENEA[56], work during the period 2007-2011 enabled an energy saving of 657.1 ktoe equivalent to 1,511.3 kt of carbon dioxide not emitted into the atmosphere (assuming an emission factor of about 2.3 tCO_2/Toe).
As a whole, the measures in the building sector avoided atmospheric emissions of 6,082.6 kt CO_2 during the period 2005-2011.

[55] ENEA, 2012, *Rapporto annuale Efficienza energetica 2011*
[56] Ibidem



The measures in the building sector avoided atmospheric emissions of 6,082.6 kt CO_2 during the period 2005-2011.

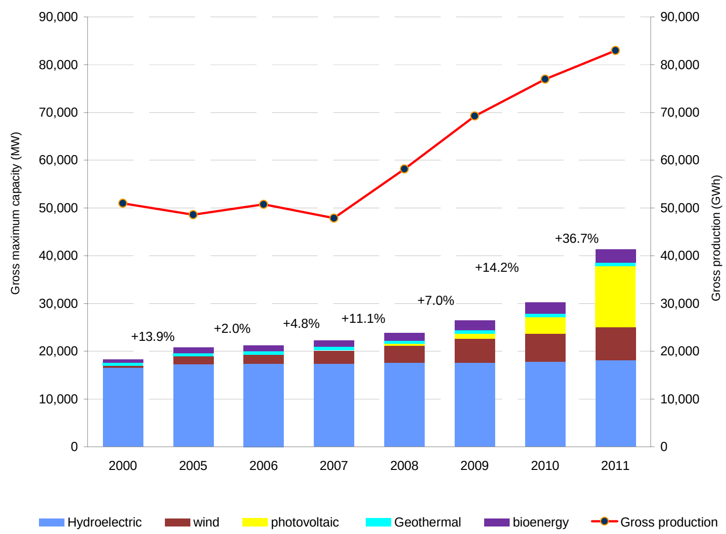
Figure 1.25: CO_2 not emitted in relation to energy efficiency improvement measures in the building sector[57]

Renewable sources

In Italy, from 2006 on there has been a marked increase in the installed capacity of plants using renewable sources.

With regard to electricity from renewable sources, from 2006 on there has been a marked increase in installed capacity and exponential annual growth.

In 2011 the operational gross maximum capacity went up to 41,399 MW, an increase of 36.7% (11,115 MW) compared to the previous year. The development of photovoltaic, which increased from 7 MW in 2006 to 12,773 in 2011, and wind, from 1,908 MW in 2006 to 6,936 in 2011, was particularly rapid. The increase in installed capacity during the past year is mainly due to the development of photovoltaic plants (+9.304 MW) and wind plants (+1,122 MW), followed by bioenergy and hydroelectric plants with +474 MW and +216 MW respectively.



In Italy, from 2006 on there has been a marked increase in the installed capacity and generation of renewable sources.

Figure 1.26: Maximum capacity and gross generation of plants using renewable sources[58]

[57] Source: ENEA data processed by ISPRA
[58] Source: TERNA S.p.A. data, processed by ISPRA

National generation of electricity from renewable sources accounts for 27.4% of the total electricity generation.

In 2011 the generation of electricity from renewable sources came to around 83 TWh (27.4% of total electricity generation) compared to electricity generation of 302.6 TWh.

The marked increase in the share of electricity from renewable sources in recent years is due to the incidental reduction in total electricity generation following the economic crisis and to the growth of electricity generation from various renewable sources.

The trend of electricity generation from renewable sources is characterised by annual fluctuations in the contribution made by hydroelectric energy, linked with weather conditions, and by the growth of the contribution made by non-traditional sources (wind, geothermal, biomass and waste, photovoltaic).

in 2011 the hydroelectric source made a contribution of 55.2% to the generation of electricity from renewable sources and, even though it is the main component, there has been a significant reduction in the relative share compared to the previous years (averages of 80% during the period 2001-2005 and 70% during the period 2006-2010) due to the increase in the contributions of other sources, particularly photovoltaic.

Between 1997 and 2011 there has been an obvious increase in the generation of electricity from photovoltaic sources (from 5.8 to10,795.7 GWh), from wind power (from 117.8 to9,856.4 GWh) and from bioenergy, which includes biomass and waste, (from 694.2 to10,832.4 GWh). Electricity generation from geothermal sources also shows an upward trend, even though lower than the other sources (from 3,905.2 to 5,654.3 GWh).

After the rapid increase during recent years, the photovoltaic contribution has reached a share of 13%.

The provisional operating data of TERNA (the electricity transmission system operator) for electricity generation[59] in 2012 show a rapid increase in generation from photovoltaic sources and wind power, amounting to 18,323 GWh and 13,119 GWh respectively.

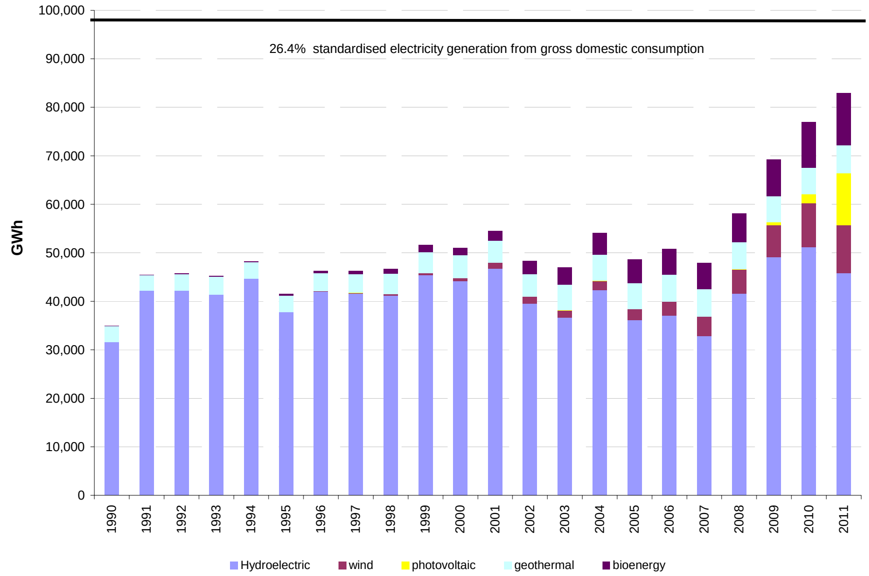
The targets laid down in Directive 2009/28/EC on the promotion of the use of energy from renewable sources by 2020 have been distributed within the scope of the National Action Plan for renewable energy among the electricity, thermal and transport sectors.

The target for the electricity sector in 2020, calculated as the ratio between standardised electricity generation from renewable sources and gross domestic consumption, is equal to 26.4%. Standardised generation[60]should therefore come to 98.9 TWh compared to the 81.6 TWh in 2011[61].

[59] TERNA, 2013, *Dati provvisori di esercizio del sistema elettrico nazionale 2012*

[60] Standardized generation refers to electricity generation from water and wind sources calculated according the procedures laid down in Directive 2009/28/EC for attenuating the effects of climate change

[61] GSE (Energy services manager) , 2012, *Impianti a fonti rinnovabili. Rapporto statistico 2011*



Domestic generation of electricity from renewable sources accounts for 2.4% of total electricity generation. An exponential growth of electricity generation from renewable sources can be seen in recent years.

Figure 1.27: Gross actual generation of electricity from renewable energy sources[62]

Table 1.5: Electricity generation from renewable sources compared to gross domestic consumption of electricity in Italy[63]

In 2011,the shares of actual and standardised renewable energy show a considerable increase: the former comes to nearly 24% and the latter to 23.5%.

Year	Electricity generation from RES[1]		GDC[2]	Percentage share	
	Actual	Standardized		Act./GDC	Stand./GDC
	TWh		TWh	%	
2005	48.4	56.4	346.0	14.0	16.3
2006	50.6	56.2	352.6	14.4	15.9
2007	47.7	56.6	354.5	13.5	16.0
2008	58.2	58.8	353.6	16.5	16.6
2009	69.3	62.7	333.3	20.8	18.8
2010	77.0	68.9	342.9	22.4	20.1
2011	83.0	81.3	346.9	24.0	23.5

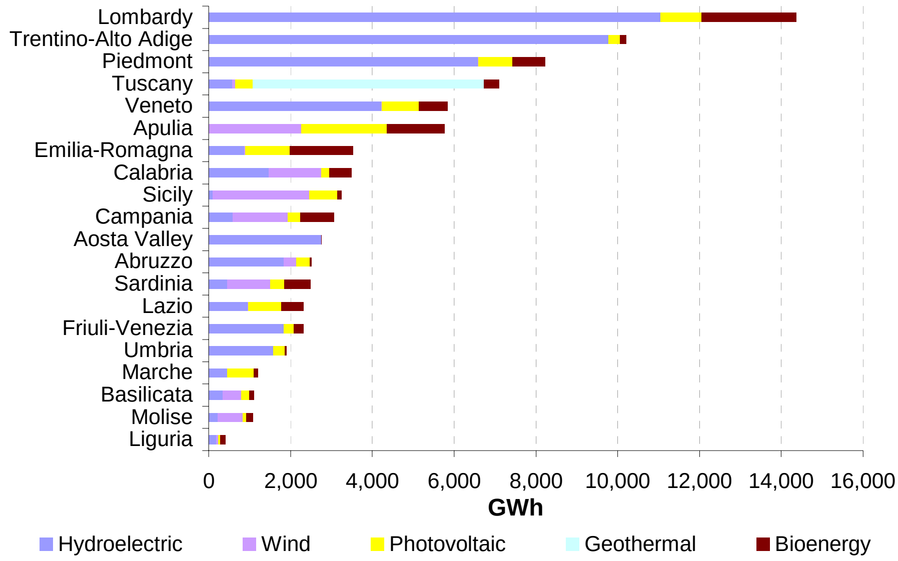
Legend
[1] Renewable Energy Sources
[2]Gross domestic consumption: Gross national consumption – Pumping generation + foreign balance

It can be seen that there is considerable heterogeneity in energy sources at the regional level. Hydroelectric energy, concentrated in the Alpine regions, accounts for 55.2% of the electricity produced from renewable sources.

Hydroelectric energy accounts for almost 55.2% of the electricity produced from renewable sources.

Generation of electricity from a geothermal source, limited to Tuscany, accounts for 6.8% of the electricity produced from renewable sources. Bioenergy accounts for 13.1%, while wind and photovoltaic for 11.9% and 13% respectively of the generation of electricity from renewable sources. Almost all wind generation is in Southern Italy and the islands (98.1%).

[62] Source: TERNA S.p.A. data, processed by ISPRA
[63] Source: GSE, 2012, *Impianti a fonti rinnovabili. Rapporto statistico2011*

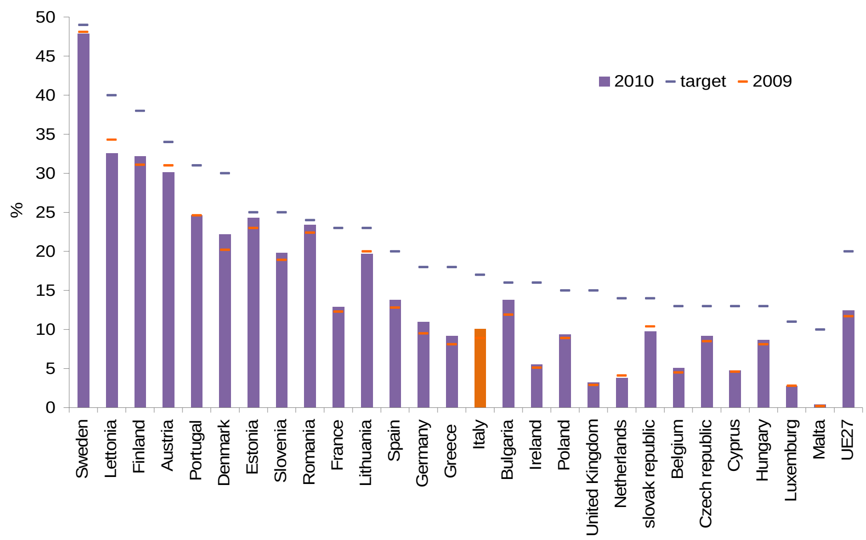


Considerable heterogeneity exists at the regional level in the gross generation of electricity from renewable sources.

Figure 1.28: Gross electricity generation from renewable energy sources at the regional level (2011)[64]

Directive 2009/28/EC fixes the shares in gross final consumption in 2020 of energy from renewable sources for each Country in the European Union; these shares include the consumption of energy from renewable sources both for the generation of electricity and for heating and in transport. It also foresees the possibility of making agreements for statistical transfer from one Member State to another of a given amount of energy from renewable sources and of cooperation between them, or even with Third Countries, for the generation of energy from renewable sources. The target for the consumption of renewable energy assigned to Italy is 17% of gross final consumption. In 2010, the overall percentage of renewable energy compared to final consumption was 10.1% (Figure 1.29).

Directive 2009/28/EC fixes the shares of energy from renewable sources in the gross final consumption in 2020 for each Country in the European Union.



The target for the consumption of renewable energy assigned to Italy (Directive 2009/28/EC) is 17% of gross final consumption. In 2010, the overall percentage of renewable energy compared to final consumption was 10.1%.

Figure 1.29: Percentage of consumption of energy from renewable sources compared to final consumption in the European countries (2010)[65]

[64] Source: TERNA S.p.A. data, processed by ISPRA

At the national level, Law no. 13 of 27 February 2009 provides for the Community renewable energy targets to be distributed, according to agreed procedures, among the Italian regions. As already mentioned, the Ministerial Decree on regional burden sharing was recently published. As things stand at present, the target assigned to the regions is equal to 14.3%, while the remainder depends on the tools available to the State.

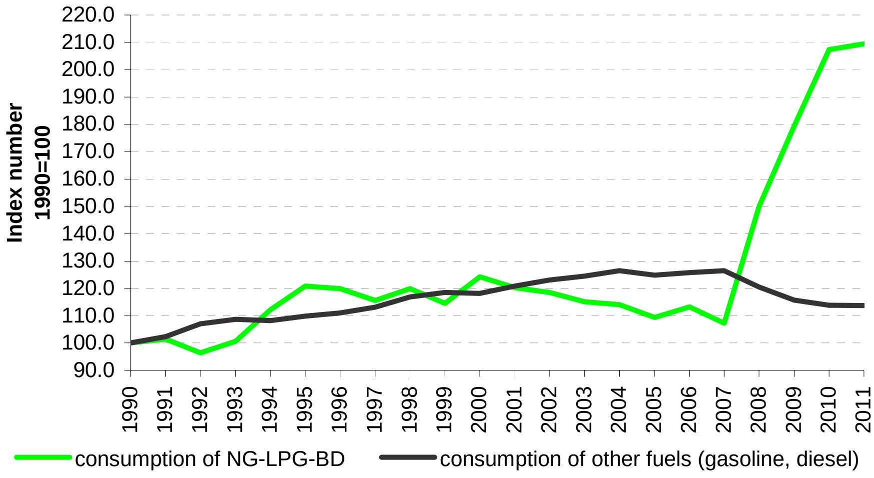
The target assigned to the regions is 14.3%, while the remainder depends on the tools available to the State.

Fuels with lower environmental impact in the transport sector

There was a constant increase in the consumption of fuels for the transport sector between 1990 and 2004 (+25.7% compared to 1990), followed by fluctuations around an average value until 2007 (+24.8% compared to 1990). Subsequently there was a downturn in consumption due to the effects of the economic crisis, bringing fuel consumption in 2011 to a level 19% higher than in 1990. The trend of consumption appears to be characterised by periodic phases of stabilisation followed by pickups. The downturn in fuel consumption during the period affected by the economic crisis only concerned classic fuels, like petrol and diesel, with reductions of 18.1% and 6.1% in 2011 compared to 2007. As a whole, the increase in the quantity of lower impact fuel consumed in 2011 compared to 1990 was 109.5%. The available data show that, for the transport sector, the progress linked with the adoption of technological measures related to engine efficiency are counterbalanced, in Italy more than in the other European countries, by a sustained demand for transport, particularly road transport, and therefore the reduction in the environmental impact of the transport sector does not appear to be linked to structural factors but to the occurrence of the economic crisis, although there has been steady growth in the consumption of low impact fuel during the past three years.

The effects of the technological measures in transport are counterbalanced by the growth in demand for transport, particularly road transport.

In recent years there was a peak in lower impact fuels mainly due to biodiesel.



Legend:
NG: natural gas; LPG: liquefied petroleum gas; BD: biodiesel.

Figure 1.30: Trend of consumption of fuels for transport(1990=100)[66]

[65] Source: Eurostat data, processed by ISPRA
[66] Source: MSE data, processed by ISPRA

The share of low impact fuels (natural gas, LPG, biodiesel), compared to total fuels, shows an irregular trend, going from 5.6% in 1990 to 4.8% in 2007, with a peak of 9.9% in 2011. Between 2000 and 2007 consumption of these fuels dropped by 13.7%, and then shot up during the following years, mainly due to the increase in consumption of biodiesel, which in 2011 went up by a factor of 9.7 compared to 2007, while consumption of LPG and natural gas increased by 34.8% and 23% respectively. Since 2009 the consumption of biodiesel outstripped the consumption of LPG and natural gas.

Since 2009 consumption of biodiesel outstripped consumption of LPG and natural gas.

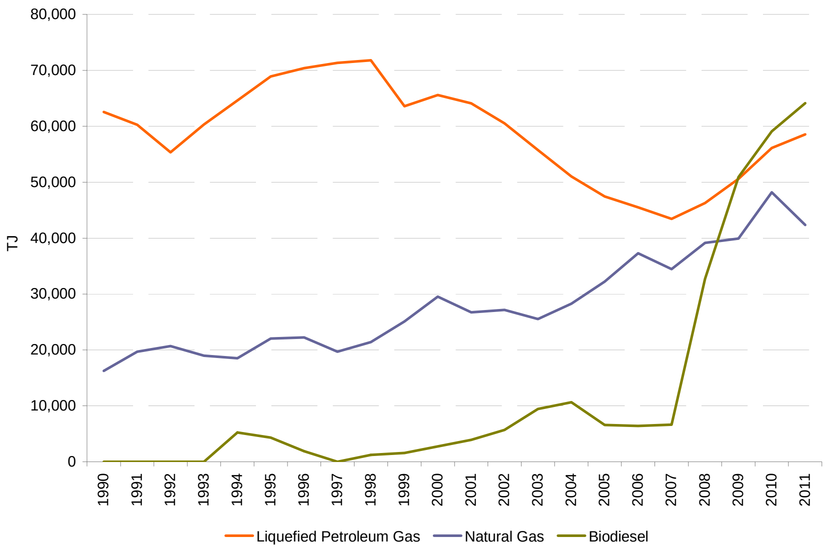


Figure 1.31: Trend of the consumption of lower impact fuels for transport[67]

LULUCF (*Land-use, Land-use change and forestry*)

In correspondence with the increase in greenhouse gas emissions originating from various generation activities and from deforestation processes, a substantial quantity of carbon dioxide was withdrawn from the atmosphere by the LULUCF sector, in the order of 0.2 thousand million tonnes of carbon during the period 1980-1989 and 0.7 thousand million tonnes of carbon at the world level during the period 1989-1998[68]. In Italy, the LULUCF sector, which includes various uses of land (such as forests, tilled land, grassland, urban settlements and wetlands) and changes in land use, was responsible for the remoal of 12.2 million tonnes of CO_2eq in 1990 and 30.6 million tonnes of CO_2eq 2011. Nevertheless, only the fraction removed by managed forests can be considered within the framework of Kyoto Protocol accounting, as foreseen by articles 3.3 (afforestation, reforestation and deforestation) and 3.4 (forestry management[69]).

In Italy, in 2011, the LULUCF sector was responsible for the capture of 30.6 Mt of CO_2 eq. Most of the removal is due to forests.

[67] Source: MSE data, processed by ISPRA

[68] IPCC, 2000, *Land-use, Land-use change and forestry*, IPCC *Special Report*

[69] Italy only elected forestry management as an additional activity as laid down in art. 3.4 of the Kyoto Protocol; the other activities are the management of tilled land, the management of pasturage and revegetation

GLOSSARY

Burden sharing:
Regional sharing of the minimum amount of energy increase produced with renewable sources, in view of the European targets fixed for 2020.

White certificates:
Also known as "Energy Efficiency Certificates", they certify the achievement of energy savings through the application of efficient technologies and systems. They are issued by the *Gestore del Mercato Elettrico* (manager of the electricity market) on the basis of the savings certificate obtained, executed by the Authority. One certificate is equal to a saving of 1 tonne of oil equivalent (Toe).

Specific average fuel consumptions in the generation of electricity:
Primary energy, in kilocalories, needed for producing a kilowatt- hour of electricity.

Emissions Trading System (**ETS**):
A system established on the basis of Directive 2003/87/EC, as a mitigation measure, which involves the fixing of a maximum limit for greenhouse gas emissions by the industrial installations that fall within the sphere of application of the directive. The admissible emission permits are assigned to each installation through the National Allocation Plan. Each permit gives the right to emit one tonne of CO_2 into the atmosphere during the reference year. Permits for emission of CO_2 allocated but not used may be exchanged among the various operators on the European market. This system is expected to set a competitive type of market mechanism in motion that would lead to a reduction of emissions by industrial installations.

Green economy:
According to the definition by the United Nations, it is an economy that results in improved human wellbeing and reduces inequality in the long term, while not exposing future generations to significant environmental risks.

LULUCF (***Land Use, Land Use Change and Forestry***):
The sector for estimating absorption and greenhouse gas emissions arising from land use, land use change and forestry foreseen by the National Inventory of greenhouse gas emissions.

Measures for mitigating climate change:
Measures for response to climate change, that is to say for the prevention of climate change by reducing greenhouse gas emissions and increasing the absorption of carbon dioxide.

Measures for adaptation to climate change:
Measures for response to climate change aimed at minimising its possible negative consequences and preventing any damage arising from climate change.

Heat waves:
They occur when temperatures are very high for several consecutive days, often associated with high levels of humidity, intense sunshine and lack of wind. These weather conditions can be a risk for the health of population.

Kyoto Protocol:
One of the most important international legal instruments aimed at combating climate change, a follow up to the United Nations Framework Convention on climate change. It contains the commitments of the industrialised nations to reduce emissions of certain greenhouse gases responsible for global warming. The total emissions of the developed countries must be reduced by at least 5% during the period 2008-2012 compared to the 1990 levels and, according to the Kyoto Protocol, Italy has to reduce its emissions during the period 2008-2012 to levels 6.5% lower than the 1990 emissions, that is to say to 483.26 Mt CO2eq.

Tonnes of oil equivalent (**Toe**):
Energy unit of measure. It is used in order to compare different amounts of energy with each other. By definition, 1 Toe is equal to 11,628 kWh.

CHAPTER 2

BIODIVERSITY AND ACTIVITIES INVOLVING ECOSYSTEMS

Introduction

Biodiversity is the wealth of life on the earth and source, for mankind, of goods, resources and services that are indispensable to survival.

Biodiversity can be defined as the wealth of life on the earth: the millions of plants, animals and micro-organisms, the genes that they contain, the complex ecosystems that they form in the biosphere. The *Convention on Biological Diversity* (CBD)[1], whose guidelines were laid out at the 1992 *Earth Summit* in Rio de Janeiro, defines biodiversity as the variety and variability of living organisms and the ecological systems in which they live, stressing that the diversity regards genes, specific species and ecosystems as a whole.

The variety in question is to be found not only in the forms and structures of living beings, but also in differences of abundance, distribution and interactions among the different components of the system. Biodiversity can even manifest itself in terms of human cultural diversity, which can be subject to the negative effects of the same factors that, as we shall see, affect the biodiversity of genes, species and ecosystems.

In addition to being of value *in and of itself*, biodiversity also provides mankind with goods, resources and services (ecosystem services) that prove indispensable to survival. All the human, animal and plant communities of the planet benefit, either directly or indirectly, from these services,which specialists classify under the categories of *provisioning*, *regulating*, *cultural* and *supporting* services. These same services play a key role in the economies of nations. Plant biodiversity, for example, with respect to both cultivated and wild plants, serves as the underlying foundation of agriculture, making possible the production of food while contributing to the health and nutrition of the world population. Genetic resources have made it possible in the past to improve the species cultivated and raised, and they will continue to do so in the future. This variability will also make it possible to respond to ongoing developments in the market for agricultural products and to adapt to changing conditions of climate and environment. The CBD points to three primary objectives: the preservation of biodiversity on a global scale, the sustainable and lasting use of its components and an equitable distribution of the resulting goods and services. In 2002, on the occasion of the sixth session of the Conference of the Parties to the CBD, 123 nations made a political commitment to significantly reduce the loss of biodiversity on the local, national and regional levels by 2010. And yet, as even the Secretary General of the United Nations, Ban Ki-moon, was forced to admit in the introduction to the *Global Biodiversity Outlook of the United Nations Environment Programme* (UNEP)[2], the pace of the decline in biodiversity shows no sign of slowing, and, indeed, the objective set in 2002 has not been reached.

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[1] www.cbd.int

[2] www.unep.org

The decline in biodiversity moves forward with unprecedented speed, as species become extinct at a rate considered to be 100 to 1,000 times higher than that registered for the pre-human era.
Given this situation, the International Year of Biodiversity proclaimed by the United Nations for 2010 increasingly became not only a celebration of the variety of different forms of life on the earth, together with the importance of biodiversity for human life, but also a heartfelt appeal to intensify the actions underway, and to undertake new initiatives, so as to safeguard this indispensable component of our planet's environment.
The target of "stopping the decline in biodiversity" set for the period 2002-2010 achieved the significant objective of catalysing major results, locally, nationally and internationally, in terms of the preservation of biodiversity.
In addition to the numerous instances of success in the preservation of specific habitats and species, major advances were made in the formulation of mechanisms to support research on biodiversity, together with its monitoring and evaluation. Especially worthy of mention is the *Global Strategy for Plant Conservation*, a universal program for the classification and description of the characteristics of all known plants, carried out thanks to the contributions of thousands of botanical gardens throughout the world, along with the IBA (*Important Bird Areas*) program of *BirdLife International*, an initiative that, promoted by the CBD, led to the identification of roughly 11,000 sites of importance for the birds of approximately 200 countries.
Millions of people, private citizens, environmental associations and socially concerned organisations, actively support programs for the preservation of biodiversity, even in third world countries. From 1970 to the present, the total extent of protected areas worldwide has grown five-fold, reaching 12% of the land above water. A large portion of the nations that have signed the CBD have approved their own plans for action and strategies for the preservation of biodiversity, though in many cases implementation of these efforts still proves incomplete or inadequate. The primary challenge is to fully integrate the preservation of biodiversity with its sustainable use in policies affecting different sectors.

Italy is included among the "hot spots" of biodiversity of planetary importance.

The variety of biogeographical, geomorphological and climatic conditions that characterise continental Europe and the Mediterranean basin make Italy the site of an extraordinary concentration of species, habitats and areas with elevated levels of natural features. Major hubs of biodiversity have been identified in Italy, as in the case of the Tyrrhenian Islands, the Maritime Alps and those of Liguria, not to mention the high rate of endemism in many areas, including the Apennine mountain chain.
On a planetary scale, Italy is included among the "hot spots" of biodiversity[3] and recognised as a priority eco-region[4].

[3] http://www.biodiversityhotspots.org/xp/Hotspots/hotspotsScience
[4] http://www.worldwildlife.org/science/ecoregions/ecoregion-conservation.html; *Biodiversity Vision dell'Ecoregione Mediterraneo Centrale.* Bulgarini F., Petrella S., Teofili C., (edited by), 2006. WWF Italy MIUR, Rome; *La Conservazione ecoregionale e la Biodiversity Vision dell'Ecoregione Alpi.* WWF Italy, 2006. WWF Italy, Rome

This massive natural heritage is threatened by a series of critical problems traceable, in the final analysis, to the overall dynamics of economic development, both global and national, which result in the destruction and fragmentation of habitats due to growing urbanisation, the proliferation of infrastructures and the intensification of agricultural practices. Apart from a net loss in the surface area of the habitats, they have also suffered a gradual deterioration on account of non-unsustainable management.

Many critical risks pose threats, both direct and indirect, to the natural heritage of the nation.

The introduction of allochthonous species, the non-sustainable use of resources and species and the effects of climate change complete the set of primary threats. Along with these negative trends of a general nature, other factors exercise more direct pressure on natural systems, such as the pollution of environmental matrices (water, air, soil, the sound and light of the environment), the increasingly artificial nature of drainage networks, the intensification of the infrastructure grid, the spread of genetically modified organisms whose effects on natural dynamics have not been properly identified and the spread of natural risks.

Both indirect and direct instruments have been used to counter the loss of biodiversity on the national and international levels. Falling under the first category are initiatives meant to reduce sources of pressure by controlling emission levels of polluting substances, for example, or safeguarding the quality of waters. The second category consists of initiatives designed to directly preserve species and ecosystems. A noteworthy foundation of regulatory measures sustains policies of preservation, not only making it theoretically possible to enact increasingly effective measures at the various levels of territorial jurisdiction, but, at the same time, permitting the establishment of increasingly focussed and effective forms of coordination between obligatory actions, territorial planning and the formulation of overall programs. Still, steps should be taken to further reinforce and harmonise these regulatory underpinnings, in particular through increased application and distribution of controls, greater availability of financial resources and adjustments in the measures to meet newly emerging problems, such as the spread of allochthonous species and global climate change. Starting from the information provided by indicators found in the ISPRA Yearbook of Environmental Data, this chapter sets out to provide an overview of biodiversity in Italy, briefly illustrating the state of natural environments, the primary threats to biodiversity and, finally, the main initiatives of defence undertaken.

National and international regulatory instruments, both indirect and direct, work to counter the loss of biodiversity.

The state of natural and semi-natural species and environments

Of all the European countries, Italy has one of the richest stores of biodiversity, thanks essentially to its favourable geographic position and its noteworthy variety of geomorphological, microclimatic and vegetational characteristics, determined in part by historical and cultural factors. Italy holds over one-half of the plant species found in European territory, and it is the leading nation on the continent in terms of absolute number of species; with regard to animal species, it possesses roughly a third of all those currently occurring in Europe.

Of all the European countries, Italy has one of the largest stores of biodiversity, accounting for half the plant species and a third of the animal species occurring in Europe.

Based on the studies carried out to date, as well as the recent *Fauna Europaea*, Italy has the largest number of animal species in Europe, together with an elevated incidence of endemic species.

Italy has the largest number of animal species in Europe (more than 58,000), with a high incidence of endemic species, including more than 9% of the terrestrial fauna.

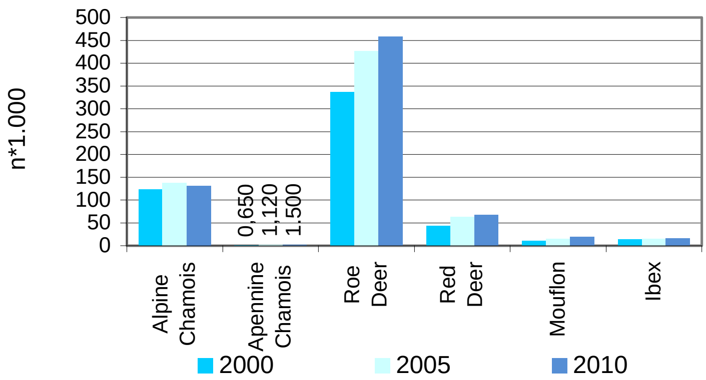
Italian fauna is estimated as including 58,000 species, of which approximately 55,000 are Invertebrates and 1,812 are species of Protozoa, representing roughly 98% of all species when taken together, in addition to which there are 1,258 species of Vertebrates (2%).

The richest *phylum* is that of the Arthropods, with more than 46,000 species, of which approximately 65% belong to the Insect class[5].

In detail, the terrestrial fauna consist of approximately 42,000 species identified to date in Italy, of which more than 9% are of particular importance, being endemic species.

The number of species in fresh-water habitats (not counting Protozoa) is estimated at approximately 5,500, or almost 10% of all Italian fauna.

The checklist of Italian marine fauna[6] includes more than 10,000 species that, given Italy's geographic position, probably account for the bulk of the species in the Mediterranean.



Figures on the number of the main species of wild Ungulates found in Italy point to decidedly positive variations for all the populations studied, with the exception of the Alpine Chamois, whose population has declined since 2005.

Note

in the case of the Wild Boar, extremely approximate estimates based on annual hunting figures (quite often incomplete or underestimated to begin with) show that there were no fewer than 300,000 – 500,000 animals in Italian territory in 2000, 600,000 in 2005 and 900,000 in 2010

Figure 2.1: Numbers of some of the main Ungulates found in the years 2000, 2005 and 2010[7]

Italy's bryological and lichen flora are among the most diverse in Europe.

Italian bryological flora, including Mosses, Hepatics and Anthocerotes, are among the most abundant in Europe, with 1,156 species, of which 864 are Mosses, while the Hepatics and Anthocerotes number 292[8]. It should also be noted that knowledge of the size of these groups is continuously being updated, thanks to ongoing exploration of relatively little known areas of the national

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[5] *GIS NATURA Il GIS delle conoscenze naturalistiche in Italia*, Ministry of the Environment and Defence of the Land, Nature Protection Department, Milan Polytechnic, 2005; *Stato della Biodiversità in Italia*, Blasi *et al.*, 2005

[6] *Checklist della Flora e della Fauna dei mari italiani* (Part I), edited by G. Relini. SIBM, 2009, Biol. Mar. Mediterr., 15 (suppl. 1) 436pp.; *Checklist della Flora e della Fauna dei mari italiani* (Part II), edited by G. Relini. SIBM, 2010, Biol. Mar. Mediterr., 17 (suppl. 1): 387-828 + indexes

[7] Source: ISPRA processing of data taken from: Carnevali L., Pedrotti L., Riga F., Toso S., 2009 - *Banca Dati Ungulati: Status, distribuzione, consistenza, gestione e prelievo venatorio delle popolazioni di Ungulati in Italia*. Report for 2001-2005. Biol. Cons. Fauna, 117: 1-168 *[Italian-English text]*; Riga F. and Toso S., 2012 - *Programma di aggiornamento e potenziamento della Banca Dati Ungulati.* Internal Report. MIPAAF-ISPRA

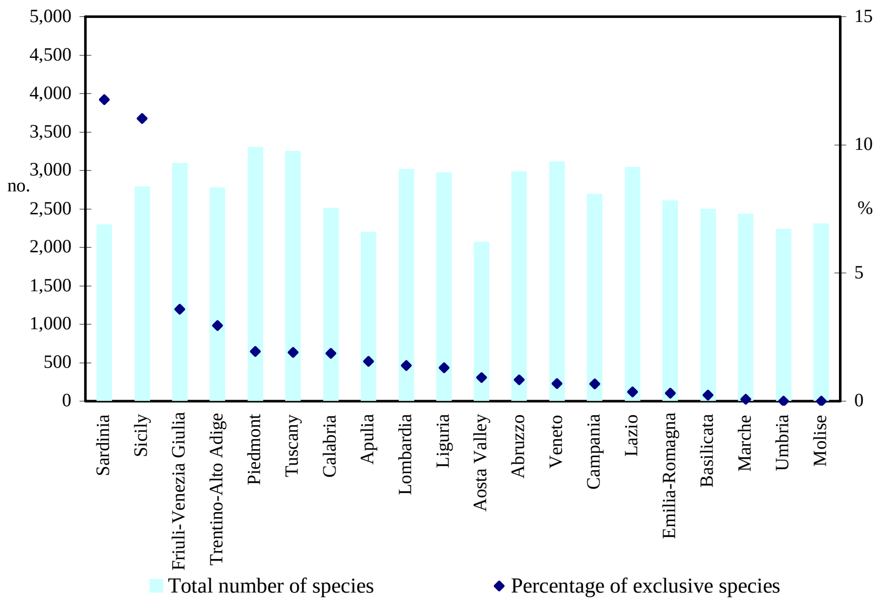
[8] *Check-list of the Hornworts, Liverworts and Mosses of Italy*. Bocconea 22. Aleffi, Tacchi, Cortini Pedrotti, 2008

territory, plus advances in techniques of genetic investigation. Italy also ranks among the leading European countries in terms of lichen diversity, with more than 2,328 *taxa* registered[9].

Italian vascular flora includes 6,711 species, or 144 Pterydophytes, 39 Gymnosperms and 6,528 Angiosperms[10], with the contingent of endemic species accounting for 15.6% of the total. The highest number of species are found among the flora of the Regions with the highest levels of environmental variability and those encompassing the largest territories, meaning Piedmont (3,304 species), Tuscany (3,249) and Veneto (3,111).

Of Italy's more than 6,700 species of vascular plants, 15.6% are endemic species.

In terms of the most prized varieties of flora, and those found in areas of limited extension, the Regions with the highest quantities of endemic or exclusive species, meaning those found only in a single region, are Sicily (322 endemic species and 344 exclusive ones) and Sardinia (256 endemic species and 277 exclusive ones).



The wealth of flora found in Italy is also demonstrated by the large number of vascular species present only in a single region, often resulting in noteworthy percentages of exclusive species.

Figure 2.2: Total number of Vascular plant species and percentage of exclusive species by region (2005)[11]

Italy is especially rich in forests: woodlands cover more than 9,000,000 hectares, while other wooded areas, meaning low-density forests, total almost 1,767,000 hectares.[12] In terms of overall surface area, taking into consideration both forests and other wooded areas, the national forest area index is approximately 36%, a figure that is rising slowly but constantly (Figure 2.3).

The overall national forest area index is 36% and continually on the rise.

[9] *ITALIC - The Information System on Italian Lichens. Version 4.0.* University of Trieste, Dept. of Biology, IN4.0/1, Nimis, Martellos, 2008

[10] *An Annotated Checklist of the Italian Vascular Flora,* Conti *et al.*, 2005

[11] Source: ISPRA processing of data taken from Conti, Abbate, Alessandrini, Blasi, 2005 - *An Annotated Checklist of the Italian Vascular Flora.* Ministry of the Environment, Nature Protection Department; University of Rome, "La Sapienza" Campus-Dept. of Veg. Biol.

[12] Italian State Forestry Corps, 2010

Furthermore, the National Inventory of Forests and Forest Carbon Pools, drawn up in 2005 by the State Forestry Corps, shows that a noteworthy portion of the new forests are of natural origin and still evolving. These last results, together with the trends in changed cover and use of the land that arise from a comparison of *Corine Land Cover 1990* and *Corine Land Cover 2000*, point to an estimated expansion of forestry resources, nationwide, of approximately 5,500 hectares a year[13].

For as long as precise statistics on forms of land use have been available in our country, there is no record of a similar extension of forests.This growth, observed not only in Italy but in almost all the other European countries as well, has been underway for decades now and is destined to continue in the future.It can be traced, on the one hand, to policies and measures for the conservation of existing resources, with further factors including forestation and reforestation activities, plus, to an event greater extent, the natural expansion of forests on abandoned farmland, especially in marginal hillside and mountainous areas of the country.

Italy is especially rich in forests, with a forest area index that is constantly on the rise, thanks to the natural expansion of woodlands, plus activities of forestation and reforestation.

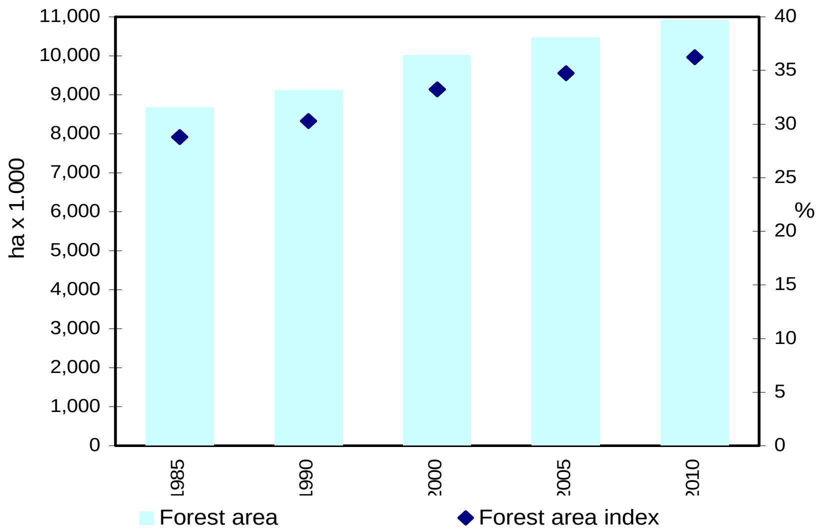


Figure 2.3: Variation in the forest area and in the forest area index[14]

In addition to natural and semi-natural environments in the strict sense of the terms, another important component of biodiversity is vegetation in urban areas and their surroundings. The natural resources found in our cities, which are as varied and complex as they have ever been, include various categories of green areas, plus the animal and plant biodiversity found therein. A number of these areas occupy more centrally located, urbanised zones of the fabrics of their cities and towns (public gardens, urban parks, tree-lined avenues, school greenery, botanical gardens etc.), while others have gradually become a part of expanding urban areas, as in the case of fragments of farmland and forest, which, though not available for direct public use, are of great value not only ecologically, but in socio-economic terms as well.

[13] *La realizzazione in Italia del progetto europeo Corine Land Cover*, APAT, 2005

[14] Source: ISPRA processing of data from the Italian State Forestry Corps

Vegetation in urban areas and their outskirts serves a number of different functions: mitigation of climate change; beautification of the landscape; ecological connectivity; environmental education; defence of biodiversity.

The quantity of urban vegetation in provincial seats shows a slight upward trend, in terms of both density and pro capita *availability, from 2000 to 2010.*

Looking at the 51 provincial seats surveyed in the 8th Report on the Quality of the Urban Environment[15], the two indicators of urban vegetation managed directly or indirectly by public bodies and authorities shows a slight upward trend from 2000 to 2010. Indeed, public urban vegetation as a percentage of municipal surface area registers positive variations, though the increases in the majority of cities and towns sampled (30 in number) were less than one percentage point, whereas the results for 11 other municipalities pointed to more significant increases (from a minimum of a +1.1 percentage-point rise in Prato to a maximum figure of +4.8 in Palermo).

The *pro capita* availability of urban vegetation also shows a general increase in 42 of the 51 municipalities (for an average rise of 5.7 m^2 per inhabitant).

The figures can differ widely from town to town, in some cases due to the presence of a large-scale protected nature areas in certain municipalities (Rome, Ravenna and Ancona hold some of the most sizeable). Areas of protected urban vegetation (for the different types of protected areas, see Sites Nature 2000) play an important role in maintaining the biodiversity and ecological continuity of a given territory.

However, the wealth of biodiversity described up to this point is seriously threatened and risks being irremediably lost.

The outlook in terms of the levels of threat to animal species within Italian territory has been drawn up by various authors in specific Red Lists, especially with regard to autochthonous species of Vertebrates[16].

In evaluating the categories and levels of threat, the authors made reference to the categories of the International Union for Conservation of Nature (IUCN).

The percentages of Vertebrate species threatened are extremely high.

An analysis showed that the percentage of vertebrate species threatened varies, depending on the assessments of the different authors, but the levels are always significantly high[17]. In the case of Cyclostomes and Fishes of inland waters, more than 40% of the threatened species are in especially critical condition (the categories CR – “critically endangered” and EN – “endangered” of the IUCN),

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[15] ISPRA, 2012 – 8th Report “Quality of the Urban Environment”.

[16] It should be noted that, shortly before this edition went to press, an updated Red List for Italian Vertebrates was issued by the Ministry of the Environment, the Italian Committee of the IUCN and the Parks Federation. However, there is no way of significantly reducing the large amounts of time that would be needed to process the data, populate the indicators and prepare the texts and illustrations, and so it was not possible to present the updated situation in this edition, though it will be illustrated in the next

[17] Bulgarini F., Calvario E., Fraticelli F., Petretti F., Sarrocco S., (Editors), 1998, *Libro rosso degli Animali d'Italia*; Peronace V., Cecere J.G., Gustin M., Rondinini C., 2012. *Lista rossa 2011 degli uccelli nidificanti in Italia;* Pinchera F., L. Boitani F. Corsi, 1997. *Application to the Terrestrial Vertebrates of Italy of a System Proposed by IUCN for a New Classification of National Red List Categories. Biodiversity and Conservation 6, 959-978;* Zerunian S., 2002, *Condannati all’estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d’acqua dolce indigeni in Italia*

whereas the percentages of Birds and Mammals threatened and at grave risk of extinction are, respectively, 28% and 15%.
To date, there is no similar evaluation for the levels of threat to Invertebrates. Nevertheless, in light of the extremely high number of species in this *taxa*, as well as the case that percentage of endemic species is greater than for the Vertebrates (more than 10% of the total), along with the elevated niche specialisation and the limited size of the areas in which many species are found, it can reasonably be assumed that, in the face of the same threatening conditions as the Vertebrates, the level of threat for the Invertebrates, and thus the level of extinction, would be decidedly higher.

15% of the higher plants and 40% of the lower plants are threatened.

The data on the threats faced by plant species in Italy are also the result of the publication of Red Lists by specialists[18]. In 1992, the number held to be at risk of extinction was 458[19], though the figure became 1,011 in 1997 with the publication of the Regional Red Lists for Plants in Italy[20], in which the threat categories of the IUCN were applied (version 2.3). This list was subsequently revised and supplemented in the Atlas of Species at Risk of Extinction[21], which identified 1,020 specie, providing a precise break-down as well: 15.2% of Italian vascular flora are currently threatened with extinction (category EN – "endangered" of the IUCN), while the worst situation is that faced by the lower plants, with 40% of all the know species in danger (Figure 2.4).

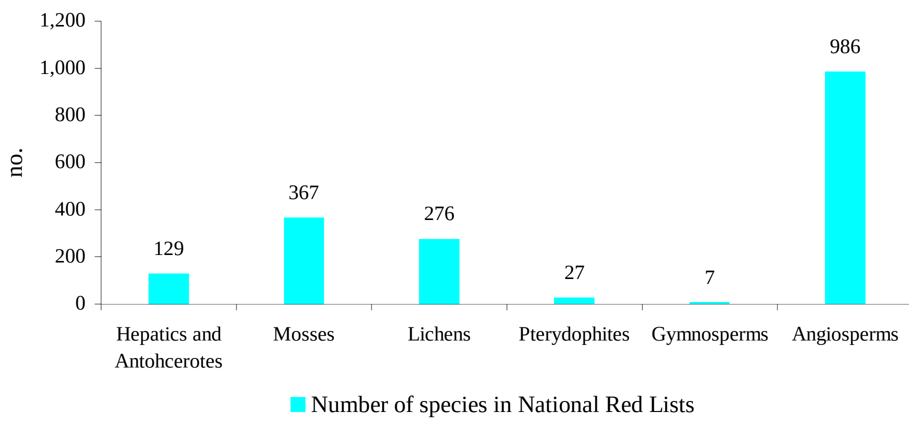


Figure 2.4: Plant species threatened in Italy, distribution by systemic group[22]

15% of Italian vascular flora is threatened by extinction. The worst situation is that faced by lower plants, with approximately 40% of all the known species in danger.
In detail, Italian plant species at risk include 772 hepatics, mosses and lichens, plus 1,020 vascular plants.

[18] It should be noted that, shortly before this edition went to press, an updated Red List for Italian Flora was issued by the Ministry of the Environment, the Italian Committee of the IUCN and the Parks Federation. However, there is no way of significantly reducing the large amounts of time that would be needed to process the data, populate the indicators and prepare the texts and illustrations, and so it was not possible to present the updated situation in this edition, though it will be illustrated in the next
[19] *Libro Rosso delle Piante d'Italia*, Conti *et al*., 1992
[20] Conti *et al*., 1997
[21] *Atlante delle specie a rischio di estinzione (CD-ROM)*, Scoppola & Spampinato, 2005
[22] Source: ISPRA processing of data drawn from: *Check-list and Red-list of Liverworts (Marchantiophyta) and Hornworts (Anthocerotophyta) of Italy*, Aleffi & Schumacker, 1995; *Libro Rosso delle Piante d'Italia*, Conti *et al*., 1992; *Liste Rosse Regionali delle Piante d'Italia*, Conti *et al*., 1997; *Atlante delle specie a rischio di estinzione (CD-ROM)*, Scoppola & Spampinato, 2005

Knowledge on the plant species at risk is currently being updated, thanks efforts to formulate new Red Lists for Italian flora undertaken in 2006 by the Italian Botanical Society. In 2012, these activities made significant advances, arriving at the assessment (IUCN criteria for 2001) of approximately 300 plant species, including all of Italy's "policy species". For the most part, these figures have yet to be published, though a number of assessment tables have been presented from time to time in the section of the Italian Botanical Bulletin entitled "Tables for a Red List of Italian Vascular and Cryptogamic Flora".

"Italian initiative for the implementation of the IUCN categories and criteria (2001) for the drafting of new Red Lists".

As for lichens, even though a updated Red List has not been published since 1992, 338 species have been identified as "extremely rare", meaning that they could potentially be placed on a future Red List[23].

Italy plays a role of significant importance in the application of the Habitat Directive (92/43/EEC), one of the most important regulatory instruments for the conservation of habitats and biodiversity. The country's distinctive geographic conditions place it in three different biogeographic regions (Alpine, Continental and Mediterranean) and, according to the Directive, it holds more than 50% of the habitats to be protected.

According to the Habitat Directive, more than 50% of the habitats to be protected are found in Italy.

Of the habitats listed in annex I to the Habitat Directive, no fewer than 131 are found in our country[24], and 24 of these (13 with priority classification) are found exclusively within Italy for their respective biogeographic regions[25]. In the "Italian Manual for Interpreting the Habitats of Directive 92/43/EEC"[26], of the 131 habitats found in Italy, 16 (4 with priority classification) fall under the category of marine-coastal habitats, while 11 (3 with priority classification) are dune habitats. In addition, 39 habitats (9 with priority classification) are forest habitats, 16 (3 with priority classification) are underbrush habitats and 15 (5 with priority classification) are natural or semi-natural meadow habitats. There are also 15 freshwater habitats, 8 bog and swamp habitats and 11 rocky habitats.

24 of the habitats to be protected, as listed in the Habitat Directive, 13 of them with priority classification, are found exclusively in Italy for their respective biogeographic regions.

In addition to natural environments, agricultural areas also play an important role in biodiversity and other environmental considerations, given the large number of species that have adapted to living in agricultural environments of secondary formation. The agricultural environment provides habitats capable of serving as "surrogates" to natural environments. A typical example is rice fields that hold numerous species originally found in wetlands. In addition to sustaining the production of foods and fibres, agricultural areas are closely connected with the environment, giving rise to extremely complex, at times contrasting relations. In confirmation of the importance of agriculture to natural environments, it should be remembered that approximately 43% of Italian territory is utilised for

Approximately 43% of the national territory is used for agricultural activities, and roughly 21% of the UAA (Utilised Agricultural Area) also plays a major role in terms of biodiversity.

[23] Nimis, Martellos, 2008 - *ITALIC - The Information System on Italian Lichens. Version 4.0.* University of Trieste, Dept. of Biology, IN4.0/1 (http://dbiodbs.univ.trieste.it/)

[24] *Manuale Italiano di Interpretazione degli Habitat della Direttiva 92/43/CEE*. MATTM, 2009 *(http://vnr.unipg.it/habitat)*

[25] *Reference list of habitat type*, EU Commission and EEA, 2009.

[26] *Manuale Italiano di Interpretazione degli habitat (Direttiva 92/43/CEE). Contributo tematico alla Strategia Nazionale per la Biodiversità.* MATTM, 2010

agricultural activities[27], and a portion of this land, equal to approximately 21% of the Utilised Agricultural Area (UAA, including fields for sewing crops, family gardens, permanent groves and crops, meadows and pastures), also has a major role in terms of the biodiversity, on the genetic level, of species and of the countryside, serving as a connecting element between natural spaces. Worth mentioning along these lines are a number of surveys, collaborative efforts involving LIPU-BirdLife, WWF Italy and the National Institute for Agricultural Economics, that use birds and lepidoptera to determine the presence and distribution of agricultural areas of elevated naturalistic value ("High Nature Value" areas, or HNV).

The abandonment of agricultural land can be followed by processes of renewed colonisation on the part of trees, brush or grass, (revegetation) or it can result in deterioration of the soil due to the loss of organic substances and to processes of erosion (devegetation and desertification).

Over the last few decades, together with the stagnation in demographic growth and in the demand for agricultural products, as well as the exodus from rural areas and the increase in productivity per unit of surface area, Italy has registered a significant reduction in both the number of agricultural enterprises and the UAA. This last figure, according to the Sixth General Census of Agriculture, stands at almost 12.9 million hectares, pointing to a gradual decline in the decade 2000-2010 (-2.5%), though at a much lower rate than in the period 1990-2000 (-12.4%). Together with this downward trend, however, it should also be noted that the average size of agricultural enterprises grew by 44.2% over the last decade, going from 5.5 hectares of UAA per enterprise to 7.9 hectares. This was a result of the noteworthy drop in the number of active farming and livestock concerns (-32.4%). European Community policies and market conditions have caused small-scale enterprises to leave the sector, favouring the concentration of farming and livestock activities in larger-scale units, thus bringing our country closer in line with the structure of the average European enterprise. The gradual reduction in agricultural surface area (in large part a reversible development) is traceable to a complex set of factors with noteworthy socioeconomic and environmental repercussions. Over the last 50 years, hundreds of thousands of hectares have undergone modifications: agricultural surface areas put to other uses (construction, infrastructures etc.); abandoned agricultural surface areas that first became unproductive, were later invaded by weeds and brush, devastated by fire, put to different land uses or recovered for agriculture. This form of "non-management" of the land, a transitory and reversible development, has followed, and continues to follow, a number of different paths, with contrasting environmental ramifications. Abandonment, for example, can give rise to processes of renewed colonisation by trees, brush or grass (revegetation); or it can result in deterioration of the soil due to a loss of organic substances and to processes of erosion (devegetation and desertification).

The specialisation and intensification of agriculture, along with the globalisation of the

In Italy, as in many other countries of the Western World, the specialisation and intensification of agricultural activities pursued from the 1950's to the early nineties, together with the globalisation of the agricultural economy, led to a serious loss of biodiversity. At

[27] ISTAT, 2012

present, almost 40% of the 12.9 million hectares of UAA is dominated by only six crops: wheat (1,962,000 hectares), olives (1,123,000 hectares), corn (890,000 hectares), grapes (664,000 hectares), barley (262,000 hectares) and rice (246,000 hectares). Even these crops have suffered an unsettling amount of genetic erosion, due to the abandonment of local varieties in favour of more productive commercial genotypes. Testifying to the loss of biodiversity in agricultural settings are the results of an indicator drawn up to trace possible developments in the nesting species commonly found in Italy, an effort that is part of the MITO2000 project (Italian Ornithological Monitoring).

agricultural economy, have led to a serious loss in biodiversity, with a decrease, for example, in the number of nesting bird populations in agricultural settings.

This indicator (the Farmland Bird Index), though as whole it does not point to a trend for the period 2000-2009, does express, considering the individual species, a drop of 44% in the cases[28].

It should also be noted that, thanks in part to the set-aside policies promoted under the 1992 reform of the CAP (Common Agricultural Policy), calling for subsidies to be given to farmers so that 10% of the farmland would lie fallow, the revival of habitats that had virtually disappeared was facilitated, as in the case of wetlands, or meadow areas that were alternately brush or flooded meadows, with the result that meadows and pastureland (currently 26.7% of the UAA), plus land left fallow or sewn with other corps (currently 4.3% of the UAA), have registered growth over the last ten years.

"Set-aside" policies facilitated the revival of habitats that had almost disappeared, such as wetlands, or meadow areas that were alternately brush or flooded meadows.

The main causes of threats to biodiversity

The primary threats to the natural heritage are linked to the impact of human activities and to an increasingly intense demand for natural resources and ecosystem services that proves less and less compatible with preservation of those resources and services in a state that can guarantee their survival and transmission to future generations. In Western and Central Europe, and throughout the Mediterranean basin, the presence of man from the dawn of time has resulted in the alteration of ecosystems and natural habitats, most of which now appear fragmented and subject to various types of disturbances. At present, five primary causes of loss of biodiversity are recognised[29]: destruction and deterioration of habitats, fragmentation, introduction of exotic species and excessive exploitation of resources and species. This last factor is tied, first and foremost, to a lack of adequate regulations, or to a failure to enforce them in such a way that the catching and trading of exotic species is governed by ecological criteria. These threats reduce biodiversity through a deterioration and banalisation of ecosystems, together with the local extinction of many species, starting with those that are more ecologically sensitive, together with endemic or localised species. At times there occurs a "turnover" of species, with the disappearance, often irreversible, of many species typical of the natural habitat taking place at the same time as the entry into the habitat of species that are exotic, competing, generalist, ruderal or synanthropic.

Biodiversity is threatened primarily by human activities and by the growing demand for natural resources and ecosystem services.

[28] National Rural Network MIPAAF, 2010

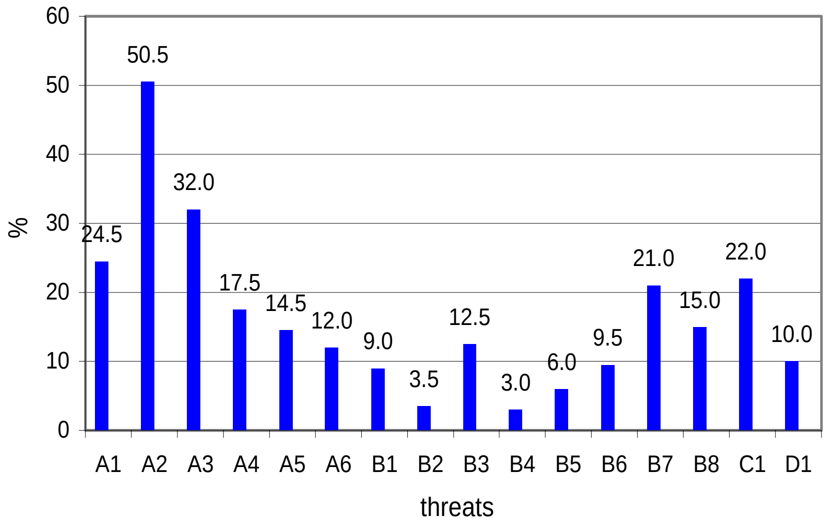
[29] *Conservazione della natura*, Primack & Carotenuto, 2007

With regard to Vertebrates, Figure 2.5 provides an overview of the different threatening factors and their incidence on the state of preservation, based on data taken from the Red Lists published to date on the IUCN categories of threats.

The transformation and modification of natural habitats threatens 50.5% of Vertebrates.

The analysis shows that, of all the indirect anthropic threats, the most frequent (50.5% of the species in danger) is the transformation and modification of natural habitats (A2), while poaching and illegal fishing (B7) are the most frequent direct anthropic influences[30]. Poaching in particular, though it is difficult to quantify, is a major threat in Italy for Birds and Mammals, including many protected species, some of which are in danger of extinction. In many Regions, illegal practices involving the capture of wild fauna with traps, snares or leg-hold traps are still widespread, as is killing with poison or firearms. These practices prove to be especially frequent in critical areas, such as the valleys of Brescia and Bergamo, the Tyrrhenian islands and the Strait of Messina[31], as well as southern Sardinia and many of Italy's smaller islands (LIPU).

In Italy, biodiversity is threatened primarily by human activities and by the growing demand for natural resources. The most frequent type of threat involving indirect anthropic influences consists of the transformation and modification of natural habitats, while poaching and illegal fishing are the most frequent threats from direct anthropic influences.



Legend

Indirect anthropic influences:	Direct anthropic influences:
A1: Reclamations of wetlands	B1: Hunting
A2: Habitat modification and transformation (construction, buildings, roads, ports, artificial riverbanks, climate variations due to anthropic influences, barriers on waterways, catchments of water, modification of flows)	B2: Pest control
	B3: Harvesting of eggs, mites, larvae, adults for sale or collecting
	B4: Vandalism
	B5: Genetic pollution
A3: Use of pesticides and water pollution	B6: Over-fishing
A4: Fire and cutting of forests	B7: Poaching and illegal fishing
A5: Changes in farming, grazing and fishing	B8: Competition or depredation by allochthonous species and/or populations
A6: Leisure activities (tourism, swimming, hiking, water sports, sport fishing, photo hunting, rock climbing or free climbing)	C1: Natural causes
	D1: Unknown causes

The Figure refers exclusively to threatened species with confirmed chronological information. It should be noted that the categories of threats found in the reference source were subsequently modified by the IUCN and so do not correspond to the current ones (ver. 3.0).

Figure 2.5: Incidence of threatening factors for Vertebrates out of the total species threatened[32]

[30] *Libro rosso degli Animali d'Italia,* Bulgarini *et al.*, 1998

[31] *Bracconaggio e trappolaggio.* Todaro G., 2006, Perdisa Ed., Bologna

[32] Source: ISPRA processing of data drawn from: *Libro rosso degli Animali d'Italia*, Bulgarini *et al.*, 1998; *Application to the Terrestrial Vertebrates of Italy of a System Proposed by IUCN for a New Classification of National Red List Categories*, Pinchera *et al.*, 1997; *Condannati all'estinzione? Biodiversità, biologia, minacce e strategie di conservazione dei Pesci d'acqua dolce indigeni in Italia*, Zerunian, 2002

Moving on to a more detailed analysis, the causes of impact include those tied to hunting, which can be practiced in more than 62% of Italian territory (ISTAT, 2007). Hunting density is not uniform throughout the nation: in certain Regions, such as Liguria, Umbria, Tuscany and Lazio, the level significantly exceeds the average. Higher concentrations of pressure are found both in Regions of extensive size (Tuscany, Lazio, Lombardy, Campania) and smaller ones (Umbria and Liguria). Assuming that the number of hunters is the primary factor for hunting pressure in a given territory, a decrease was registered between 2000 and 2007, due to a drop of 6.2 percentage points in the number of hunters nationally. Of the Regions, no fewer than eleven show percentage reductions in the number of hunters greater than the figure registered for Italy as a whole. Only five Regions (Trentino-Alto Adige, Lazio, Calabria, Sardinia and Molise) show increases in the number of hunters.

Among the causes of impact are those tied to hunting, which can be practiced in more than 62% of Italian territory. Hunting pressure varies, however, from region to region.

In any event, numerous species in unfavourable state of conservation can be hunted in Italy, as is described by BirdLife International[33] and detailed in Italy by LIPU, ISPRA, FLA e CISO[34]. In fact, 19 species that can still be hunted in Italy are considered SPEC 2 ("Species of European Concern", with 2 signifying a species in an unfavourable state of conservation and concentrated in Europe) or SPEC 3 (unfavourable state of conservation and not concentrated in Europe). The group numbers six species of ducks, six of galliformes, five of charadriiformes and, finally, a dove and a lark. For many of these species, it would be better to suspend or remove them from the list of animals that can be hunted, even if hunting has neither caused nor even contributed to their "unsatisfactory" state of conservation[35]. The document referred to earlier on the state of conservation of nesting species in Italy also proposes that hunting be suspended or excluded for 13 of the 19 species in a state of unfavourable conservation in the country.

The impact of hunting is not tied solely to the removal of the fauna hunted, an activity for which, to date, only partial data are available, seeing that not all of the regional governments provide hunting statistics. The indirect impacts are also of noteworthy importance, such as: the disturbance, the unintended killing of species similar to the ones approved for hunting and the spread of lead from the cartridges shot. Data for disturbance are available only for certain types of environments (such as wetlands), but they show that hunting, when not properly regulated, can render certain environments unsuitable for fauna. The involuntary killing of species

[33] *BirdLife International, 2004. Birds in Europe: population estimates, trends and conservation status*. Cambridge, UK: BirdLife International. (*BirdLife Conservation Series* No. 12)

[34] *Valutazione dello Stato di Conservazione dell'avifauna italiana. Specie in Allegato I Direttiva Uccelli.* Ministry of the Environment and the Defence of the Land and Sea, Italian Bird Protection League (LIPU), pp. 1156; Gustin M., Brambilla M. & Celada C. (edited by) 2009. *Valutazione dello Stato di Conservazione dell'avifauna italiana. Volume I. Non-Passeriformes.* Ministry of the Environment and the Defence of the Land and Sea, Italian Bird Protection League (LIPU), pp. 842; Gustin M., Brambilla M. & Celada C. (edited by) 2010a. *Valutazione dello Stato di Conservazione dell'avifauna italiana. Volume II. Passeriformes.* Ministry of the Environment and the Defence of the Land and Sea, Italian Bird Protection League (LIPU), pp. 1186; Gustin M., Brambilla M. & Celada C. (edited by) 2010b

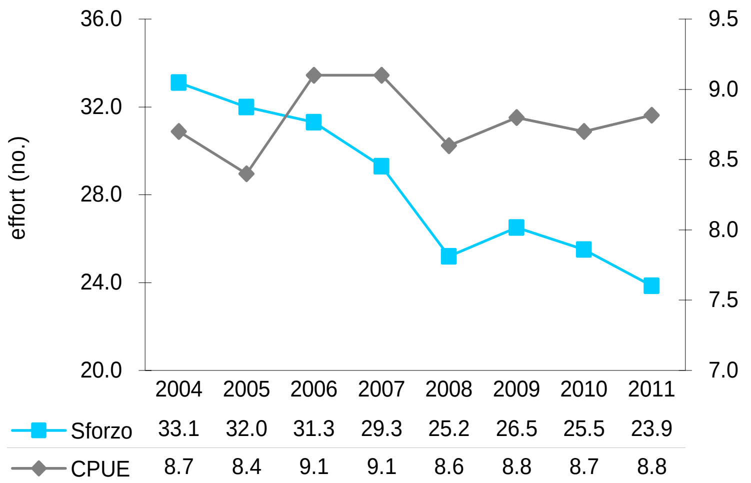
[35] *Guidance Document on Hunting under Council Directive 79/409 EEC on the Conservation of Wild Birds "The Birds Directive"*, European Commission 2008

similar to those hunted most likely has an effect on certain groups of species (Alaudidae, Anatidae), though adequate information is still not available on the subject.
It should also be noted that some Regions permit the hunting of species that should not be authorised for it, doing so through a mechanisms of exceptions to art. 9 of the Birds Directive, though such rulings have been criticised on more than one occasion by the European Commission.
As for the dispersion of lead in the environment, to date this problem has been greatly underestimated.
Recent estimates formulated by ISPRA show that each year large quantities of lead are introduced into the environment.
A portion of the exploded gunshot accumulates in the soil, giving rise to instances of localised pollution; other shot hits the prey, often becoming part of the food chain, with related problems of intoxication for wild animals and humans. Similar risks are connected to the bullets used with bored rifles to hunt ungulates. With this in mind, steps should be taken to replace the lead with an atoxic material and to carry out a campaign of awareness and information.

Fishing can have a major impact on the marine environment. Italy accounts for approximately 5% of the total catch in Europe and it contributes, as do the other countries of the European Union, to limiting the impact of fishing, a goal that has been pursued for some time now.

With regard to fishing activities, they have a major impact on the marine environment, potentially altering vast portions of benthonic habitats, with repercussions for both the demographic structure and the biomass of the populations targeted by the fishing activities, as well as for their specific diversity.
Italy accounts for roughly 5% of the total fishing catch in Europe. Together with the other countries of the European Union, it has implemented a policy to limit fishing activities, in accordance with the Common Fishing Policy (CFP) that went into effect on 1 January 2003.
In 2011, the significant decline in the size of the fishing fleet that has been underway since 2000 continued in terms of both the number of vessels (-1.2% compared to 2010) and their overall power (-2.6% compared to 2010).
The figure for the overall tonnage of the national fleet also continued to follow a constant downward trend (-4% compared to 2010).
The effort put into fishing, constantly on the decline since 2005, registered a slight increase in 2009, having gone from 25.2 in 2008 to 26.5 in 2009, only to rise again, between 2009 and 2011, to 23.9; 8.8 kg/day, the catch per unit of effort (or CPUE) remains in line with the figures for the last two years[36].

[36] MIPAAF-IREPA data



In recent years, fishing effort has fallen, while the level of CPUE has remained constant.

Figure 2.6: Performance of the main domestic fishing indicators[37]

The Italian fishing fleet generally consists of medium-small vessels; in many Regions, small-scale fishing is still the type most widespread.

The Italian fishing fleet generally consists of medium-small vessels, demonstrating that, in many Regions, small-scale fishing is still the type most widespread. The situation varies, however, in different parts of Italian territory. In 2011, more than 35% of the vessels in the national fleet were registered in Sicily (23.1%) and Apulia (12.3%), while the highest average number of days fishing was recorded in Apulia (171.8), Marche (151.9) and Campania (147.1).

The fishing systems most widely used were trawling, small-scale coastal fishing and Larsen trawling, confirming the tendency in the Mediterranean to engage primarily in small-scale fishing. In 2011, 34.2% of the total national catch was obtained by trawling and 45.2% was caught by the boats of Sicily and Apulia.[38]

The biodiversity of forest ecosystems is also subject to a variety of threats, despite a positive growth trend.

The biodiversity of forest systems is also subject to different forms of threat, even though, as mentioned earlier, the national forest area has registered a positive trend for a number of decades now, though this is a result of decisions made in other economic sectors, rather than deliberate policies of forestry management and environmental defence, as demonstrated by the fact that the growing forest area is increasingly subject to abandonment, leading to instances of deterioration, first and foremost fires.

After a sharp resurgence in 2007, from 2008 to 2011 there was a decrease in the number of forest fires.

In terms of fires, there was an exceptionally critical period in the mid 1980's, followed by years in which the overall level of such incidents remained high, falling off gradually through 2006, only to register a sharp resurgence in 2007, though levels were more contained from 2008 to 2011, a period in which 8,181 fires occurred, involving 72,007 hectares, of which 38,430 were forest areas in the strict sense of the term. Approximately 72% had negligence as their cause, while almost 14% were cases of criminal action, while the origin of the remaining 14% was uncertain[39].

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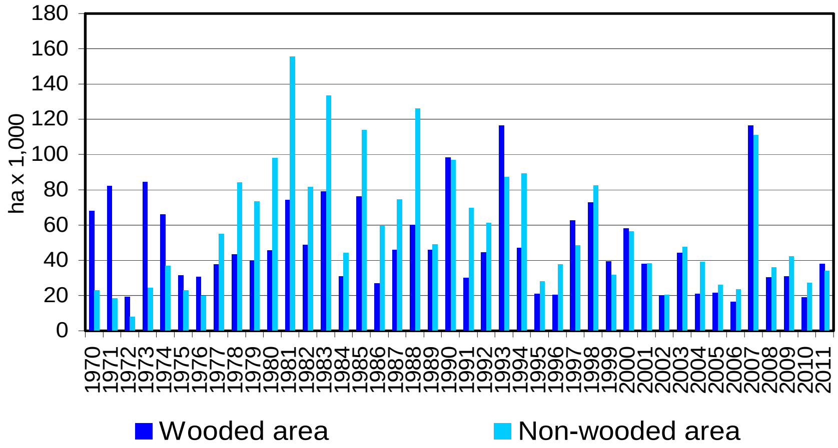
[37] Source: ISPRA processing of MIPAAF-IREPA data

[38] MIPAAF-IREPA, 2011

[39] CFS, 2011



Forest fires gradually decreased until 2006, followed by a sharp resurgence in 2007, and then a more limited number of events from 2008 to 2011.

Figure 2.7: Wooded and non-wooded areas subject to fires[40]

Also of note is the fact that in 2011 forest fires, by then the main source of disturbance for Italy's forestry resources, caused emission in the atmosphere of approximately 3.6 million tons of hydrogen dioxide ($MtCO_2$ eq), equal to 0.7% of total national greenhouse gas emissions (488,792 $MtCO_2$eq).

The increase in wood volume is limited by harvesting, fires, disease and natural mortality.

The expansion of forest area in Italy has been accompanied by an increase in the volume of tree trunks and large branches (this last figure equal to 1.269 billion cubic metres, or an average of 144.9 cubic metres per hectare), making for an overall ongoing increase in the total wood volume of Italian forests of roughly 37 million cubic metres (4.3 cubic metres per hectare)[41].

The increase in the volume of tree trunks and large branches, and of the biomass in general, is limited by the harvesting of trees, by fires, by disease and by natural mortality.

The harvesting of wood from Italy's forests fell from 2000 to 2010, registering levels significantly lower than the ongoing increase.

Based on data published by EUROSTAT[42], only a limited number of uses are made of wood from forests, with the volume taken for industry showing a negative trend since the early 1980's, offset by an upward trend for wood put to energy-related uses.

In 2010, almost 7.3 million cubic metres of lumber were harvested from Italy's forest, equal to 19.4% of the ongoing increase in the overall volume of wood (37.6 million cubic metres of wood).

Wood harvesting has fallen compared to the almost 8.7 million cubic metres of 2005 (24.2% of the ongoing increase in wood volume) and the more than 9.3 million cubic tons of 2000 (equal to 27.0% of the ongoing increase in wood volume). The use of forest wood as kindling accounted for two-thirds of total uses in 2010. This percentage has increased in recent years, pointing to a process of despecialisation of wood production towards the use presenting the least absolute value and the least final value added.

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[40] CFS, 2011

[41] CFS, 2010

[42] In 2008 ISTAT stopped publishing figures on wood harvesting (quantity and value), as it also did for forest area and for figures on non-wood forest products

In terms of the rate of harvesting (the ratio between metric cubes harvested and total forest area), the figure gradually fell between 2000 (0.9 cubic metres per hectare) and 2005 (0.8 cubic metres per hectare), reaching an annual figure of 0.7 cubic metres per hectare in 2010.

The rate of harvesting gradually fell between 2000 and 2010: from 0.9 to 0.7 m^3/ha.

The introduction of potentially invasive allochthonous species represents another threat to biodiversity. Their presence in Nature can essentially be traced to two types of introduction: intentional (for raising, growing, hobby pursuits etc.) and accidental or secondary (for example, through the transport of cargo, the ships ballast waters, fouling etc., or *taxa* originally introduced in areas outside Italy's borders, only to arrive in our country independently).

The introduction of potentially invasive allochthonous species constitutes another threat to biodiversity. The number of documented allochthonous animal and plant species in Italy currently stands at 2,029.

It should be noted that, in many cases, the origin and paths of introduction of the species are unknown.

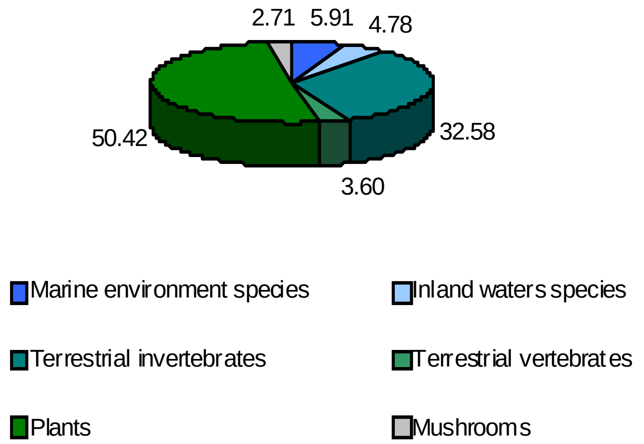
Based on the data available for the presence of allochthonous animal and plant species introduced in Italy from 1500, the date used as the standard reference for introductions into Europe, the total number of documented allochthonous species currently stands at 2,029[43] [44]. It should be pointed out, however, that this number underestimates the true dimensions of the phenomenon, both on account of the limited extent of specific studies or focussed monitoring and due to the delays with which the species, once identified, are placed on the lists or in the databases.

An analysis of the percentage distribution of allochthonous species among the different taxonomic/environmental groups (Figure 2.8), modelled on the taxonomic distribution utilised in the *European Invasive Alien Species Gateway* (*Delivering Alien Invasive Species Inventories for Europe* – DAISIE), shows that, of the 2,029 allochthonous species documented in Italy, plants represent 50% of the total, followed by terrestrial Invertebrates, which account for approximately 33%.

The percentages for the other groups are significantly lower: marine species almost 6%, species found in internal waters 4.8%, terrestrial vertebrates 3.6% and mushrooms 2.7%.

[43] *DAISIE European Invasive Alien Species Gateway* (http://www.europe-aliens.org) – updated 2007

[44] *Non-native Flora of Italy*. Celesti-Grapow *et al. (editors),* 2009

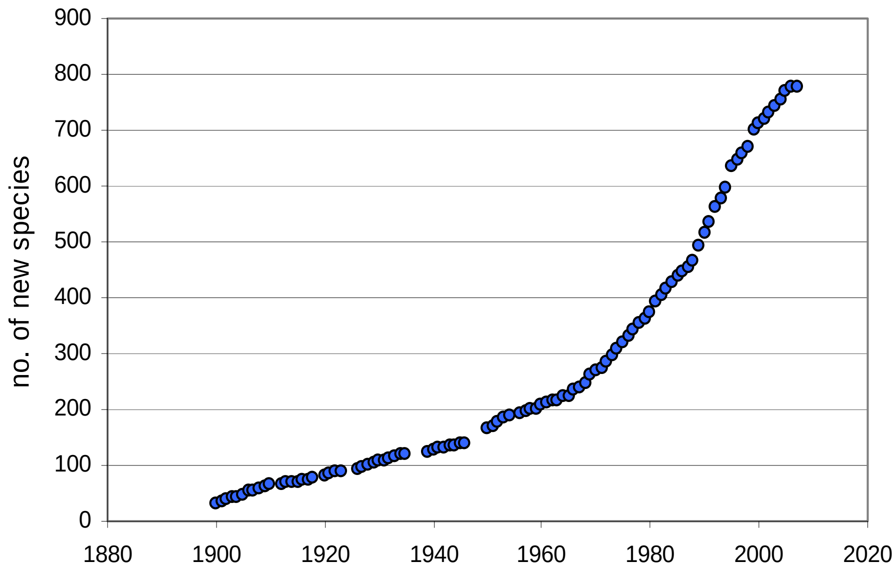


Plants account for 50% of all documented allochthonous species in Italy, followed by terrestrial invertebrates, which represent approximately 33% of the total.

Figure 2.8: Percentage distribution among environmental/taxonomic groups of the 2,029 allochthonous species introduced in Italy from 1500 (updated to 2007; to 2009 exclusively for vascular plants)[45]

A trend analysis, arrived at by calculating the cumulative number of allochthonous species introduced in Italy from the year 1900 (Figure 2.9), points an exponential increase in the number of introductions, in particular starting from the 1950's. This rapid increase, attributable to increased trade activity and the development of systems of transport, does not show any signs of having reached saturation, confirming the assumption that ecological systems rarely prove to be saturated by newly introduced species.

The rapid increase in allochthonous species introduced in Italy is attributable to increased trade activity and the development of transport.



The trend for introductions into Italy starting from 1900 points to an exponential increase in the number of allochthonous species, especially starting from the 1950's.

igure 2.9: Cumulative number of allochthonous species introduced ıto Italy starting from 1900, calculated on the basis of 778 species ıtroduced on a known date (updated to 2007)[46]

[45] Source: ISPRA processing of data drawn from *DAISIE European Invasive Alien Species Gateway* (http://www.europe-aliens.org) – updated to 2007*; Non-native Flora of Italy*, Celesti-Grapow *et al. (editors)*, 2009

[46] Source: ISPRA processing of data drawn from *DAISIE European Invasive Alien Species Gateway* (http://www.europe-aliens.org) – updated to 2007

In addition, the average annual rate of new "introductions", calculated from 1900 on the basis of the same contingent of species, points to an exponential increase in the average number of allochthonous species introduced per year, which goes from slightly more than one species a year in the early 1900's to approximately 15 species a year at the end of that same century.

The average annual rate of new introductions, calculated from 1900 on, points to an exponential rise in the average number of allochthonous species introduced per year.

Though the proportion of "introductions" that are accidental or of unknown origin has risen, intentional introductions are still the most common type, especially for certain groups of animal species, such as the fresh-water species of interest in sport fishing.

Also worthy of mention are the indirect effects of anthropic action, and especially those brought about by climate change. Year after year, increasing scientific evidence is gathered on the impact of clime change on biodiversity, be it aquatic or terrestrial, regarding the ecosystem, species or genetic level[47] [48]. Different surveys carried out in Italy, over what is by now an extensive timeframe, show that the climatic anomalies registered to date, and especially those involving daytime temperature and rainfall, have altered physiological processes (photosynthesis, respiration, plant growth, efficiency of water use, composition of tissues, metabolism and decomposition), as well as the distribution and phenology of plants, plus the migration patterns and reproduction periods of many animal species, together with the interactions between these species and biotic and abiotic factors.

The indirect effects of anthropic action, and especially those attributable to climate change, are noted in a number of surveys carried out in Italy.

The impacts observed to date include a shift northwards, and towards higher altitudes, of the geographic ranges of many species. The lengthening of the vegetative season has resulted in increased productivity in the Alpine biogeographic region, while drier, hotter climatic conditions are responsible for lower forestry productivity and for an increased number and severity of fires, in the Mediterranean zone.

In Italy, the impact of climate change influences the geographic range of may species, as well as the vegetative season.

In the future, the impact of climate change on agricultural and forestry ecosystems will become increasingly acute, though the magnitude will vary, depending in the geographic regions and the types of vegetation involved. In the case of agriculture, much of the research points to climate change having a generally negative effect on the sector's production capacity. The higher temperatures recorded in Italy have already had the effect of moving forward the period in which grapes are harvested, in addition to increasing their sugar content and lowering their acidity, resulting in alterations in the bouquet.

Climate changes will have generally negative effects on the production capacity of the agricultural sector.

The Alpine region and the mountainous ecosystems are held to be especially vulnerable to climate change. In the country's Mediterranean region, climate scenarios of reduced precipitations (especially in the summer period) and temperatures above the levels forecast globally, would result in an expansion of the adjoining arid and semi-arid systems. Experts foresee variations in the spatial distribution of flora, plus diminished distribution of forests,

The Alpine region is considered to be especially vulnerable to the impact of climate change, while, in the case of the Mediterranean

[47] Butchart *et al.* (2010). *Global Biodiversity: Indicators of Recent Declines.* Science 328: 1164-1168

[48] Bálint *et al.* (2011). *Cryptic Biodiversity Loss Linked to Global Climate Change.* Nature Climate Change, 1: 313–318

especially in the South; endemic Mediterranean species will face the greatest threats, on account of the forecast reduction in precipitations, the increased intensity of fires and alterations in phenology and in the vegetative season. The positive effects of carbon fertilisation could be offset by a limited availability of water and higher temperatures. Finally, climate change will inevitably have an impact on the ecosystem services that agriculture and forests offer, with significant economic and social consequences for the sector.

area, an expansion of adjoining arid ad semi-arid systems is foreseen.

Many areas could become suitable for growing grapes or for new varieties (in replacement of others no longer right for the changed climate); at the same time, certain winemaking regions might no longer be able to ripen their traditional grape varieties; areas with hot-arid climates (Pantelleria, Salento) could wind upside outside the area of grape cultivation (and even that in which olives and citrus fruit can be grown). As far as wines are concerned, the greatest difficulties are expected with white varieties, and especially aromatic vintages. The growing of wheat, a crop symbolic of Italian agriculture, could be subject to noteworthy impacts from future climate change[49].

The resistance of natural areas to climate change depends to a great extent on biodiversity.

Ample scientific evidence shows that the capacity of natural, semi-natural and agricultural areas to resist climate change, and to be resilient in response to its effects, depends to a large extent on biodiversity, in terms of both seasons and bioregions, with regard to genetics as well as ecosystems.

Natural and agricultural areas play a significant role in the overall carbon cycle and therefore with the problem of the greenhouse gas effect.

On the subject of climate change, it should be remembered that natural and agricultural areas play a significant role in the overall cycle of carbon and, therefore, with respect to the problem of the greenhouse effect. Taken as a whole, the agricultural sector is a net emitter of greenhouse gas, primarily on account of the intestinal fermentation of livestock, their defecations, agricultural soil, rice fields and the burning of agricultural waste [50].

According to the National Inventory of Greenhouse Gas Emission and Absorption prepared by ISPRA[51] and sent in 2013 to the Secretariat of the UN Convention on Climate Change (United Nations Framework Convention on Climate Change – UNFCCC), containing data for 2011, agriculture was responsible for 33,530 $MtCO_2eq$ of emissions in the air, confirming a downward trend compared to 1990 (40,7 $MtCO_2eq$). Agriculture accounted for 6.9% of the quantity of greenhouse gas emissions, and between 1990 and 2011 emissions fell by 17.7%, primarily on account of a decrease in the quantity of livestock raised and a drop in the UAA. At the same time, approaches to using and managing far and forestry lands made it possible to increase the quantity of CO_2 temporarily fixed through the conservation and expansion of stocks of carbon in forest ecosystems and in agricultural soil. This capacity is tied to the ongoing development of the sector, meaning policies of agriculture

49 Ferrise R. *et al.* (2011). *Probabilistic Assessments of Climate Change Impacts on Durum Wheat in the Mediterranean Region.* Natural Hazards and Earth System Sciences 11: 1293-1302

50 Tubiello *et al.* (2013). *The FAOSTAT Database of Greenhouse Gas Emissions from Agriculture*. Environ. Res. Lett. 8 (2013) 015009 (10pp) doi:10.1088/1748-9326/8/1/015009.

51 http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php

and rural development, as well as those on energy and climate, all of which influence procedures for managing the land, just as they influence the capacity of the sector to react “spontaneously” to the very process of climate change.

According to the Inventory, the figures for 2011 show net positive balance between absorption and emissions for the LULUCF sector (Land Use, Land Use Change and Forestry) of 31,012 $MtCO_2eq$ (+141.6% compared to 1990, established by the UNFCCC as the benchmark year for greenhouse gas balances). In detail, the forest areas were responsible for absorbing 29,480 $MtCO_2eq$, while fields and pasturelands absorbed 8,031 $MtCO_2eq$. As for greenhouse gas emissions, 3,101 $MtCO_2eq$ were recorded for agricultural activities while 3,397 $MtCO_2eq$ were attributable to the establishment of anthropic facilities (infrastructures, buildings, industrial and urban areas etc.) on natural and semi-natural areas.

Agricultural surface areas sustain the negative impact of other economic activities, while, at the same time, they can cause pollution and loss of biodiversity.

When the causes of impacts on the natural heritage are examined, activities tied to agriculture play a controversial role. On the one hand, agricultural surface areas sustain the negative impact of other activities and other production sectors, seeing that they are often subject to processes of urbanisation, illicit dumping or industrial pollution. At the same time, agricultural activities themselves are often identified as one of the primary causes of water pollution, of undermining land stability and of soil pollution, as well as of increases in the greenhouse effect, loss of biodiversity and simplification of the landscape.

In Italy, the main impacts on the environment and on biodiversity directly attributable to agriculture arise from the use of fertilisers and plant protection products.

In Italy, the main impacts on the environment and on biodiversity attributable directly to agriculture arise from the use of fertilisers and plant protection products.

The distribution of synthetic fertilisers on agricultural land, the spreading of liquid runoff from livestock enterprises and small food and farming concerns and the distribution of sludge from purification operations are key factors not only for the pollution of inland bodies of water and marine coastal habitats, but also with respect to eutrophication, all with consequences for human health, as well as the flora, fauna and the ecosystems as a whole. What is more, numerous studies point to the fact that reductions in agricultural biodiversity (meaning reductions in the variety of species grown, in the “buffers” of unfertilised grassy areas and in hedgerows along waterways and ditches), together with the abandonment of crop rotation and the absence of adjoining areas left fallow, has well determined consequences for the migration of nutrients and other pollutants towards surrounding water tables.

Surface and underground waters present concentrations of plant protection products in excess of the legal limits.

A recent ISPRA report that analyses the figures for 2010 provided by the regional and provincial environmental defence agencies, as well as by the governments of the Autonomous Provinces and the Regions, on the contamination of surface and underground waters by residues of plant protection products conforms a high level of widespread contamination throughout the territory[52]. Of the monitoring points for surface waters, 55% are contaminated, and in 34% of the cases with concentrations of pesticides above the legal limits; as for underground waters, 28% of the points are contaminated and 12% present

[52] ISPRA (2013). Rapporto Nazionale Pesticidi nelle Acque. ISPRA Report 175/2013

concentrations above the limits. Residues of every type of plant protection product were found in surface and underground waters, though herbicides and the related metabolites were the most widely encountered substances.

In Italy, a steady decline in the distribution of fertilisers came to a stop in 2011 with a resumption of growth.

With regard to the distribution of fertilisers in Italy, there was an increase in the period 1998-2007, followed by a gradual decrease during the years 2008-2010 (4.4 million tons), and then another reversal in the trend in 2011, when approximately 4.9 million tons of fertiliser were distributed.

Mineral fertilisers are the main type, accounting for more than 2.2 million tons and consisting, first and foremost, of simple nitrogen-based minerals (urea, ammonium nitrate and calcium nitrate).

Organic fertilisers, primarily soil improvers, are seeing increasing use, having moved beyond the 2 million ton mark. This development can have important ramifications for the environment, seeing that organic fertilisers provide increased benefits for the structure of the soil, have a lower impact in terms of any pollution of water tables and reduce emissions of greenhouse gases into the atmosphere.

During the period 2001-2011, the quantities of plant protection products placed on the market showed a decrease of 3.6%.

In the period 2001-2011, the placement on the market of plant protection products registered a drop of 3.6%.

In 2011, a little less than 142.5 thousand tons were marketed, making for a drop of 1.0% compared to the previous year. Of these products, 69.1% were "non-classifiable", 25.3% were hazardous and 5.6% were toxic or extremely toxic. The last two categories, given the danger they pose, were subject to greater restrictions in terms of their sale and storage.

In 2011, a reduction of 7.5% in sales of non- classifiable products (-7,992 tons) and of 2.6% with respect to toxic and extremely toxic products (-213 tons) coincided with an increase of 22.9% in hazardous products (+6,722 tons)[53].

The main actions of protection

Italy is party to numerous international conventions ad agreements designed to safeguard biodiversity, such as the Convention on Biological Diversity.

As already noted, the conservation of biodiversity often stands at odds with man's approaches to utilising the environment. Efforts to reconcile conservation as best possible with the needs of society often result in agreements and legislative instruments, key tools of indispensable importance for mediating the demands of conservation with the economic, social and cultural concerns of the local populations.

Italy is party to a number of international conventions and agreements designed to biodiversity. One that has already been cited, but deserves special mention for its strategic importance on a global scale, is the CBD, which sets itself three main objectives: 1) the conservation *in situ* and *ex situ* of biological diversity; 2) the sustainable use of its components; 3) an equitable distribution of the benefits resulting from the use of genetic resources.

In Italy, the CBD was ratified under Law no. 124 of 14 February 1994. Subsequently, on 16 March 1994, the Inter-Ministerial Committee for Economic Planning approved the document "Strategic Guidelines and Preliminary Program for the Implementation of the

[53] ISTAT, 2011

Convention on Biodiversity in Italy". Specifically, the CBD acknowledges the importance of an ecosystemic approach to a strategy for the integrated management of the territory, waters and living resources capable of promoting conservation and sustainable use in an equitable manner; application of this principle makes it easier to reach a balance between the three objectives of the CBD. The key is to utilise appropriate scientific methodologies focussed on levels of biological organisation that include the essential processes, functions and interactions between the organisms and their environment. The Convention recognises that human beings, complete with their cultural diversity, are an integral part of ecosystems.

The CBD Strategic Plan of Action for 2011-2020.

The CBD Strategic Plan of Action for 2011-2020, approved during the Tenth Conference of the Parties to the CBD (COP10), held in Nagoya (Japan) in 2010, included 20 main objectives organised into five strategic points: identifying the underlying causes of the loss of biodiversity; reducing pressures on biodiversity; safeguarding the biological heritage at all levels; increasing benefits and reinforcing capabilities.

Of the various objectives, the following deserve particular note:

- halving, and where possible reducing to zero, the rate at which natural habitats, including forests, are lost;
- the objective of placing 17% of terrestrial areas and inland waters under protection, along with 10% of marine and coastal areas;
- the commitment of the governments to recover at least 15% of the deteriorated areas through initiatives of conservation and reclamation;
- special attention focussed on reducing pressure on coral reefs.

By 2020, the values of biodiversity must be introduced into planning procedures, national accounting systems and systems of reporting, (*Target 2*), with steps taken to prevent the extinction of endangered species and improve their state of conservation (*Target 12*).

The Plan for Strategic Action ("*Aichi Target*") shall serve as the general reference framework on biodiversity not only for conventions closely related to biodiversity but also for the entire system of the United Nations.

The Nagoya Protocol.

Also approved at the COP10 was the Nagoya Protocol on "*Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization*".

The agreement establishes a reference framework that balances access to genetic resources. It calls for an informed consensus and mutually endorsed agreements, with an eye towards obtaining a fair and equitable sharing of the benefits while also taking into account the important role of traditional knowledge.

The international initiative TEEB (The Economics of Ecosystems and Biodiversity) is

On the occasion of the COP10, the conclusive report on the major international initiative "*The Economics of Ecosystems and Biodiversity*" (TEEB)[54] was also presented.

The purpose of the TEEB Report is to amalgamate all the

[54] www.teebweb.org

experiences, knowledge and know-how to be found throughout the Planet, so as to ensure that our economy increasingly be based, both in theory and practice, on the biophysical cornerstones of the natural systems that support it.

geared towards ensuring that the economy, both in theory and practice, increasingly be based on the biophysical cornerstones of the natural systems that support it.

The report illustrates the failure of the market system to give adequate consideration to the value of ecosystems, not to mention the full biodiversity of the Planet, demonstrating, in contrast, how activities geared towards achieving the conservation, restoration and rational management of natural systems constitute an authentic economic investment. The lack of a market price for the services offered by ecosystems and for biodiversity demonstrates that the fundamental benefits resulting from these resources (which, in many cases, are public or collective resources) are almost always neglected or given too little importance in public decisions. The repercussions are visible not only in the gradual, ongoing deterioration of the state of health of the ecosystems of the entire world, but also in the state of health of humanity and of human wellbeing as a whole. Paradoxically, the economy that guides and informs political decisions throughout the world is currently blind to the value of ecosystems and biodiversity. And instead acquired scientific knowledge shows us that natural capital, ecosystems, biodiversity and natural resources are the building blocks for the wellbeing of economies, societies and individuals.

Other major international accords include the conventions of Bonn and Berne.

Among the other major international agreements of particular importance, mention should also be made of the Bonn Convention on the Conservation of Migratory Species of Wild Animals, or CMS, passed in Bonn on 23 June 1979, as well as the Berne Convention on the Preservation of Wildlife and the Natural Environment of Europe, approved in Berne on 19 September 1979. The Bonn Convention is a framework agreement under which further agreements were subsequently signed for the defence of specific species, such as the bats (EUROBATS), the cetaceans (ACCOBAMS), species of wild birds that migrate between Europe and Africa (AEWA) and raptors (addressed in a memorandum of understanding).

The "Siracusa Charter on Biodiversity".

Finally, the "Siracusa Charter on Biodiversità" is also worth noting. Signed by the Ministers of the Environment of the G8, in concert with the other countries and international organisations taking part in the meeting of 22-24 April 2009 in Siracusa, the Charter calls for a series of initiatives to be taken regarding biodiversity and the climate, the economy, ecosystem services, science, research and politics. Based on these initiatives, a common approach was proposed to address the post-2010 scenario with respect to biodiversity.

The European Strategy for Biodiversity with a eye towards 2020.

Looking at Europe, it can be noted that the European Union is strongly committed to the defence of nature and biodiversity.

The strategies on individual topics of the Program for Environmental Action, with respect to the defence of Nature, are closely integrated with both the Strategy for Sustainable Development and the objectives of the Treaty of Lisbon, as well as with the policies for the individual sectors, including agriculture and fishing, industry, energy and transport. In 2011, the EU approved the 2020 Biodiversity Strategy, whose goal is to stop the decline of biodiversity and,

whenever and wherever possible, rebuild degraded ecosystems on both the European and global levels[55].
The Strategy is in line with the international commitments entered into by the EU, and in particular with the aforementioned Plan of Strategic Action of the CBD. It is based on six specific targets: full implementation of the EU regulations for the protection of biodiversity; improved protection of ecosystems and improved use of infrastructures; development of sustainable agriculture and forestry operations; more attentive management of fish stocks and development of sustainable fishing; control of invasive species; intensification of EU commitments in defence of biodiversity, on both the continental and global levels.
For each target, the Strategy is accompanied by a corresponding set of actions.
The cornerstones of EU policy on the conservation of Nature and biodiversity are two key directives: the Birds Directive (79/409/EEC), regarding the protection of wild birds, and the Habitat Directive (92/43/EEC) on the conservation of natural and semi-natural habitats, as well as wild flora and fauna.

The two cornerstones of EU policy on the conservation of Nature and of biodiversity are the Bird Directive and the Habitat Directive.

The Bird Directive was subsequently abrogated and replaced in full by the codified version of Directive 2009/147/EC, which maintained all the key aims.
The specific objectives of the Habitat Directive include the creation of a European ecological network in keeping with its aims, named Nature Network 2000 and consisting of Special Areas of Conservation (SACs) and of Special Protection Areas (SPAs), these latter being identified by the Birds Directive.
What is more, the nature conservation policies are able to draw on a specific financial instrument: the LIFE-Nature Fund.
On the national level, the Bird Directive was transposed into Italian legislation with Law no. 157 of 11 February 1992, while the latest updated list of the SPAs was published in a Ministerial Decree of 19 June 2009.

The Nature Network 2000 in Italy consists of 609 SPAs, for a surface area of 4,402,323 hectares, plus 2,299 SCIs with an overall surface area of 4,831,624 hectares. After accounting for overlapping, the sites of the Nature Network 2000 number 2,576, covering a surface area of 6,379,090 hectares (21% of the national territory). The Habitat Directive requires that the member states monitor the state of conservation of

The Habitat Directive was fully transposed into Italian law under Presidential Decree no. 357 of 8 September 1997, subsequently modified with Presidential Decree no. 120 of 2003.
At present, the Nature Network 2000 in Italy consists of 609 SPAs, accounting for a surface area of 4,402,323 hectares, plus 2,299 Sites of Community Importance (SCIs), with an overall surface area of 4,831,624 hectares.
After accounting for overlapping between the SPAs and the SCIs, the number of sites of the Nature Network 2000 in Italy totals 2.576, for a total surface area of 6,379,090 hectares, equal to approximately 21% of the national territory[56].
The Habitat Directive requires the member states to monitor the state of conservation of habitats and species of importance to the European Community, and not only within the Nature Network 2000, but throughout the national territory.
Based on article 17 of the Directive, the results must be submitted to

[55] http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm
[56] Ministry of the Environment and Defence of the Land and Sea, October 2012

the European Commission every six years, in the form of a report containing a large quantity of data and evaluations on the state of conservation of the habitats and species listed in appendices I, II, IV and V of the Directive.

habitats and species.

As per art. 17, the state of conservation is described by means of categories (satisfactory, unsatisfactory-inadequate and unsatisfactory-bad or unknown) that assess the remove from a given satisfactory situation.

The 2nd National Report (for the period 2001-2007) was presented by Italy in 2007[57]. At present, the 3rd Report (2007-2012) is being prepared, with its presentation to the European Commission scheduled for June 2013.

To this end, the Ministry of the Environment has assigned ISPRA to provide support with the collection and processing of the data and the drafting of the report.

There are 871 protected areas in Italy, covering a land surface area of more than 3 million hectares (10.5% of the national territory).

Another fundamental reference for the conservation of biodiversity in Italy is the Framework Law no. 394 of 6 December 1991 on Protected Areas, which "lays down the key principles for the establishment and management of protected nature areas, in order to guarantee and promote, in a coordinated manner, the conservation and optimisation of the country's natural heritage".

The law is accompanied by a series of measures designed to safeguard fauna and flora, regulate hunting, protect marine species, discipline maritime fishing and safeguard forestry resources.

The sum total of the laws approved made it possible to carry out various initiatives that attempted to safeguard and improve the conditions of our natural heritage.

There are 871 protected areas in Italy, covering a land surface area of 3,163,591 hectares (10.5% of the national territory)[58].

Protected sea areas of particular importance include the Marine Protected Areas (MPAs), plus the "Pelagos" Sanctuary for Marine Mammals.

Of particular importance among the protected sea areas are the Marine Protected Areas (MPAs), (MPAs), meaning marine environments consisting of waters, sea bottoms and portions of the coast looking out on the waters, all of interest due to their natural, geomorphological, physical and biochemical characteristics, in particular as regards the marine and coastal flora and fauna, and based on the scientific, ecological, cultural, educational and economic importance of the areas.

In Italy, MPAs may be established if they have previously been identified under the law as *areas of marine study*.

Laws 979/82, 394/91, 344/97, 426/98 and 93/01 provide a list of 50 areas of study; to date, 27 have been established as MPAs and 2 as Underwater Parks.

These areas simultaneously meet the objective of safeguarding biodiversity while maintaining and developing the local economy through three main levels of differentiated protection (Zones A, B and C). Finally, mention should also be made of the "Pelagos" Sanctuary for Marine Mammals, which, being an international pelagic protected area, the result of an agreement reached by France,

[57] *Implementation of the Habitat Directive ad State of Conservation of Habitats and Species in Italy*, Ministry of the Environment, 2008

[58] *VI EUAP – Official List of Protected Areas*, Ministry of the Environment, 2010

the Principality of Monaco and Italy, followed a different procedure for its establishment and currently engages in the promotion of measures for maintenance of a good state of conservation of the populations of marine mammals, together with a prohibition against offshore racing.

The aforementioned Law 394/1991 introduces the instrument entitled "Plan for the Park", which subdivides the territory based on the different levels of protection, in this way guaranteeing continued conservation of the biodiversity, as well as its reconciliation with the anthropic activities.

Law 394/1991 introduced the instrument "Plan for the Park", which subdivides the territory based on the different levels of protection, in this way guaranteeing continued conservation of the biodiversity, as well as its reconciliation with the anthropic activities.

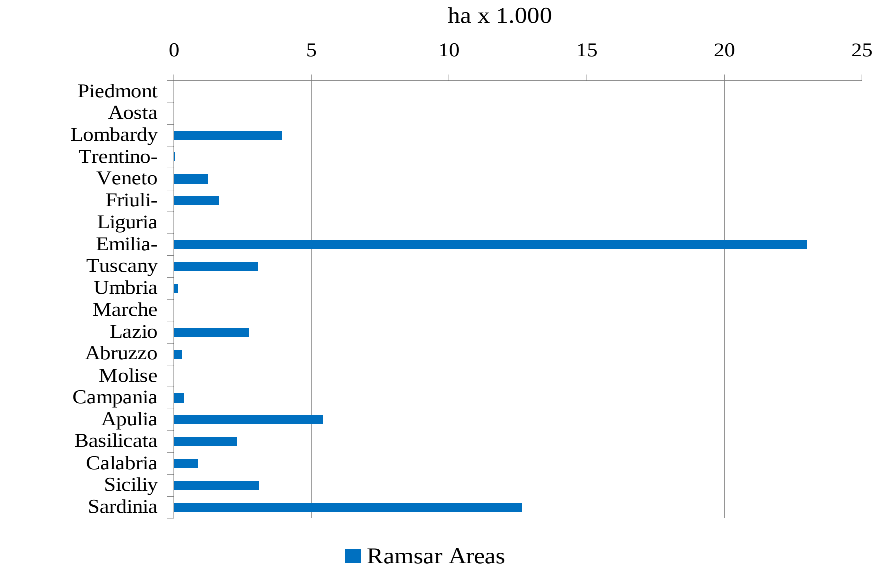
This instrument, which is of fundamental in managing environments for which conservation is a priority concern, has encountered numerous difficulties in the course of its approval process.

In fact, as of 31 February 2012, the status of Italy's national parks was: the National Park (4%) has not yet established the Park Agency; 12 (50%) are in the phase of preparation and adoption; 3 (13%) are in the phase of filing and consultation; 8 (33%) are in the final phase of approval and publication.

To complete the overview of the national areas subject, for various reasons, to forms of protection, it should also be remembered that, thanks to Italy's endorsement of the 1971 Convention of Ramsar (Iran) on wetlands of international importance, 57 sites of major ecological importance are protected, accounting for a total surface area of 60,768 hectares.

Thanks to Italy's endorsement of the Ramsar Convention, 57 wetlands of major ecological importance are protected.

Figure 2.10 shows the regional distribution of the surface areas protected in accordance with the instruments illustrated earlier.



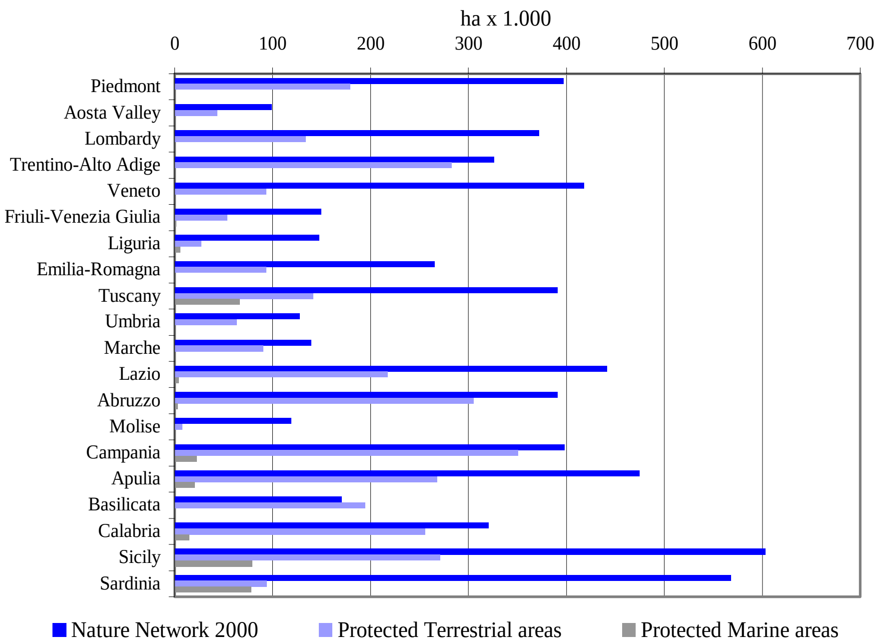


Figure 2.10: Regional distribution of protected areas[59] (excluding the Sanctuary for Marine Mammals)[60]

21% of Italian territory is part of the Network Nature 2000. 10.5% consists of protected terrestrial areas. There are also 27 Marine Protected Areas and 57 Ramsar sites.

In accordance with the international conventions on the defence of biodiversity, as well as the European Community Directives on Birds and Habitats, plus Italian legislation on protected areas and the preservation of fauna, sixteen "Plans of Action" were drawn up for endangered species of fauna, along with four "Guidelines" for the containment of species that cause damage to autochthonous fauna and natural habitats. Almost all of the documents were drafted by the former National Institute for Wild Fauna (currently the ISPRA), on assignment from the Ministry of the Environment. Contributing to the task, depending on the specific case, were the leading experts for

A number of different "Plans of Action" for endangered species of fauna were drafted in Italy, together with "Guidelines" for the containment of

[59] Source: for the Ramsar Sites: the Ministry of the Environment, 2011; for the terrestrial and marine protected areas: 6th Official List of Natural Protected Areas, Ministry of the Environment, 2010; for the Nature 2,000 Network: Ministry of the Environment, October 2012 (the surface areas of the Nature 2000 sites by region are calculated minus the overlapping between SCIs and SPAs).

[60] The Sanctuary for Marine Mammals occupies a total of 2,557,258 hectares.

species that cause damage to autochthonous fauna and natural habitats.

The National Strategy for Biodiversity.

each species, plus national bodies or agencies (national parks, the State Forestry Corps) or the local ones (protected areas, regional and provincial governments) with territorial jurisdiction over the enactment of the actions found in the plans.

The understanding (file no. 181/CSR) reached by the Permanent Conference on Relations between the Central Government, the Regions and the Autonomous Provinces at its session of 7 October 2010 concluded the approval process of the National Strategy for Biodiversity, the result of a fruitful concerted effort involving the Ministry of the Environment and the governments of the Regions and the Autonomous Provinces, as well as the participation and consultation of a variety of institutional, social and economic parties with an interest in the effort.

Participation in the drafting of the Strategy was made possible by the holding of a series of local seminars, culminating in the organisation of the 1st National Conference on Biodiversity in Rome on 22 May 2010.

The National Strategy for Biodiversity, whose formulation is called for by the CBD, represents an instrument of great importance in terms of guaranteeing, in the years to come, an effective integration of the country's objectives of development with the defence of its incalculable heritage of biodiversity.

In confirming the national commitment to reach the objective of halting the loss of biodiversity, the Strategy presents itself as an instrument for making considerations of biodiversity an integral part of national policies in the sector, acknowledging the need to maintain and reinforce the conservation and sustainable use of biodiversity, both on account of its intrinsic value and as a key factor in human wellbeing.

The vision of the Strategy with regard to the conservation of biodiversity states that: "Biodiversity and ecosystem services, our natural capital, are conserved, assessed and, to the extent possible, restored, both on account of their intrinsic value and so that they can continue to provide lasting support for economic prosperity and human wellbeing, despite the far-reaching changes in course on both the global and local levels".

To achieve this vision, the National Strategy was organised around three key themes (Biodiversity and Ecosystem Services; Biodiversity and Climate Change; Biodiversity and Economic Policies). The identification of three strategic objectives, closely related to the three key themes and complementary to each other, was the outcome of an attentive technical-scientific evaluation that deemed defending and restoring ecosystem services, within the context of their deep-rooted relation to human life, to be the priority consideration in arriving at the conservation of biodiversity. The three strategic objectives call for steps to be taken, by 2020, to guarantee the conservation of biodiversity, to ensure the safeguarding and restoration of ecosystem services, to significantly reduce the impact of climate change on biodiversity within the national territory and to make the conservation of biodiversity an integral part of policies of economics and individual sectors.

The achievement of the strategic objectives is addressed in 15 work areas, in order to evaluate the efficiency and effectiveness of the Strategy, a system of periodic monitoring is to be established, based on a set of evaluation indicators that make it possible to estimate the effectiveness of the policies implemented and achieve specific objectives through the priority initiatives set for arriving at the visions and the strategic objectives. In doing so, points of reference on a national level that can prove to be of use in identifying the indicators are provided by the Yearbook of Environmental Data drawn by ISPRA, as well as by all the tools for the monitoring of local territories produced by the Regions and the Autonomous Provinces, by the institutions that manage protected areas and by universities and research bodies. The set of indicators in the Strategy, to which ISPRA contributed with preliminary study done on assignment from the Ministry of the Environment, was recently adopted by the National Observatory of Biodiversity. This last body, together with the Joint Committee for Biodiversity and the Advisory Table, is one of the operating entities of the Strategy established under a decree issued by the Minister of the Environment and the Defence of the Land and Sea on 6 June 2011 and published in the Official Gazette, issue no, 143, on 22 June 2011.

Of the instruments for governing urban vegetation, the Green Plan as of 2010 was still little used.

Looking at the instruments for governing urban vegetation in the primary urban areas examined under the 8th Report, the presence of the Green plan is still sparse (18 municipalities out of the 51 surveyed), while more widespread use was made of the Green Regulations (found in 33 of the 51 cities examined) and the Green Census, found in 47 cities.

Within the cities and towns, worthwhile tools for identifying the areas of greatest interest, in terms of conservation, are the fauna atlases, and especially the ornithological versions, which contribute to enhancing knowledge of urban biodiversity.

Of the 51 cities analysed in the Report, there are still only a few for which an ornithological atlas of nesting and/or migratory birds is available, though their number is growing.

The importance of biodiversity in an urban setting is recognised internationally: indeed, at the urging of the Secretariat of the Convention on Biodiversity, the Index of Urban Biodiversity has been promoted as an instrument that aid cities with the monitoring and auto-evaluation of their own policies in favour of biodiversity.

The Common Fishing Policy (CFP) is the tool used by the EU, and therefore its member states, to manage all facets of fishing and aquaculture: biological, environmental and social.

The sector of fishing, along with agriculture, which we shall address further on, is one of those jurisdictions that, in the past, had been shared by the European Union and the member states, at least until the Treaty of Lisbon went into effect in 2009, when it was placed under the exclusive control of the European Union. The instrument used by the EU to manage all facets of fishing and aquaculture (biological, environmental, economic and social) is the Common Fishing Policy (CFP).

In 2002, a first reform of the policy had to be carried out, as it was no longer sufficient, in light of advances and developments in the sector, for achieving the purpose for which it was conceived: namely, to ensure the economic profitability of the European fleets, together with a product of good quality for the consumer, all while guaranteeing the conservation of fish resources and the safeguarding of the marine environment.

The shortcomings of the CFP were essentially tied to the difficulties encountered by the policy of the European Community when it came to solving grave problems, such as: 1) the excessive exploitation of stocks of fish and the oversized capacity of the fleet; not even the instruments of application of the CFP, such as the Multi-Year Orientation programs, could reduce the excess fishing effort; 2) the scarce profitability of the fishing sector, on account of excess investment, increased operating costs (manpower and fuel) and reduced resources.

The scarce profitability resulted in a steady drop in employment. The full extent of the negative situation became especially apparent at the time of the enlargement of the European Union, and in light of the globalisation of the economy (which brought into play new subjects, including many developing countries, ushering in new and forceful operators in the fishing sector worldwide) and the growing attention paid to topics tied to the environment. The scarce effectiveness of the measures of control in the CFP, together with the failure to involve the interested parties, compromised full compliance with the measures of conservation taken. This made it necessary to reform the policy, in order to arrive at fishing activities exercised on an ecologically and economically sustainable basis.

The current CFP is the product of a reform implement ed in 2002 and it contains numerous innovations.

The current CFP is based on a reform implemented in 2002, the principles for which were enunciated under (EC) Regulations nos. 2369/2002, 2370/2002 and 2371/2002. The numerous innovations introduced under this measure include simplification of the policy for the management of fishing capacity, a long-term approach to the management of fishing as a whole, with the introduction of multiyear plans for the replenishment and management of stock, the establishment of incentives for definitive decommissioning and the introduction of restrictions of measures for the renewal or modernisation of fishing ships. Framework Regulation no. 2371/2002 on the conservation and sustainable exploitation of fishing resources under the CFP, approved by the Council on 20 December 2002, constitutes the legal framework for all subsequent legislation passed by the European Union on these matters. Regulation 2371/2002, which abrogated 3760/1992, essentially modified the European Community regulations governing the preservation and sustainable exploitation of fishing, reformulating the field of application, the contents and the objectives of the CFP in the process. Under the CFP, a precautionary approach was introduced, in an attempt to protect and conserve resources while minimising the impact of fishing on ecosystems, while, at the same time, responses were proposed to certain specific problems having to do with the conservation of living marine resources, the preservation of the environment, the management of the fleet, the organisation of markets, systems of control etc.. From a structural point of view, the European Fisheries Fund (EFF), established under Regulation no. 1198/2006, which was passed by the Council on 27 July 2006, represents the financial component, being based on seven-year programs (2007-2013).

In terms of measures for the sustainable exploitation of fishing resources in the Mediterranean, Regulation no. 1967/2006 was issued, introducing modifications in (EEC) Regulation no. 2847/1993 and abrogating (EC) Regulation no. 1626/1994.

The most noteworthy measures introduced under the reform of the CFP include the TAC (Total Admissible Catch), a limit that is currently set in the Mediterranean, but only for red tuna, by the ICCAT (International Commission for the Conservation of Atlantic Tuna), plus technical measures, such as the minimum size of the net mesh, the use of selective fishing equipment, prohibitions against fishing in certain areas or periods, minimum sizes of fish that can be unloaded; reduction of accessory or accidental catches; limitations on fishing efforts in terms of capacity (displacement, engine power and days spent at sea); reduction in illegal, unreported and unregulated fishing (IUUF). A number of the technical measures listed, such as the use of nets with larger meshes or new minimum requirements for distance form the coast or depths, as well as rules on protected species and habitats, are specifically addressed by the Mediterranean Regulation (Reg. (EC) 1967/2006) that went into force on 1 June 2010. This regulation stipulates that, in order for certain activities to continue, national plans for the management of those activities must be drawn up, based on scientific evaluations that guarantee ecological and biological sustainability.

The most noteworthy measures introduced under the CFP include the TAC, plus technical measures, such as the reduction of accessory or accidental catches, limitations of fishing efforts, , reduction of IUUF.

Despite the progress made under the CFP in terms of ensuring the environmental and socio-economic sustainability of fishing, the sector still appears to be economically and socially fragile.

The objectives of reducing fishing capacity have not been reached, fish stocks, on the whole, are over-exploited, while catches and profitability fall, due in part to the difficulty of extending the effects of the CFP to fishing practices in non-EU Mediterranean countries.

Despite progress made under the CFP to ensure the environmentally and socio-economically sustainable fishing, the sector still appears fragile.

The environmental and economic aspects of fishing, though they can conflict in the short run, should be considered indispensable components of any farsighted approach to the management of fishing (*Reykjavik Declaration* – FAO, 2001). This is why a revision of the CFP was undertaken, complete with a phase of consultation and the publication by the Commission, in April 2009, of a *Green Book* on the reform of the CFP (COM(2009)163), a document that illustrates the challenges which European fishing must face in the years to come.

During 2011, the process for proposing legislation to reform the CFP was initiated with a series of EC communications promoting the passage and enactment of new legislation originally planned for 1 January 2013. However, as of today (Spring 2013) this process has not yet been completed.

The search for the indispensable balance between the environmental and economic aspects of fishing has led to the reform of the CFP, with an eye towards an "ecosystem approach".

The key elements of the new proposals include: actions geared towards reducing over-fishing and ensuring the productivity of fish stocks; the formulation of multi-year plans based on the principle of precaution and an ecosystem approach; greater independence on the part of the member states in enacting the measures and objectives agreed to on the EU level; support for small-scale coastal fishing; a new and more effective regulatory framework for aquaculture; new standards of labelling, quality and traceability, in support of sustainable fishing practices; a more modern and capable system of financing; greater responsibility on the part of the EU internationally.

The CFP is part of the European Union's new integrated maritime policy, which has as the focal point for its implementation of an ecosystem approach the recent Framework Directive on Marine Environmental Strategy (2008/56/EC), a measure transposed into Italian law under Legislative Decree no. 190 of 13 October 2010, and which has as its objective arriving at a good environmental state for European marine waters by 2020, plus the aforementioned Habitat Directive (92/43/EEC).

Numerous other initiatives, some of them regional or local in scope, focus on the study and monitoring of species and habitats, on environmental reclamation and restoration of natural conditions, on the creation of ecological networks, on the introduction of criteria of sustainability in the various production sectors, and on product certification and environmental education.

Numerous other initiatives, some of them regional or local in scope, focus on the study and monitoring of species and habitats, on environmental reclamation and restoration of natural conditions, on the creation of ecological networks on the introduction of criteria of sustainability in the various production sectors, and on product certification ad environmental education.

Many of these have direct or indirect ties with a variety of efforts pursued on the local or national levels by public or private institutes, universities or other organisations.

Monitoring plays an important role in the conservation of biodiversity, meaning the monitoring of its different components and of the categories of activities that can have a negative impact on biodiversity.

The Nature Charter, created under Framework Law no. 394/1991 on Natural Protected Areas, together with the monitoring networks of the system of environmental protection agencies and reporting activities involving environmental data, such as ISPRA's Yearbook of Environmental Data, are directly inspired by, or at least take much of their direction from, the objectives referred to art. 7 of the CBD.

An operative example would be the "Ecological Value" indicator calculated as a part of the Nature Chart produced at a scale of 1:50,000. The "Ecological Value" refers to natural worth and it is calculated as an index of a set of indicators traceable to three different groups.

The first group's reference framework are so-called institutional values, meaning those of the European Community directives; the second considers the components of biodiversity, ad the third addresses the indicators typically used for landscape ecology.

The "Ecological Value" stands at significant levels (high or very high) in 62% of the territory of Val d'Aosta, 54% of Friuli-Venezia Giulia, 34% of Veneto and Abruzzo, 32% of Sardinia, 28% of Lazio, 26% of Sicily, 20% of Umbria, 16% of Molise and 14% of Apulia, with these being the Regions for which the Nature Chart has already been drawn up in full.

Plans for on-site conservation include not only the establishment of protected areas, as described above, but also the identification of areas where for the enactment of special measures of conservation.

Falling under this objective are measures of protection to be undertaken in areas bordering on protected areas, plus the various initiatives for the establishment of ecological networks, both terrestrial and marine, examples of which, some quite significant, can be found within Italian territory.

On the subject of ecological networks, which play a very important role in guaranteeing ecological connectivity between different ecosystems and territorial settings, it is interesting to determine to what extent they have been included in ordinary planning; the response of provincial governments can be considered satisfactory, seeing that references to ecological networks were found in almost 90% of the Provincial Plans for Territorial Coordination (PTCP) in force or in preparation.

The Italian National Network of Germplasm for the on-site conservation of wild flora (RIBES) is another important initiative, both for the conservation of germplasm and to provide further incentive for such studies (art. 9 of the CBD).

As part of an initiative undertaken by ISPRA, together with BIOFORV (a workgroup for Flora and Greenhouse Biodiversity) and RIBES, a document was published presenting a summary of the on-site conservation status of both wild and cultivated species in Italy[61]. The document illustrated the state of the art in on-site conservation for the different categories of plants and for the individual sectors of research, but it also shed light on the more critical problems, listing the primarily actions to be taken to resolve them.

In examining the initiatives, notice should be taken of the special type of conservation referred to as on-farm, an on-site approach that consists of continuing to grow and raise local varieties and races, meaning the populations of cultivated and raised species that are the result of a centuries-long process of selection carried out by the environment, as well as by the farmers and breeders of a given territory, showcasing the key role of agricultural enterprises in the conservation of biodiversity.

Working towards the objective of a lasting use of biological components (art. 10 of the CBD), on the other hand, are initiatives designed to encourage the routine use of biological resources in accordance with compatible traditional cultural practices, carried with the involvement of the local population as well, through the planning of actions for the restoration of biodiversity through improved cooperation between government authorities and the private sector. Major initiatives towards this goal include the activation of the Agenda 21 efforts, meaning activities aimed at promoting participation and access to information, environmental certification and seals of quality for local products, a number of which have been carried out locally through the national territory.

The Environmental Impact Evaluation, the Strategic Environmental Evaluation, Evaluations of Incidence of Plans and Projects, as well as surveys designed to evaluate environmental damage, are all actions provided for under art. 14 of the CBD, in order to evaluate, and therefore minimise, impacts that could undermine biodiversity. Not least in importance are initiatives of environmental research and training (art. 12 of the CBD) and of instruction and dissemination to the general public (art. 13 of the CBD). In the case of the latter, in

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[61] *La conservazione* ex situ *della biodiversità delle specie vegetali spontanee e coltivate in Italia. Stato dell'arte, criticità e azioni da compiere*, Piotto B., Giacanelli V., Ercole S. (edited by), ISPRA manuals and guidelines 54/2010.

particular, the Ministry of the Environment, together with the Ministry of Education, have engaged in a significant effort of coordination, through the INFEA program (Environmental Information, Training and Education) of 1995, in order to channel experiences and initiatives that were widely dispersed on the local level into national programs and structures.

Of note in the forestry sector is the promotion of a series of forms of partnership and collaboration between the public and private sectors, with the main goal being to favour initiatives to provide information, heighten awareness and distribute voluntary type instruments for the promotion of responsible forestry management, plus the development, in more general terms, of practices based on corporate social responsibility, along with measures to contrast illegal procedures. These instruments include: compensatory investments on the part of enterprises that intend to offset, at least in part, the impacts resulting from their activities, doing so, for example, through the reclamation of natural areas subject to deterioration, or through reforestation efforts; forestry certification, with respect both to the management of forests on a national scale and the chain of custody, meaning certified raw materials by enterprises in the wood/paper processing sector.

Of note in the forestry sector is a series of forms of partnership and collaboration between the public and private sectors, with the primary objective of favouring actions to provide information, heighten awareness and spread the use of voluntary type instruments.

In the farming sector, after decades of rural-development policies stressing the specialisation and intensification of agriculture, with the primary goal of increasing productivity, in the 1990's the Common Agricultural Policy (CAP) sought to integrate the objectives of environmental policy with agricultural policies geared towards the market and rural growth, in part to correct the environmental impacts that had resulted from the direction taken by agriculture in previous years.

In 2003, the medium-term reform of the CAP (the Fischler Reform) introduced a system of agricultural support no longer tied to the type of crops planted and the quantity produced, but rather to the exercise of farming activities and the payment of a "consolidated subsidy for each enterprise". These payments 'depended' on compliance with certain obligatory operating criteria regarding environmental safeguards, some of them established under environmental directives on natural habitats, wild flora and fauna (the Bird and Habitat Directives) and on water (directives on nitrates, underground waters, purification sludge), as well as food safety, animal welfare and biodiversity, as stipulated on the Lisbon Agenda of March 2000 and in line with the interests and expectations of society.

With the medium-term reform of the CAP in 2003, and to an even greater extent following the "Health Check" of 2008, spending on rural development in Italy and the other EU countries shifted away from market-based measures towards forms of income support for farmers, not only for their role in production but, first and foremost, for their role in the conservation of the landscape and the environment.

In November of 2008, the ministers of agriculture of the EU reached agreement on the "Health Check" of the CAP. The objective of the Health Check, a medium-term revision of the reform enacted in 2003, was to better respond to six "new challenges" that included, among others, climate change, bio-energy and the management of waters and biodiversity. It was also decided to increase the level of modulation and to transfer funds from direct payments to farmers and spending on market policies (Cornerstone I of the CAP) to rural development (Cornerstone II). The Health Check ruled out set-aside measures for good.

In revising the Strategic Community Guidelines (Decision 2009/61/EC, taken by the Council on 19 January 2009) the objective of safeguarding biodiversity was reinforced, with the result that countering the decline of biodiversity was identified as one of the most important goals of the European Community. Rural development was bound to play a strategic role in a similar effort, seeing that the concept of biodiversity is unquestionably linked to and dependent on agricultural and forestry activities.

The most recent guidelines of the CAP assign a key role to the so-called "High Nature Value Agricultural Areas", or HNV, of which Italy is particularly well endowed.

It should also be observed that the most recent guidelines for the agricultural policy of the European Community assign as key role to the so-called "High Nature Value", or HNV, agricultural areas, especially as regards the conservation of biodiversity within European ecosystems. HNV areas are those in which agriculture, carried out by minimising levels of external input (fertilisers, pesticides, energy etc.), represents the prevailing use of the soil, with the agricultural activities themselves fostering a large variety of genetic resources, species and habitats of interest to Europe. As already noted, Italy, together with Spain, Greece, northern Great Britain and Scandinavia, can point to the highest percentages of this special type of agricultural area. In Italy, they are found primarily on less productive lands, were physical limitations tied to the soil, topography, climate, distance etc. have prevented the intensification of agriculture. As a rule, the HNV are located in semi-natural areas where the primary form of agriculture is the extensive variety (mainly permanent meadows and pastures), or where there exist certain types of habitats (i.e. rice fields) or natural elements such as hedges, tree rows, grassy plots, small forested patches and rustic facilities (ditches, stonewalls).

Many regions, in the course of the revision of planning for rural development for 2007-2013, opted for the use of measures to reinforce and safeguard biodiversity.

In order to multiply efforts to protect this natural and semi-natural heritage, many regions, in the course of the revision of planning for rural development for 2007-2013, opted for the use of a wide range of measures designed to reinforce and safeguard biodiversity. An analysis of the financial resources allocated to the six "new challenges" under the Rural Development Plans of the different regions following approval of the Health Check and the Recovery Package, show that 86 million euros were concentrated on the challenge of "biodiversity", meaning 18.4% of the total, while "climate change" received 83 million euros, or 17.7% of the total, and "water management" 88 million euros, or 19.0% of the total[62]. The different types of operations funded by the agro-environmental payments are all geared towards safeguarding genetic biodiversity, conserving types of vegetation with a large variety of species, protecting and maintaining formations of grasslands, protecting birds and other wild fauna, improving the network of biotypes, reducing the presence of harmful substances in surrounding habitats and conserving protected flora and fauna. Furthermore, considering the highly interdependent relations between biodiversity and climate change, as well as bio-energy and water management, a large part of the measures implemented under the regional plans will ultimately have

[62] Camaioni B. e Cicetti A. (2010). *La PAC di fronte alle "Nuove Sfide". Una analisi attraverso i piani finanziari dei Programmi di Sviluppo Rurale.* Agriregionieuropa 23: 1-10

the effect of safeguarding biodiversity, even though they do not address it directly. Examples include initiatives to favour the adjustment of forest and agrarian ecosystems to climate change or to reconstruct stonewalls and tree rows, so as to favour the regulation of water and the control of erosion, together with measures for the diversification of the rural economy or for providing support to family farming and agro-tourism enterprises.

The environmental dimension of the future reform of the CAP for the period 2014-2020.

In March of 2013, the European Parliament approved the reform of the CAP for the period 2014-2020 (though it will not go into effect until 2015). With respect to environmental concerns, the next CAP shall introduce, within the framework of payments disbursed directly to farmers as income subsidies, an ecological, or "greening" component that is very similar to the agro-environmental measures for rural development, together with a supplementary component of aid for enterprises in areas subject to naturalistic restrictions. The ecological payment is one of the main components of the direct funding, and it can account for up to 30% of the national maximum amount. In order to benefit from the funding, farmers must simultaneously observe three types of practices: crop diversification for enterprises that plant fields; the maintenance of permanent meadows; the presence of areas of ecological interest (fields left fallow, terracing, areas of landscape value, buffer zones, reforested areas) on 7% of the land. Support of future agro-environmental measures will become increasingly focussed, selective and rigorous[63]. In the case of biological agriculture, awarding of the ecological payment shall not depend on the three practices listed earlier, seeing that the biological approach, in and of itself, produces environmental benefits.

European Community agro-environmental policies include incentives for systems of production with low environmental impact.

In terms of maintaining or increasing the national quantity of UAA, there are no specific objectives stipulated under international or national regulations or standards, though the last two European Programs of Environmental Initiatives, along with the Agenda 21, set a number of general objectives, such as the sustainable use of the land, protection of nature and biodiversity, and maintenance of levels of productivity. These objectives are reiterated in the resulting strategies for specific topics, in the legislative proposals associated with the same and in the numerous legislative measures already passed. European Community agro-environmental policies include incentives for systems of production with low environmental impact, such as integrated and biological agriculture, production activities that utilise naturally extensive resources, the safeguarding of habitats of noteworthy natural value, the maintenance of biodiversity and the management of low-intensity pastures. It is interesting to note that, under Ministerial Decree 27417 of 22 December 2011, starting 31 December 2011 the introduction of buffer zones protecting waterways became obligatory. These are grassy areas 5-metres deep that limit the surface and underground flow of pollutants towards the bodies of water.

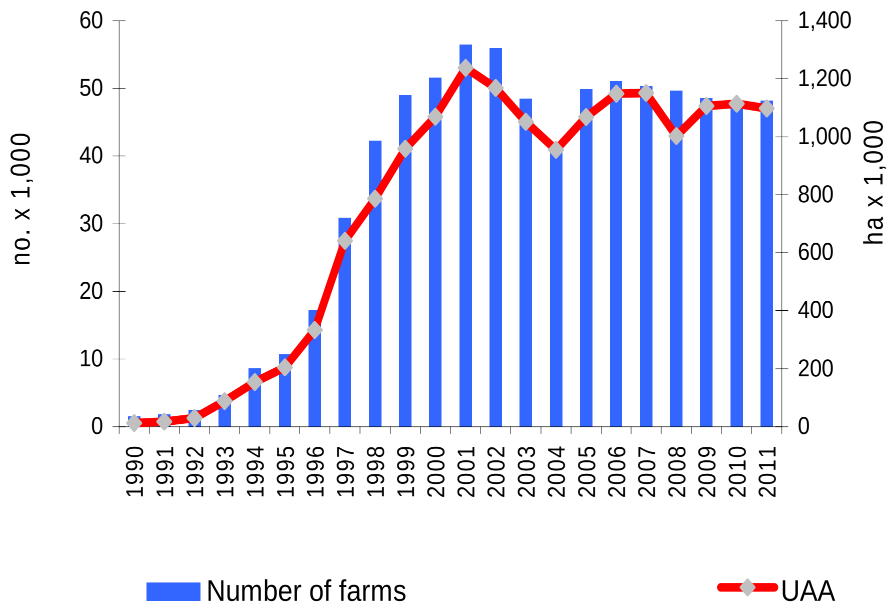
The standard was formulated in keeping with the Framework Directive

[63] De Filippis *et al.* (2012) *Il nuovo regime dei pagamenti diretti*. In De Filippis F. (edited by), *La nuova Pac 2014-2020*. An analysis of the Commission's proposals, Quaderni Gruppo 2013, Edizioni Tellus, Rome

on Waters and it lays the groundwork for the possibility of future application of agro-environmental measures for the benefit of agricultural enterprises. Equally important are the national guidelines geared towards promoting a generational rejuvenation, together with the economic and social development of agriculture, in addition to providing incentives for the renewed consolidation of both the land and the farming enterprises.

Within this framework of measures and subsidies, special attention has been placed on Italian biological agriculture (often referred to as "bio"), which truly represents a success story for European agriculture. And this despite the fact that, at the end of 2011, the surface area committed or being converted to "bio" farming totalled 1,096,889 hectares, making for a drop of -1.5% compared to 2010. Biological agriculture involves 8.5% of the national UAA. The operators number 48,124, for an increase of approximately 1% compared to 2010. Within the EU, Italy holds a leading position in the biological sector, as regards both the number of its farms and the surface area utilised, with readily apparent benefits in terms of soil quality, carbon fixing, reduction of greenhouse gas emissions, conservation of biodiversity and reduced introduction into the environment of pesticide and fertiliser residue.

Within the EU, Italy holds a leading position in the biological sector, as regards both the number of its biological enterprises and the UAA, all with readily apparent environmental benefits.



In 2011 there was a slight increase in the number of operators in the biological sector; at the same time, however, the surface area committed to biological agriculture decreased slightly.

Figure 2.11: Numbers of operators and utilised agricultural areas (UAA) managed according to biological methods[64]

The various initiatives taken to protect Nature and biodiversity, as listed up to this point, can only be effectively applied when supported by adequate financial resources.

Based on the available data provided by ISTAT[65], spending by government bodies and authorities (by COFOG groups)[66] for the protection of biodiversity and landscape resources stood at 4.838 billion euros in 2011.

During the decade of 2000-2009, an average of almost 3.0 billion euros a year were allocated for the protection of biodiversity and the landscape.

[64] Source: SINAB

[65] Spending by government bodies and authorities by function, level II. Years 2000-2011.

[66] *Classification of Function of Government*: an internationally formulated classification of the main institutions that handle national accounting

In 2000, this spending item totalled 3.007 billion euros, making for growth of 60.9% in the period 2000-2011, in confirmation of the attention focussed on the sector under public policies.

Of the possible responses to the loss of biodiversity, and apart from measures of direct protection, a decisive role is also played by the sustainable and conservation-based management of natural environments, both terrestrial and marine, that are not protected per se.

As seen up to this point, there are various responses to the incessant loss of biodiversity and various approaches to safeguarding natural and agricultural areas. These definitely include a growing designation of new protected areas, as well as further reinforcement of the existing instruments of protection, especially in terms of heightened application and distribution of controls, availability of greater financial resources and addressing newly emerging problems, such as, for example, the spread of allochthonous species and climate change.

Furthermore, a decisive role is played by the ever increasing distribution of sustainable, conservation-oriented management to natural settings, both terrestrial and marine, that are not protected *per se*. Within this context, the national agricultural sector is also extremely important, being called on to make a difficult choice between the growing demand for both “conventional” and “new” products (first and foremost bio-fuels) and the need to safeguard biodiversity and the environment, an area in which it can provide worthwhile options for resolving specific, and very pertinent, problems, with examples including bio-remediation, carbon sequestration etc..

Finally, as observed earlier, it is important to remember that policies and measures for the protection of biodiversity must necessarily be made an integral part of policies in the various individual sectors. Contributions from policies of agriculture, forestry and fishing are of particular importance in achieving objectives tied to biodiversity.

Specific regional characteristics

ARPA Tuscany

The marine environment is an indispensable element for life on earth: it plays a key role in balancing climatic factors, as serving as a case of biodiversity and a major factor in economic prosperity. The protection of marine ecosystems is the subject of the European Community’s Marine Strategy for countering the gradual deterioration of marine habitats.

With the support of the cross-border Italian-French “Maritime” cooperation program for 2007-2013, the four regions that face onto the Pelagos Sanctuary have promoted the implementation of the GIONHA project (Governance and Integrated Observation of Marine Natural Habitats), with the goal of facilitating the defence and optimisation of the ecosystem of the most extensive marine protected areas in the Mediterranean.

To this end, the Environmental Protection Agency of the Tuscany Region (project leader), the *Office de* l’*Environnement de la Corse*, the Liguria Region, the Autonomous Region of Sardinia and the Province of Leghorn – the subjects undertaking the project – have worked together in performing numerous technical-scientific activities meat to gain more in-depth knowledge of the ecological status of this marine area while promoting instruments ad actions to heighten awareness of the need for its defence. (For more information: *http://www.gionha.it/*)

GLOSSARY

Allochthonous:
A specific entity introduced by man, either deliberately or accidentally, outside of the setting of its natural distribution (synonyms: alien, exotic, introduced, non-indigenous, xenophyte in the case of plant species).

Protected Marine Area:
Any area in the marine domain, including its waters, flora and fauna, as well as its historical and cultural characteristics, that is preserved under legislative measures designed to partially or totally protect the environment in question.

Bio-remediation:
The use of biological processes or agents to remedy environmental damage, especially that caused by pollution.

Bryology:
The sub-discipline of botany that studies the Bryophytes, meaning terrestrial plants that do not present separate elements constituting roots, stems, leaves, and that still need to live a an extremely humid environment (i.e. mosses and hepatics).

Endemic:
A species whose range is limited to a single territory, generally of limited size.

Eutrophication:
An abnormal proliferation of plant biomass (microalgae). The term "eutrophication", from the Greek *eutrophia (eu = good, trophòs = nutrient)*, originally referred, in keeping with its etymology, to water environments with a wealth of nutrients (nitrates and phosphates); today it is commonly used to indicate the phases subsequent to the biological process that follows this enrichment, meaning the abnormal development of algae, often with detrimental consequences for the environment.

Natural Habitats:
As per the "Habitat" Directive, these are terrestrial or aquatic zones that set themselves apart by virtue of their geographic, abiotic or biotic characteristics, and which may be either entirely natural or semi-natural.

Hot Spots of Biodiversity:
The thirty-four locations on the face of the earth where the majority of its biodiversity lives. To qualify as a "hot spot", a site must have at least 1,500 endemic plant species (0.5 of the planet's total) and it must have sustained losses amounting to at least 70% of the original habitat.

Phylum:
The *phylum* (from the Greek *φυλόν*, “nation”, “tribe”, “people”) is the taxonomic classification that ranks just below kingdom and just above class.

Ecosystem Services: According to the definition in the *Millenium Ecosystem Assessment* (MA, 2005), “the multiple benefits that ecosystems provide to the human race”.

Set-Aside:
In agronomy, the regulatory procedure of the European Community under which a plot of land is removed from production and left fallow for a period of varying length. When this is done, the European Community pays the owner of the land an economic subsidy.

Synathropic Species:
An animal or plant species that lives in the same environment occupied by man.

Taxa:
In the classification system, *taxa* are groups of similar species.

Ungulates:
The zoological group that includes mammals with hooves that cover the fronts of their knuckles (such as horses, oxen, cows etc.).

CHAPTER 3

AIR QUALITY

Introduction

Air pollution continues to be an emergency and one of the major environmental risk factors for human health. Emissions of many air pollutants have declined substantially in recent decades, resulting in better ambient air quality. In spite of this, due to the complexity of the air pollution phenomenon that leads to the now well-known lack of linear correlation between emissions and concentrations in the air, the levels of some pollutants are still too high and the problems linked to air quality persist.

Air pollution is an environmental emergency. Emissions are decreasing, but the levels in the air are still too high.

A significant portion of the population, particularly those living in large urban areas, is exposed to high levels of pollutants exceeding the limits set by existing legislation (Directives 2008/50/EC and 2004/107/EC, Leg. Decree No. 155/2010). If we then take into account the more conservative information from the World Health Organization (WHO)[1], the exposure of the population rises to even more concerning levels. It is estimated that 90% of the population living in urban areas in Europe is exposed to unsafe levels of air pollutants[2].

This emergency applies to large urban areas in particular.

There are many epidemiological studies that have scientifically documented the acute and chronic health effects of air pollution, these effects range from respiratory symptoms to morbidity and mortality due to respiratory or cardiac reasons or cancer[3]. In the recently published report "*Review of evidence on health aspects of air pollution. First results*", WHO confirms the scientific conclusions presented in the previous report "*Air Quality Guidelines. Global update 2005*" for particulate matter, ozone and nitrogen dioxide, at the same time stressing that health effects can arise at concentrations lower than those indicated in previous guidelines. It is estimated that in many areas of Europe, life expectancy is reduced by one year due to air pollution[4].

In addition to atmospheric particulate matter (PM_{10} and $PM_{2.5}$) and ozone, which affect human health more significantly, there are also high levels of nitrogen dioxide (NO_2) that often exceed regulatory limits. Another pollutant that is worrying due to its proven carcinogenic properties and the relatively high levels (in 2013 the target value of 1.0 ng/m^{3}entered into force) recorded, is benzo(a)pyrene.

In addition to particulate matter, nitrogen dioxide and ozone, high levels were also recorded for B(a)P.

In May 2012, as part of the United Nations Convention on Long Range Transboundary Air Pollution (CLRTAP) negotiations were concluded for the revision of the 1999 Gothenburg Protocol, leading to, among other things, the allocation of emission ceilings to be achieved for SO_2, NO_X, $PM_{2.5}$, NMVOC and NH_3 by 2020. Compared to the previous version of the protocol the ceiling was added for $PM_{2.5}$ emissions along with the commitment to reduce emissions from 2005 to 2020 in

Gothenburg Protocol revision: new emissions ceilings to be reached by 2020 for SO_2, NO_X, NH_3, NMVOC and $PM_{2.5}$.

1 WHO Regional Publications, European Series n.91. *Air Quality Guidelines for Europe*
2 Final Report "Fifth Ministerial Conference on Environment and Health" (Parma, 2010)
3 For more information on health impacts see "Key topics, ISPRA, 2011 Edition – Chapter: Air Quality"
4 Final Report "Fifth Ministerial Conference on Environment and Health" (Parma, 2010)

percentage terms rather than in absolute terms The reduction percentages to be achieved by 2020 for Italy are defined as follows: -35% for SO_2, -40% for NO_X, -10% for $PM_{2.5}$, -35% for NMVOC and -5% for NH_3[5].

2013, declared "Year of the Air" in Europe, will see the completion of the review process of the Thematic Strategy on air quality with a Proposal for a new EU Environment Action Programme to 2020. The proposal to review the Thematic Strategy will likely be accompanied by a proposal to review Directive 2001/81/EC the so-called NEC (National Emission Ceiling) Directive, implemented by Leg. Decree No. 171/2004, which establishes national emissions caps at European level. In fact, this directive transposes the commitments made at international level to EU Community level with the Gothenburg Protocol. Therefore, the review will most likely take place in 2014[6].

2013, declared "Year of Air" in Europe, will see the completion of the review process of the Thematic Strategy on air quality.

The recent publication of Directive 2012/33/EU, amending previous Directive 1999/32/EC, has been an important new piece of legislation, reducing the sulphur content in marine fuels.

Within the framework of Directives 2008/50/EC and 2004/107/EC, implemented in Italy by Leg. Decree No. 155/2010[7], which establish limits for the concentrations of pollutants in the air and require Member States to draw up plans to improve air quality, a new system is being worked on for reporting information on air quality between Europe and the Member States. This system, as defined in Decision 2011/850/EU[8], will be a single system, based on the exclusive use of computer technology and aligned with the INSPIRE[9] (INfrastructure for SPatial InfoRmation in Europe) Directive, which will ensure interrelation between all information components, quality check, completeness, consistency and updating, sharing and interoperability of information between the different levels (European, national, local) and the timeliness of information. Using the new system, which should be operational in 2014, the excessive fragmentation and diversification of existing flows of information[10] on air quality will finally be resolved.

A new system for reporting information on air quality between Europe and the Member States will soon be operational (Decision 2011/850/EU).

With the aim of improving knowledge of air pollution and ensuring greater quality, consistency and compliance in the assessment and management of air quality throughout the country, Leg. Decree 155/2010 has introduced important new tools and criteria and, on this basis, has provided for many activities.

Leg. Decree 155/2010 aims to improve understanding of air pollution and ensure greater quality, consistency and

One activity that is currently underway is to establish new zoning

[5] For further information see the dedicated webpage of the United Nations - Economic Commission for Europe at http://www.unece.org/env/lrtap/multi_h1.html

[6] For more information on this subject see the dedicated webpage of the European Commission at http://ec.europa.eu/environment/air/review_air_policy.htm

[7] Leg. Decree 155/2010 has been recently modified with Legislative Decree 24th December 2012, No. 250

[8] *Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting an ambient air quality*

[9] Directive 2007/2/EC establishing an Infrastructure for territorial information in the European Community implemented in Italy by Leg. Decree No. 27th January 2010, No. 32

[10] The current information flows on air quality are: 1) *Exchange of Information*, Decision 97/101/EC that travels by electronic means through dedicated procedures; 2) Ozone summer, Leg. Decree 183/2004; 3) Air quality assessment, Decision 2004/461/EC; 4) Plans to restore air quality, Decision 2004/224/EC. The latter three travel on computer media or spreadsheets by regular mail or email

projects for the territory and air quality assessments (art. 3, 4, 5) by the Regions and Provinces Autonomous. These new projects, developed on renewed and more precise establishment criteria, already show positive results, particularly the establishment of monitoring networks that are more representative of air pollution and human exposure to it. Another example is the recent publication of the Ministerial Decree of 29/11/2012 (art. 6) which, by identifying "special" stations in the country, launched activities aimed at a better understanding of atmospheric particulate matter (PM_{10} and $PM_{2.5}$), PAHs, metals, ozone and its precursors.

compliance in the assessment and management of air quality.

Another important activity that is currently underway that will allow Italy to recover from a certain delay compared to other Mediterranean countries such as Spain and Portugal, is the assessment of the Saharan contribution to PM_{10}, in order to subtract exceedances caused by this contribution from the total number of exceedances recorded at a monitoring station[11] (art. 15)[12].

Derogation from the application of the limit value of NO_2.

In 2012, as set out in Directive 2008/50/EC (art. 22), and as it was for PM_{10}[13], the Italian State sent a derogation notice to the European Commission for nitrogen dioxide that concerned the application of an annual limit value in 48 areas and an hourly limit value in one area. The derogation from the application of the annual limit value for NO_2, with the Decision of 6th July 2012[14], was granted in 23 areas[15] (until 1st January 2013 in 3 areas, until 1st January 2014 in one area and until 1st January 2015 in 19 areas)[16].

Much has been done to restore air quality, especially in the mobility sector, which remains among the leading causes of pollution; despite some weak but encouraging signs of improvement, the restoration measures implemented so far have not been effective enough to bring the levels of pollutants in the ambient air (atmospheric particulate matter, ozone and nitrogen dioxide) within the regulatory limits and this does not seem likely to be achieved in the near future. Therefore, it is both desirable and urgent to adopt, in addition to the measures that intervene on local sources and which on their own are insufficient, as provided by art. 9 of Leg. Decree 155/2010, integrated measures on a national scale that can act on the sectors that are most responsible for pollution and reduce the regional background, especially where there are high values due to adverse dispersion conditions that dominate a large area, such as in the Po basin.

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[11] In the Mediterranean, the transport into the atmosphere of natural particles from dry, arid areas such as the Sahara is one of the natural events with the greatest impact on air pollution, in particular on PM_{10} levels

[12] Currently, the contribution of the Sahara to PM_{10} is only assessed by some ARPA (Regional Environmental Protection Agencies) such as the one in Puglia

[13] As explained in the report "Key topics, ISPRA, Ed. 2011 – Chapter: Air Quality”

[14] Decision of the Commission of 06/07/2012 relating to the notice of the Italian Republic for an extension of the deadline for attaining the nitrogen dioxide limit values in 48 air quality areas *(C(2012) 4524 final)*

[15] However, several of the areas for which the derogation has not been granted have resubmitted this request, proposing new documentation and their position is currently being assessed by the European Commission

[16] For more details, see: Bonanni P., Cusano M, De Santis A., Sarti C. NO_2- Extensions to the application of the limit values -ISPRA Report 2013 (in print)

In our country, it is therefore a question of integrating economic and political choices with the safeguarding of human health and the environment as a whole and to overcome fragmentation due to legislative and administrative decentralisation, as the OECD has also recently recommended for our country[17]. What is ultimately needed is an evolution of Community legislation towards real integration between policies on air quality and greenhouse gases, as well as a fundamental change in individual lifestyle.

The state of air quality

O_3, PM_{10}, NO_2 and B(a)P are the most critical pollutants.

Besides ozone, atmospheric particulate matter and nitrogen dioxide, whose regulatory limits continue to be frequently exceeded, high atmospheric levels were also recorded for benzo(a)pyrene.
Figures 3.1, 3.2 and 3.3 show PM_{10}, nitrogen dioxide and ozone, respectively and the updated situation in Europe as of 2010, as seen in the monitoring data reported by European countries under the *Exchange of Information* (EoI) framework[18] and stored in the European AirBase data base.
The daily limit value for PM_{10} (Figure 3.1), which is known as a more stringent regulatory standard of the annual limit value, is exceeded (orange and red points) more frequently than the annual limit value (red dots)[19]. Exceedances affect the majority of European countries, including Italy. Most exceedances of the daily limit value are recorded at the traffic-oriented monitoring stations (33%), followed by urban-background (29%) and rural (14%) stations[20].
The annual limit value for nitrogen dioxide was exceeded in the majority of European countries (Figure 3.2) and the exceedances are more frequent in traffic-oriented stations: 44% of the latter is exceeded.
The map in Figure 3.3 clearly shows a North-South gradient for ozone, with the highest concentrations in Mediterranean countries. Unlike PM_{10} and NO_2, the highest ozone levels are recorded in rural stations followed by urban stations and traffic-oriented stations. High concentrations can be observed in high-altitude stations.

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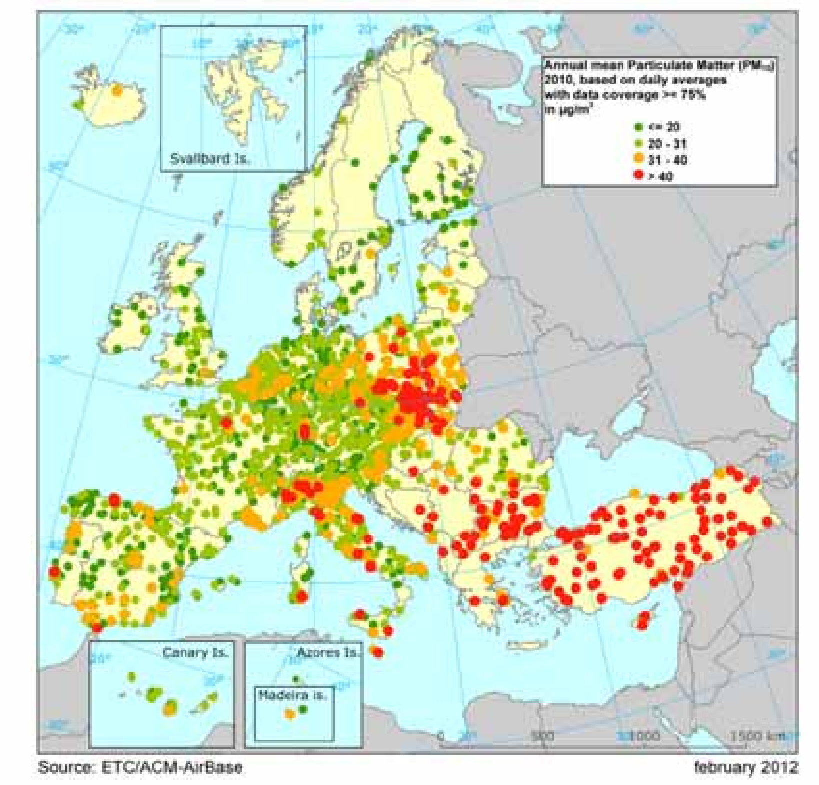
[17] OECD (2013), OECD Reports on environmental performance: Italy 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264188754-it

[18] Decision 97/101/EC taken from Leg. Decree 155/2010 (art. 19, paragraph 17)

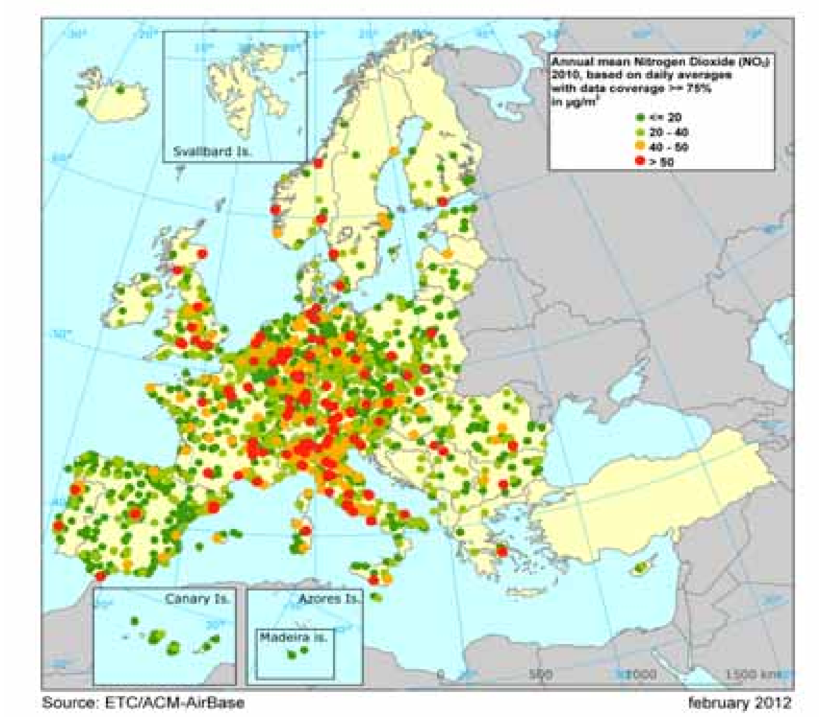
[19] The map is constructed on the basis of annual mean and also allows us to estimate exceedances of the daily limit value as, from consolidated statistical analysis, it appears that the daily limit value corresponds to an annual mean of about 31 µg/m^3.

[20] EEA Report N.4/2012, *Air quality in Europe-2012 report*



PM_{10}, 2010, Europe: 33% of traffic-oriented stations exceed the daily limit value.

Figure 3.1: PM_{10} - Annual mean concentration in 2010 (limit value 40 $\mu g/m^3$)[21]

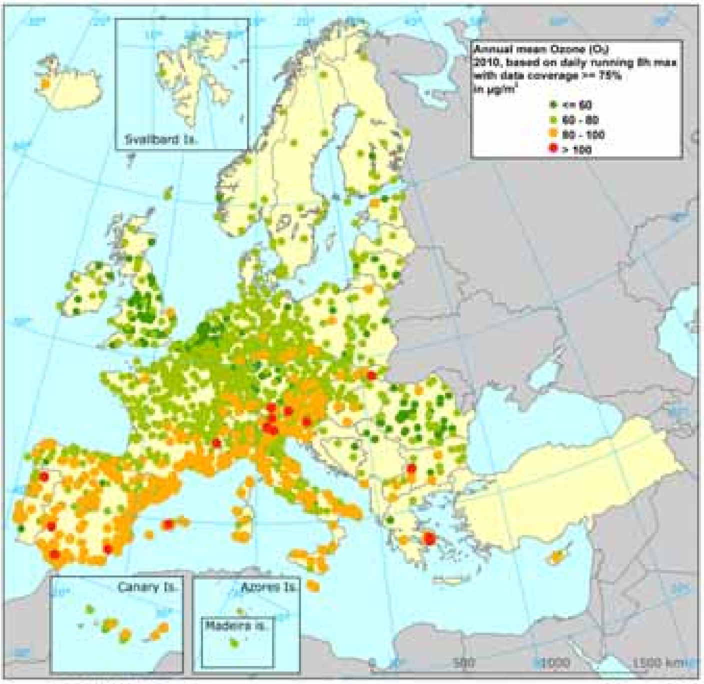


Nitrogen dioxide 2010, Europe: 44% of traffic-oriented stations exceed the annual limit value.

Figure 3.2: NO_2 - Annual mean concentration in 2010 (limit value 40 $\mu g/m^3$)[22]

[21] Source: ETC/ACM-AirBase (http://acm.eionet.europa.eu/databases/airbase/eoi_maps/eoi2011/map_annavg_PM10_conc2010.png)

[22] Source: ETC/ACM-AirBase (http://acm.eionet.europa.eu/databases/airbase/eoi_maps/eoi2011/map_annavg_NO2_conc2010.png)



Source: ETC/ACM-AirBase february 2012

The health-related threshold of the O_3 target value was exceeded more than 25 times in 2010 at 40% of the rural stations.

Figure 3.3: O_3, - Annual mean value in 2010 of the average daily maximum over 8 hours (long-term objective 120 $\mu g/m^3$)[23]

Europe, 2010: the $PM_{2.5}$ figures remain inadequate.

For $PM_{2.5}$ in 2010 there were 754 stations fulfilling the criterion of more than 75% data coverage. Compared to 2009, 150 additional stations measured $PM_{2.5}$ in 2010. The $PM_{2.5}$ concentrations were higher than the annual target value to be met by 2010 (25 $\mu g/m^3$) at several stations in Italy, Bulgaria, the Czech Republic, Poland and Slovakia and at several stations in other countries.

Europe, 2010, B(a)P: 38% of stations exceed the target value.

The target value of 1.0 ng/m^3 for benzo(a)pyrene, which to be met by 2013[24], is exceeded in 38% of the stations; the areas most affected by high B(a)P levels are in central and eastern Europe. These exceedances affect all types of stations (lower concentrations are recorded in rural stations) and seem to persist over the years.

As regards CO, only about a dozen stations are in excess of 1,159 and about 80% show signs of reduction of the concentrations measured.

For heavy metals (Pb, As, Cd, Ni), exceedances of the target values are also rare and linked to local situations, referring to only a few areas in Europe, generally in industrial environments[25].

Europe, 2001-2010: a weak but significant downward trend is observed for NO_2 and PM_{10}.

In addition to the "resolved" sulphur dioxide, carbon monoxide and benzene, some signs of a decrease in the atmospheric levels of NO_x and PM_{10} could take hold in Europe. In the 2001-2010 period, nitrogen oxides show a weak downward trend (the downward trend of NO_2 is less pronounced than that of total nitrogen oxides).

Over the same period for PM_{10} a weak (-1 $\mu g/m^3$) but significant downward trend is observed in 54% of stations[26].

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[23] Source: ETC/ACM-AirBase (http://acm.eionet.europa.eu/databases/airbase/eoi_maps/eoi2011/ map_annavg_O3_conc2010.png)

[24] The Regions and Provincies Autonomous must seek to achieve the target value by 31st December 2012 (Leg. Decree No. 155/2010, art. 9, paragraph 2)

[25] For metals, compared with atmospheric levels, the deposition and exposure of the ecosystem and organisms is more significant, leading to bioaccumulation in the food chain

[26] EEA Report N.4/2012, *Air quality in Europe-2012 report*

In the 2001-2010 period, it is not generally possible to identify a clear trend for ozone; a weak negative trend was recorded in 66% of stations (only 7% of stations show a more pronounced reduction in concentration). 28% of stations show a pronounced positive trend (involving stations from traffic located in the Iberian Peninsula and the cause seems to be lower consumption of O_3 by NO as a result of lower NO_x emissions).
The air quality situation in Italy for 2011 is summarised in the following figures.
For PM_{10}, the regulation establishes a daily limit value of 50 $\mu g/m^3$ which is not to be exceeded more than 35 times a year, and an annual limit value of 40 $\mu g/m^3$. These limits are often exceeded, especially the more stringent daily limit which was exceeded in 48% of stations (Figure 3.4) in 2011. The map, in addition to a difference in monitoring density between the North and South of Italy (higher in the North and lower in the South), highlights the problems of big cities, especially in the Po Valley where levels more frequently reach higher values.

PM_{10}, 2011, Italy: 48% of monitoring stations exceed the daily limit value.

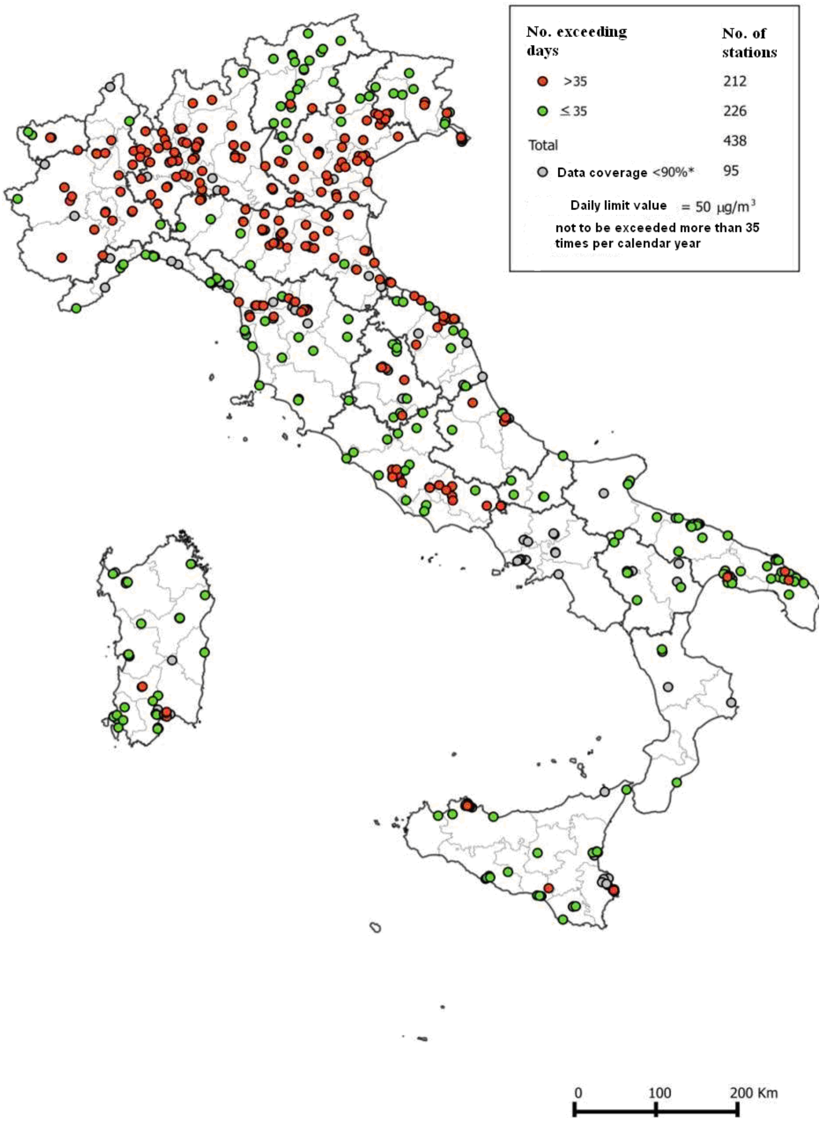


Figure 3.4: PM_{10} - Monitoring stations and exceedances of the daily limit value (2011)[27]

[27] Source: ISPRA

Figure 3.5 shows an analysis of PM_{10} trends from 2006 to 2011, carried out on a sample of 144 stations[28]. 65% of stations show a statistically significant downward trend, with an estimated average annual reduction of 1.6 μg/m^3. These results support the findings of an estimate made on a smaller number of stations (70) for a longer period (2003-2011).

Italy, PM_{10}: from 2006 to 2011, 65% of stations examined show a statistically significant downward trend.

Figure 3.5: PM_{10}, trend estimate for the 2006-2011 period[29]

[28] The estimate of the trend was performed using the Theil method (Theil, H., 1950. *A rank invariant method of linear and polynomial regression analysis*. Proceedings of the Koninklijke Nederlandse Akademie Wetenschappen, Series A – Mathematical Sciences 53, 386–392, 521–525, 1397–1412) and Sen (Sen, P. K., 1968. *Estimates of regression coefficient based on Kendall's tau. Journal of the American Statistical Association* 63, 324), evolution of the non-parametric test of Mann Kendal (Mann, H.B., 1945. *Non-parametric test against trend. Econometrica*, v. 13, p. 245-259). In addition, it was corrected for seasonality (Hirsch, R. M.; Slack, J. R.; Smith, R. A. *Techniques of trend analysis for monthly water quality data*. Water Resour. Res. 1982, 18, 107-121)

[29] Source: ISPRA

As regards $PM_{2.5}$, the information reported for 2011 (124 monitoring stations have sets of data with temporal coverage of 90%) despite being higher than in previous years, is still inadequate in terms of spatial coverage for accurate assessments. The available information indicates that in 2011, 27% of stations exceeded the annual limit value of 25 $\mu g/m^3$ that will become effective in 2015.

Italy, $PM_{2.5}$,: 27% of stations exceed the daily limit value.

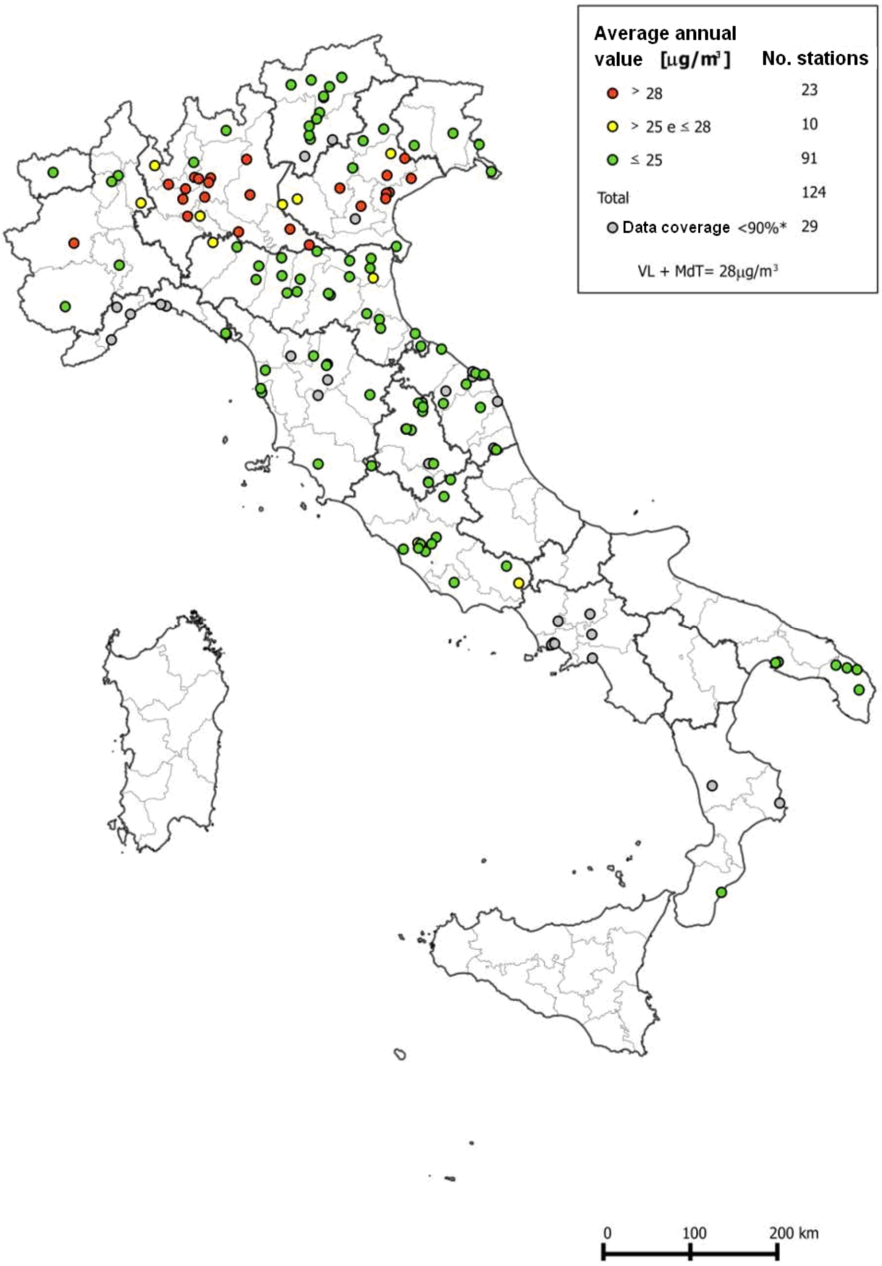


Figure 3.6: $PM_{2.5}$ - Monitoring stations by classes of average annual value (2011)[30]

[30] Source: ISPRA

For ozone, the long-term objective of protecting human health (120 μg/m^3) which, of the parameters defined by the regulations, is what best describes the conditions of pollution and population exposure averaged over time, during summer 2012 (from April up to and including September) it is exceeded in most stations; only 7% of stations (19 stations out of 277 that provided information for at least five out of the six summer months) have not recorded exceedances of the long-term objective (Figure 3.7).

Italy, Ozone, summer 2012: in 93% of monitoring stations, exceedances of the long-term objective were recorded. The most critical situation is in Northern Italy.

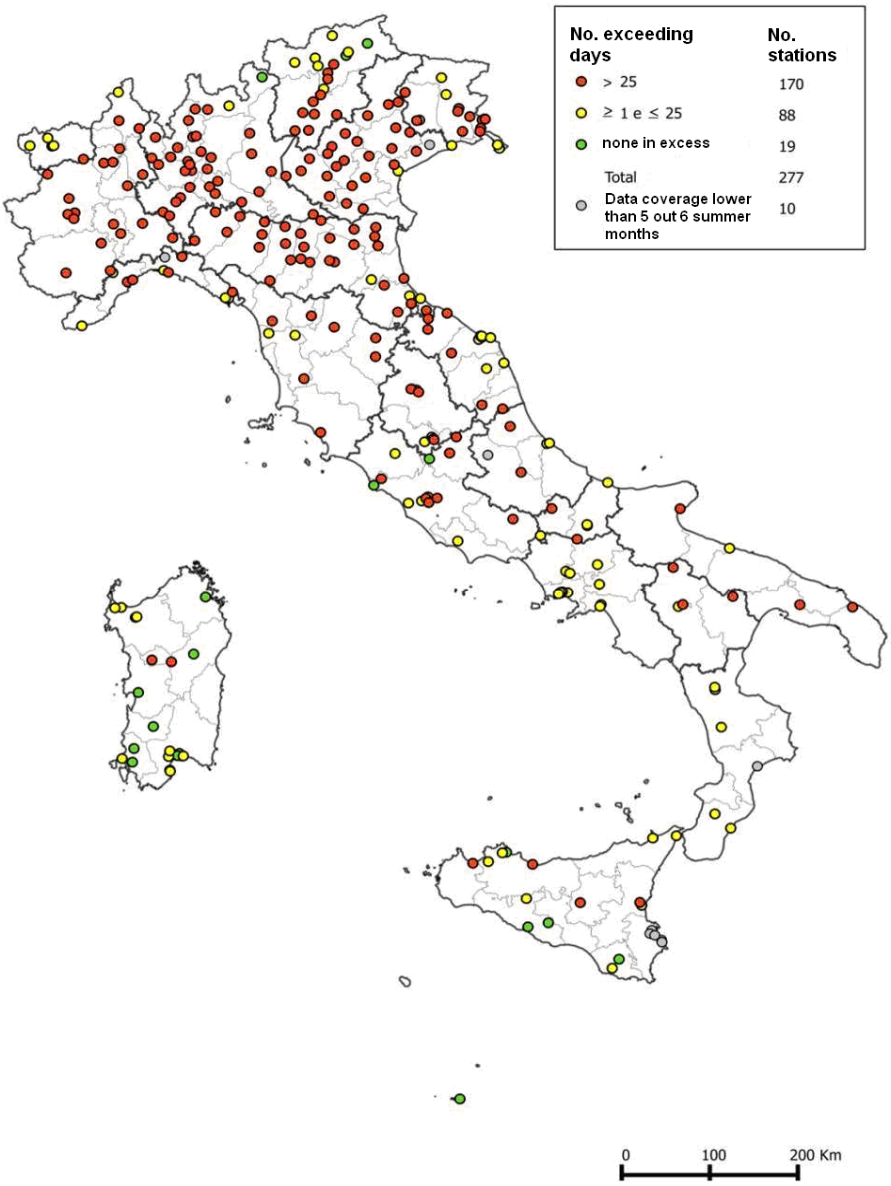


Figure 3.7: O_3 summer - Monitoring stations by classes of days exceeding the long-term objective of protecting human health (120 μg/m^3) (2012)[31]

The most critical problems, as shown on the map, are in the regions of Northern Italy.

For ozone, which, due to strong dependence on meteorology, has greater variability from year to year than the other pollutants, it is not possible to indicate any trend.

[31] Source: ISPRA (provisional data)

This is what emerges from Figure 3.8 which shows that for the summer period from 2003-2011, some descriptive statistics[32] of the SOMO0 indicator[33] calculated for a set of monitoring stations restricted in terms of numbers (72 monitoring stations) but uniform in type of station and temporal coverage.
Figure 3.9 shows an analysis of the trend[34] on the same set of stations during the period 2003-2011 and confirms the absence of a statistically significant general trend (a statistically significant downward trend is only observed in 24% of cases).

Italy, Ozone summer: from 2003 to 2011 a situation stationary is observed.

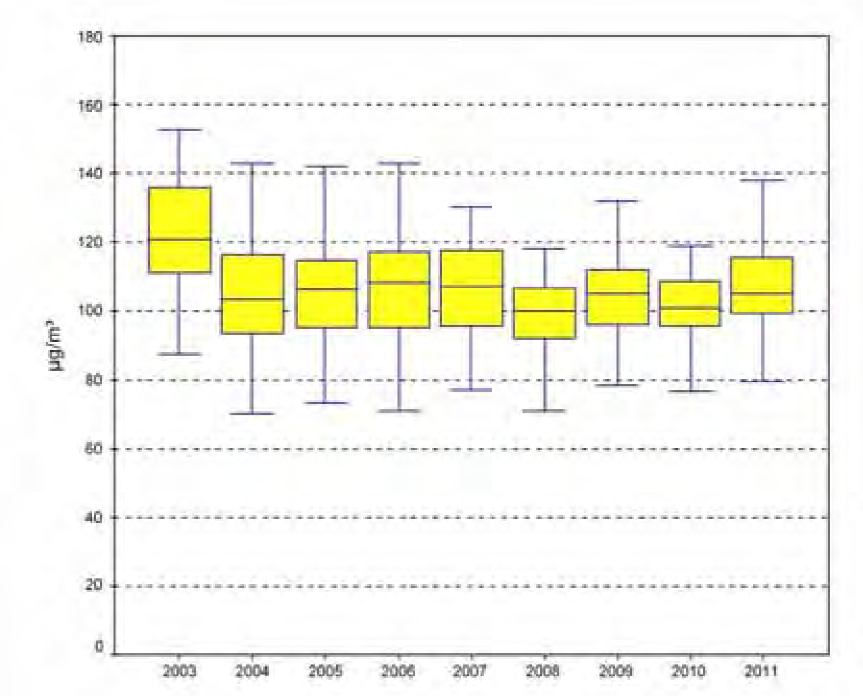


Figure 3.8: O_3 summer, SOMO0 - Descriptive statistics calculated on a selection of 72 monitoring stations distributed throughout the country[35]

[32] A box plot is a compact graphical method to represent statistical distributions. In the graph, the line inside the rectangle represents the median, the ends of the rectangle represent the first quartile (25th percentile) and third quartile (75th percentile). The ends of the lines that extend from the edges of the rectangle represent the lower adjacent value and the upper adjacent value, respectively. Most observations fall within the range between these two values. It is possible that there are values outside the range defined by the two adjacent values. These data are defined as anomalous or extreme and should be analysed separately to assess the reasons that led to this anomaly with respect to the distribution of the data

[33] SOMO0 is an exposure index calculated as the sum of the maximum daily moving averages over eight hours, divided by the number of valid days, for which an average of eight hours is provided. SOMO0 was introduced by the Task Force UNECE to calculate health effects attributed to ozone (UNECE 2004. *Modelling and assessment of the health impact of particulate and ozone. Geneva, United Nations Economic Commission for Europe.* http://www.unece.org/fileadmin/DAM/env/documents/2004/eb/wg1/eb.air.wg1.2004.11.e.pdf)

[34] See note 28

[35] Source: ISPRA

Italy, Ozone summer: from 2003 to 2011 a situation stationary is confirmed (only 24% of stations examined show a statistically significant downward trend).

Figure 3.9: O_3, summer, trend estimate for the 2003-2011 period[36]

Nitrogenous compounds, whose main sources are transport and agriculture, play an important role as precursors to particulate matter and ozone and are currently the main acidifying components in the air, following the reduction of emissions of sulphur oxides. As regards nitrogen dioxide, in 2011 the annual limit value for the protection of human health (40 µg/m^3) was exceeded in 20% of stations (Figure 3.10).

[36] Source: ISPRA

Italy, nitrogen dioxide, 2011: 20% of stations exceed the annual limit value.

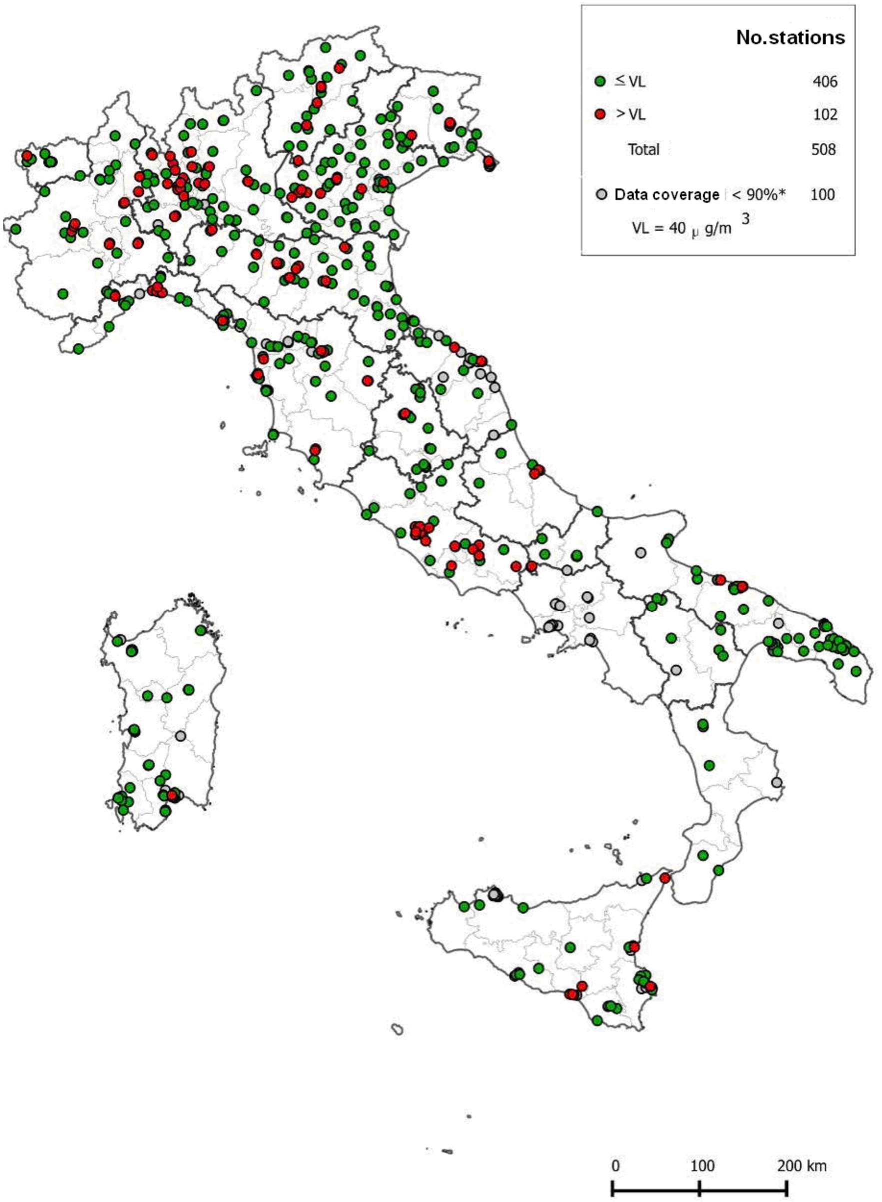


Figure 3.10: NO_2 - Monitoring stations and exceedances of the annual limit value (2011)[37]

From the analysis of NO_2 trends from 2006 to 2011, carried out on a sample of 225 stations[38] (Figure 3.11), 58% of stations show a statistically significant downward trend, with an estimated average annual reduction of 1.6 $\mu g/m^3$. These results confirm what was shown on a smaller number of sites (108) between 2003-2011.

[37] Source: ISPRA
[38] See note 28

Italy, Nitrogen dioxide: from 2003 to 2011, 58% of stations examined show a statistically significant downward trend.

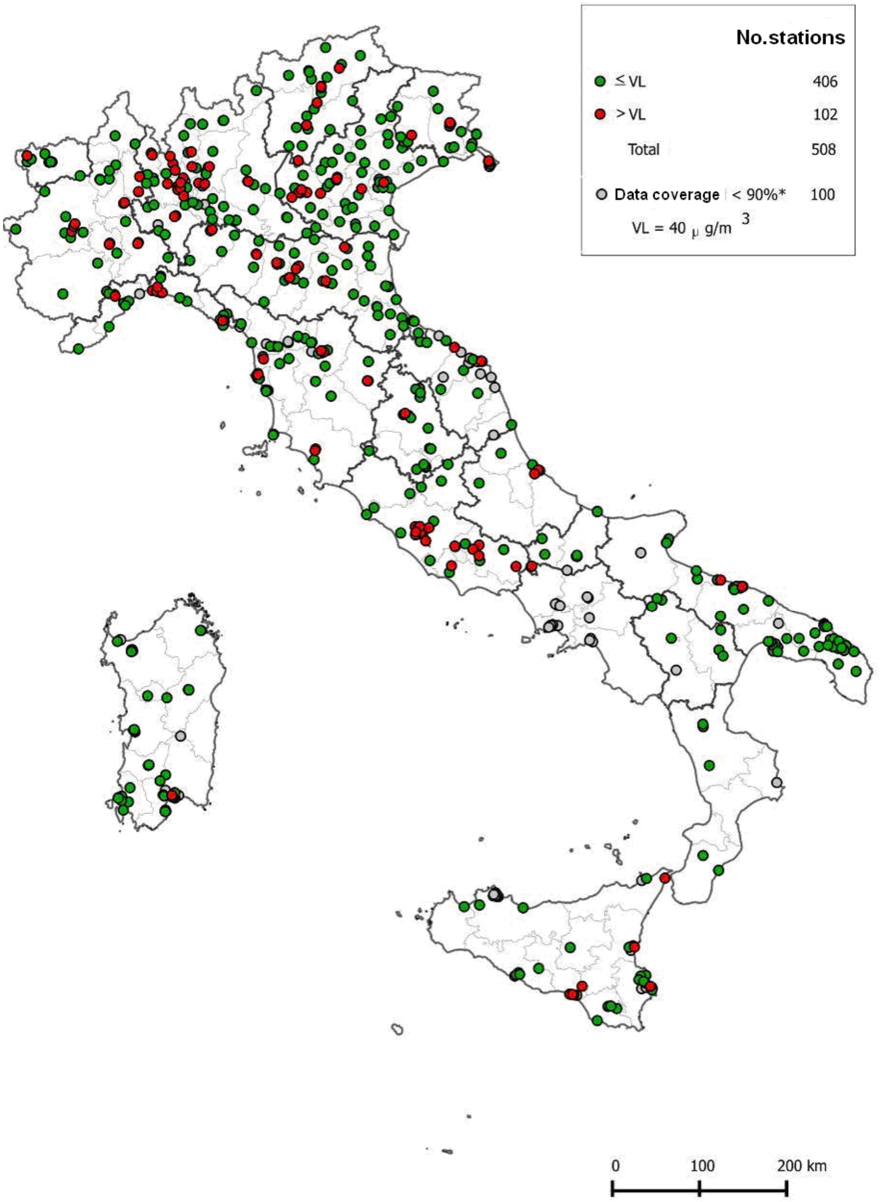


Figure 3.11: NO_2, trend estimate for the 2006-2011 period[39]

Italy, B(a)P, 2011: 20% of stations exceed the target value.

Polycyclic aromatic hydrocarbons (PAHs) are a family of pollutants that deserves renewed attention, besides its established toxicity and carcinogenicity, also because of the still poor knowledge of the atmospheric concentrations and emission framework that is emerging recently.

Regulations currently provide for a B(a)P target value of 1.0 ng/m3 to be achieved by 31st December 2012. In 2011, 69 stations, mainly located in Northern Italy, monitored B(a)P: 14 stations recorded exceedances of the target value.

[39] Source: ISPRA

Regional characteristics

ARTA Abruzzo

The air quality in the city of Pescara is measured by 6 base stations that have been in operation since 1998. The measuring stations are owned by the Municipality of Pescara, which provides for the routine and extraordinary maintenance of the equipment; they are managed by ARTA by agreement. The Chemical Laboratory of the ARTA District of Pescara periodically performs further analytical determinations of samples taken at the control units of the network.

ARPA Emilia-Romagna

The Supersito project, funded and implemented by the Emilia-Romagna Region and Emilia-Romagna ARPA in collaboration with the CNR ISAC and other national and international institutions, aims to increase general knowledge about the environmental and health effects of fine and ultrafine particulate matter present in the atmosphere and in indoor environments. Particulate matter sampling is carried out over a period of three years in four monitoring stations situated in the Emilia-Romagna region (BO, San Pietro Capofiume, PR, RN). The data are then integrated with those recorded by the CNR ISAC station located on Mount Cimone. The objective is to characterize five scenarios that represent the different aspects of the region: meteo-climatology, emission density, related population basins. The following are the main measuring tasks provided by the project: analyses of the chemical composition of particulate matter; study of the number of particles present in the air, divided by diameter, with sub-micrometer dimensions; toxicological investigations to define the types of powder containing substances, elements, compounds or mixtures of compounds that can affect health; meteorological variables analyses.
The consequent developments will have the following objectives: to improve modelling for predictions and air quality scenarios; to identify sources of pollution by using "receptor models" and multivariate statistical techniques; to perform short and long-term epidemiological investigations; to analyse health risks on the basis of chemical and toxicological data observed and by comparing with epidemiological analyses; to support the actions of governance.
Further information can be found at the site: www.supersito-er.it

ARPA Friuli-Venezia Giulia

In 2012, Friuli Venezia Giulia witnessed the confirmation of two emerging signals regarding air quality. The first was positive and referred to the downward trend in annual average concentrations of NO_2 in traffic type stations. The second was negative and referred to the rising trend in exceedances of the target value for O_3. In the first case, although the reduction of transportation due to the economic crisis has been a burden, the signal range is certainly sought in improving the vehicle fleet in circulation. However, in the second case the reason can be found both in the slight decrease of background values of pollution from dust and nitrogen oxides and the increasing trend of sunny days, and thus the contribution of the solar radiation. However, the reduction in dust concentrations continues to show a trend that modulates according to annual meteorological variability, which encourages atmospheric dispersion in 2012.

Currently, in the Lazio region there is a monitoring system in operation consisting of a fixed monitoring network and two modelling chains that can constantly ensure the reconstruction of air quality in near real-time and, for the city of Rome, for the Frosinone municipality area and the central and northern Tyrrhenian coast, a 5-day air quality forecast that lets the authorities put plans in place well in advance to reduce emissions to cope with the potentially critical environmental conditions forecast for the immediate future. To improve all this, by introducing new measures to the monitoring system in order to strengthen realism, a new component has been added to the monitoring system. In fact, the regulations require that in the assessment process indicative measurements may also intervene, namely: *"measurements of pollutant levels, based on quality objectives that are less stringent than for measurements at fixed sites, carried out in stations located at fixed sampling sites or in mobile measuring stations..."* (Leg. Decree No. 155/2010 Art.2, letter *u*). These measurements that are almost always made with the help of mobile equipment, in some way integrate all measurements of the fixed monitoring network without increasing the economic costs and operational efforts. In Lazio, it was therefore chosen to use this tool to improve and complete the assessment of air quality. A monitoring program was launched in 2013 that provides for a system to take approximate measurements in a further 10 points of the territory for a period equal to 8 weeks evenly distributed throughout the year. This will be repeated in subsequent years. These measurements then allow us to determine a statistical model of the site (that the regulations indicate as an objective assessment method) for each measurement point; therefore in these ten new sites, there is a virtual monitoring station that, during the period in which the mobile equipment operates locally, provides the real measurements, while in periods in which the mobile equipment operates elsewhere it provides an estimate of which the inherent uncertainty is known. Therefore, ARPA Lazio, as it has an additional set of reliable measurements/estimates available in places where there are no fixed monitoring stations but that are seen to be potentially critical to correctly assess air quality, will be able to improve its performance in assimilating with the modelling system. The Agency will also commence exploratory work aimed at using the statistical methodology developed for managing periodic measurements made with mobile equipment in implementing air quality forecasts in the region.	**ARPA Lazio**
In 2012, Friuli Venezia Giulia witnessed the confirmation of two emerging signals regarding air quality. The first was positive and referred to the downward trend in annual average concentrations of NO_2 in traffic type stations. The second was negative and referred to the rising trend in exceedances of the target value for O_3. In the first case, although the reduction of transportation due to the economic crisis has been a burden, the signal range is certainly sought in improving the vehicle fleet in circulation. However, in the second case the reason can be found both in the slight decrease of the	**ARPA Friuli-Venezia Giulia**

background values of pollution from dust and nitrogen oxides and the increasing trend of sunny days, therefore the contribution of the solar radiation. However, the reduction in dust concentrations continues to show a trend that modulates according to annual meteorological variability, which encourages atmospheric dispersion in 2012.

ARPA Marche

The air quality in the Marche region has until now been monitored by measuring stations owned by the provincial government. With the entry into force of Leg. Decree No. 155/2010, transposing European Directive 2008/50/EC on ambient air quality and cleaner air for Europe, it was established that the network of measuring stations is subject to the public management and control of ensured by the regions and/or by delegation to ARPAM. Since 2010 in the Marche Region the technical and administrative phases have been operational to review and restructure the network of air quality monitoring in accordance with the new directives of Leg. Decree 152/2010. The Regional Council has deemed it appropriate, with the agreement of the General Director of ARPAM, to entrust the management of the monitoring network to ARPAM, in the previous management ARPAM was only responsible for the validation of data. For ARPA Marche therefore a new field of activity opens up involving the complete reorganization and management of networks for measuring air quality, also based on the new classification of the regional territory.

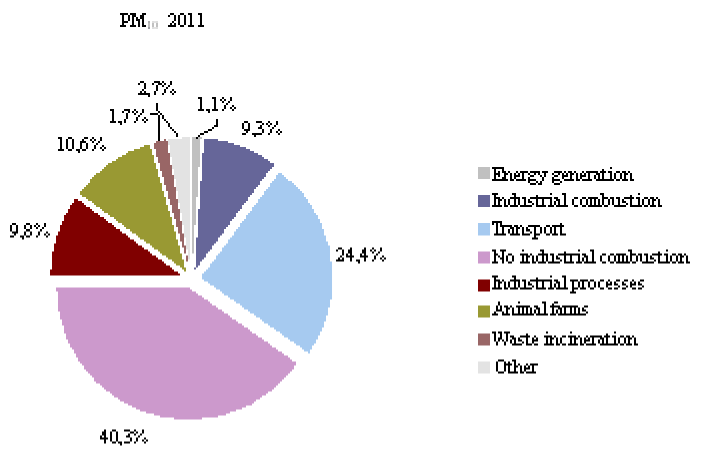
The main causes of air pollution

To understand the phenomenon of air pollution, it is essential to know the emission load that is its first cause. This means knowing the emissions of pollutants and their precursors[40] coming from different production sectors and the trend in emissions over time.

Europe, 2011, the main emission sector for PM_{10} and $PM_{2.5}$ is household heating; for NO_x it is the transport sector; for NMVOC it is the use of solvents.

In Europe[41], in 2011 for PM_{10} and $PM_{2.5}$ the main emission sector is household heating (34% and 44% respectively) followed by road transport (14% and 17% respectively). For NO_x the main emission source is transport, in particular road transport, which accounts for 40% of emissions, followed by electricity generation (18%), industrial combustion (9%) and the civil sector (9%). For NMVOC the majority comes from the use of solvents (43%); the transport sector, particularly road transport, accounts for 14% and the civil sector for 12%.
In Italy, the information presented in the Italian Emission Inventory developed by ISPRA[42] shows that in 2011, for $PM_{10,}$ limited to the primary component of the pollutant, the transport sector is the second greatest source of pollution, after the civil sector (40%), with a contribution of 24% to the total, of which more 2/3 comes from road transport, followed by industry and industrial processes (19% overall), and animal farms (11%) (Figure 3.12). In particular, about 90% of PM_{10} emissions from household heating comes from the burning of biomasses.

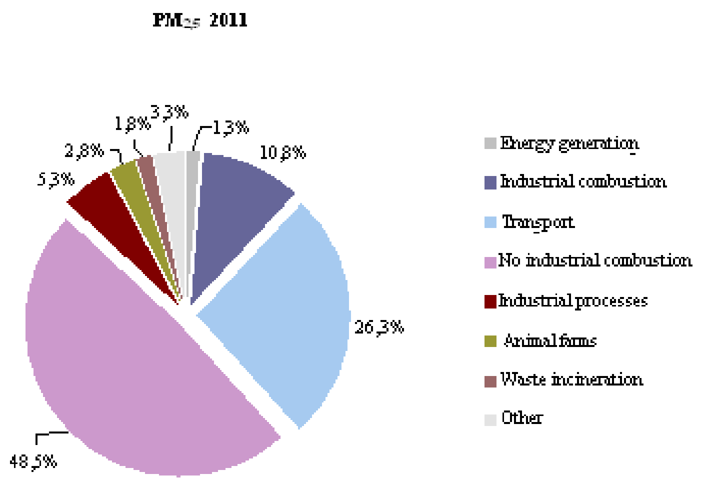
[40] Precursors are those substances that, through photochemical reactions occurring in the atmosphere, lead to the formation of other pollutants
[41] *European Union emission inventory report 1990–2011under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP),* EEA Technical report no. XX/2013
[42] http://www.sinanet.isprambiente.it/it/sia-ispra/serie-storiche-emissioni



Italy, 2011, emissions of primary PM_{10} : 40% comes from the civil sector, 24% from the transport sector, 19% from industry, 11% from animal farms.

Figure 3.12: PM_{10} (primary): Emissions by sector (2011)[43]

Transportation is also the second largest source of emissions for $PM_{2.5}$ (limited to the primary component) in 2011 (Figure 3.13) with a contribution of 26% (more than 2/3 coming from road transport) after the civil sector (48%), followed by industry (11%) and industrial processes (5%).



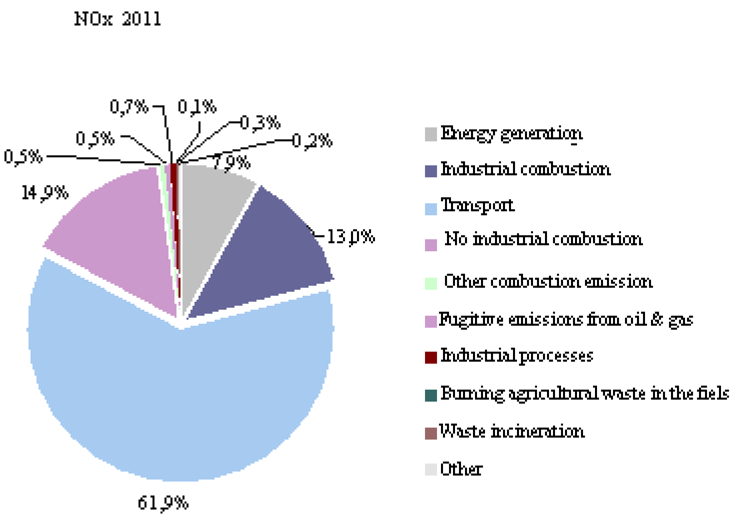
Italy, 2011, emissions of primary $PM_{2,5}$: 48% from the civil sector, 26% from the transport sector, 16% from industry.

Figure 3.13: $PM_{2.5}$ (primary): Emissions by sector (2011)[44]

Regarding nitrogen oxides (NO_x), in 2011, the main emission source is the transport sector (62%), of which road transport constitutes about 3/4; the civil sector contributes 15%, industry 13% and energy generation 8% (Figure 3.14).

[43] Source: ISPRA

[44] Source: Ibidem



Italy, 2011, the main source of NOx emissions is the transport sector.

Figure 3.14: NOx: Emissions by sector (2011)[45]

For Non-Methane Volatile Organic Compounds (NMVOC), the transport sector contributes 34% while 41% comes from the use of solvents and the rest from the civil sector (12%), the industrial sector (11%) and other minor sectors.

94% of ammonia emissions (NH_3) come from agriculture, and in particular from cattle farms (49%) and the use of fertilizers (14%).

Sulphur oxides (SO_x) emissions mainly come from refineries (29%), industrial combustion (19%), energy generation (15%) and shipping (14%).

Italy, 2011, PAH emissions: 46% come from industry and 35% from biomass combustion for domestic heating.

As regards Polycyclic Aromatic Hydrocarbons (PAHs) benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene) for 2011, 46% of the emissions come from combustion processes in the steel industry, and 35% from biomass combustion for heating.

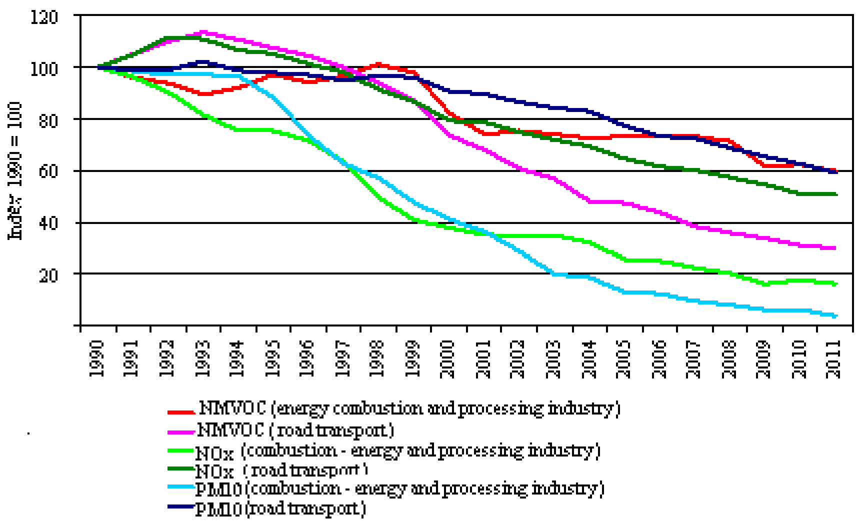
From 1990 to 2011, in the EU27 countries, emissions of NO_x, NMVOC, SO_x, PM_{10} and $PM_{2.5}$ have decreased.

Italy, 2011, PM_{10}, NO_x and NMVOC: are downtrend in emissions continues.

The emissions trend in Europe from 1990 to 2011 was characterized by strong reductions: in the EU27 countries, NO_x emissions decreased by 48%, NMVOC by 59%, SO_x by 82%. From 2000 to 2011, PM_{10} and $PM_{2.5}$ emissions decreased by 19% and 22% respectively. As regards the Italian emissions trend, substantial reductions were recorded in emissions of PM_{10}, NO_X and NMVOC, especially since the mid-90's[46]. As shown in Figure 3.15, for the pollutants PM_{10} and NO_x, the greatest contribution to reducing emissions comes from the energy sector; for NMVOC and to a lesser extent for NO_x, it is road transport that contributes most to the reduction of emissions.

[45] Source: ISPRA

[46] ISPRA, Italian Emissions Inventory, 1990-2011, 2013



The reduction of emissions for NMVOC is mainly to be attributed to transport sector.

Figure 3.15: Italy NMVOC, NOx and PM_{10} emissions by sectors: energy and transport[47]

Exposure of the population

Air pollution is one of the major factors of risk to human health.

Air pollution is one of the major environmental risk factors for human health; its significance to health depends on the combination of the toxicity and distribution of high atmospheric concentrations of many of his constituents. The problem particularly concerns large urban areas where human settlement is greatest: the high density of population and thus activity causes high emissions, high concentrations of pollutants into the ambient air and as a result, the exposure of the population and the health impact become significant[48].

The average exposure to major pollutants of the urban population of major European cities has been estimated (Figure 3.16) based on the levels of pollutants measured in the urban background monitoring stations.

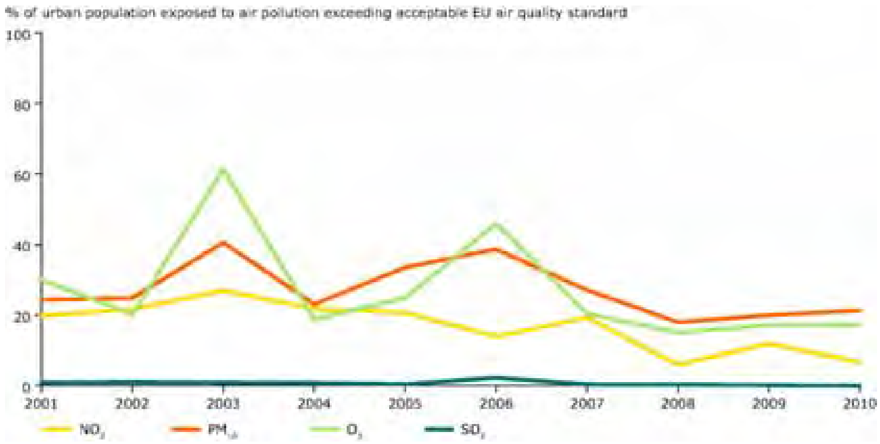


Figure 3.16: Percentage of EU urban population exposed to air pollutants exceeding acceptable EU air quality Directive 2008/50/EC standards[49]

[47] Source: ISPRA

[48] For information on health impact see "Key topics, ISPRA, 2012 Edition – Chapter: Air Quality"

[49] EEA Report, No. 4/2012, *Air quality in Europe –2012 Report*

In 2010 about 21% of the urban population in the EU is exposed to PM_{10} above the limit value (40 µg/m^3). The extent of exposure above the limit value has varied between 18 and 41% since 2001 and there is no apparent trend over this period. Considering the reference level of the WHO, equal to 20 µg/m^3 as an annual average, the estimate of the exposure of Europe's urban population in 2010 rises to 81%.

PM_{10}, 2010 Europe: 21% of the urban population is exposed to levels above the annual limit value.

As regards ozone, in 2010, about 17% of the EU population in urban areas is exposed to levels above the target value (120 µg/m^3), ranging from 15% to 61% since 2001. The exposure estimate rises to 97% in 2010 when considering the WHO reference value, equal to 100 µg/m^3. It is important to stress that the exposure of the population in rural areas is higher than in urban areas, due to the proximity to the traffic source, ozone is consumed by NO emitted precisely from the traffic source that is oxidized to NO_2.

Ozone, 2010 Europe: 17% of the urban population is exposed to levels above the target value.

The estimate of the exposure of Europe's urban population at levels above the annual limit value for NO_2 (40 µg/m^3) in 2010 amounted to 7%. This exposure ranged from 6 to 27% in the period 2001-2010 with a slightly negative trend. The NO_2 exposure estimate is certainly an underestimate of actual exposure of the urban population, as the proportion of the population that lives and moves in close proximity to areas of heavy traffic is exposed to higher levels of NO_2 (the concentration gradient between background stations and traffic stations in urban areas is high).

NO_2, 2010 Europe: 7% of the urban population is exposed to levels above the annual limit value.

The exposure of the urban population to levels above those set for metals is a local problem, which affects few industrial areas in Europe; the same is true for benzene.

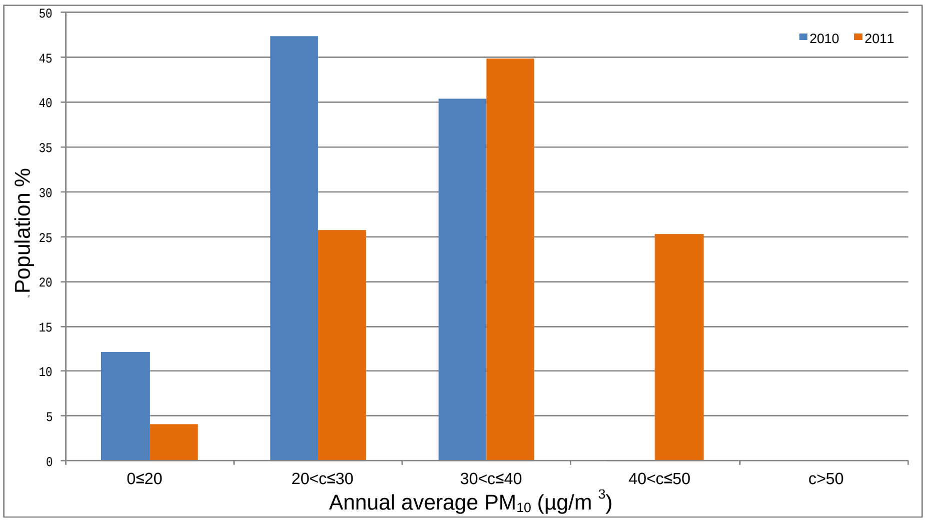
Exposure to benzo(a)pyrene is rather considerable and extensive, particularly in Central and Eastern Europe. Between 2008-2010, 20-29% of the urban population has been exposed to levels above the target value (1.0 ng/m^3); compared to the WHO reference value, equal to 0.12 ng/m^3, the exposure of the population rises to 94%.

B(a)P, 2010 Europe (Central and Eastern Europe): the exposure of the urban population is quite significant and extensive.

The average exposure of the urban population in Italy was estimated by ISPRA, based on the concentrations of the pollutants measured in the urban background monitoring stations distributed throughout the country. The study focused on PM_{10}, $PM_{2.5}$ and ozone[50]

In 2011, annual PM_{10} averages recorded in urban background stations used to estimate the exposure of the urban population vary between 14 µg/m^3 in Livorno and 47 µg/m^3 in Milan and Monza. The percentage of the urban population exposed to levels above the annual limit value for PM_{10} (40 µg/m^3) is equal to 25% (in 2010, exposure to levels above the annual limit value was zero). Taking the WHO reference level of 20 µg/m^3 as the annual average, the population exposed to levels above this threshold rises from 88% in 2010 to 96% in 2011 (Figure 3.17).

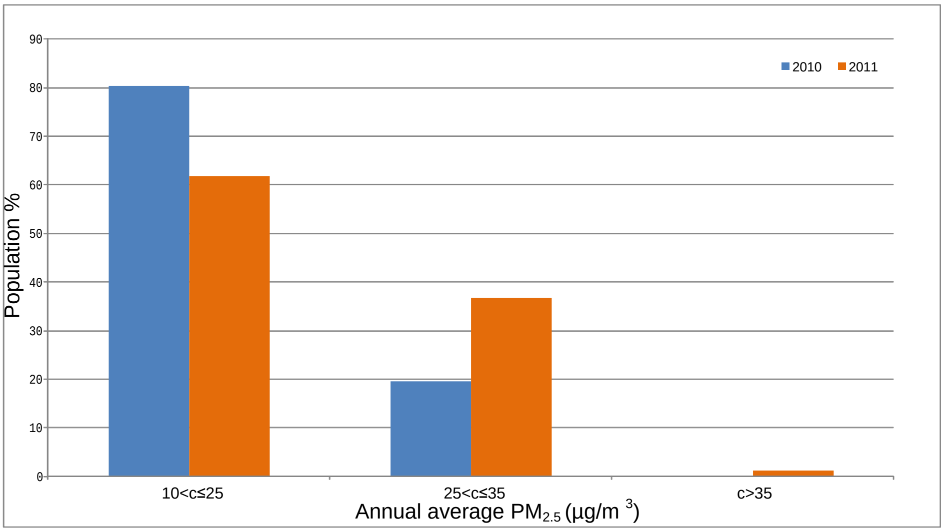
[50] For details see Environmental Data Yearbook, ISPRA, 2012 Edition – Chapter “Environment and health”



PM_{10}, 2011 Italy: 25% of the urban population is exposed to levels above the annual limit value.

Figure 3.17: Percentage of urban Italian population exposed to PM_{10} by concentration ranges[51]

A similar trend is observed for $PM_{2.5}$. In 2011, the annual average $PM_{2.5}$ urban background concentrations used to estimate the exposure of the urban population vary between 12 µg/m^3 in Macerata and Grosseto and 39 µg/m^3 in Monza.
The percentage of the population exposed to levels exceeding 25µg/m^3 (target value in force since 2010) varies from 20% in 2010 to 38% in 2011. If we take the WHO reference value of 10µg/m^3, the entire urban population surveyed is exposed to higher levels (Figure 3.18).



$PM_{2.5}$, 2011 Italy: 38% of the urban population is exposed to levels above the target value.

Figure 3.18: Percentage of urban Italian population exposed to $PM_{2.5}$ by concentration ranges[52]

[51] Source: ISPRA and ISTAT data processed by ISPRA
[52] Source: Ibidem

To assess population exposure to ozone, the SOMO35 (*Sum of Ozone Means Over 35)* indicator has been used in the ISPRA study as an index of cumulative exposure[53]. Based on the SOMO35 values calculated for the surveyed cities, it appears that the percentage of population exposed to levels exceeding 6,000 µg/m^3/day from 2010 to 2011 varied from approximately 42% to 55% (Figure 3.19).

Ozone, 2011 Italy: 55% of the urban population is exposed to higher levels of SOMO35, equal to 6.000µg/m^3/ day.

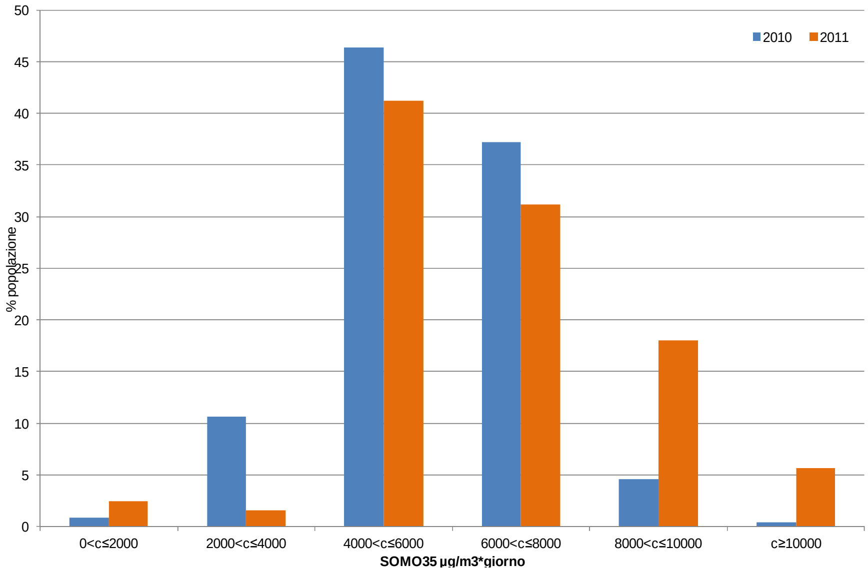


Figure 3.19: Percentage of urban population exposed to ranges of SOMO35 levels[54]

Measure to improve air quality

The relevant regulations provide for the implementation of actions necessary to reduce the exceedances of the regulated atmospheric pollutants limits.

As provided by Leg. Decree 155/2010 and its corrective Leg. Decree 250/2012 as well as previous legislation (Leg. Decree 351/1999), the Regions and Provincies Autonomous, given that they are responsible for assessing and managing air quality, are required to prepare an air quality plan in cases where exceedances of the established limits are recorded, even for only one of the regulated air pollutants, such as sulphur dioxide, nitrogen dioxide, benzene, carbon monoxide, lead and particulate matter, ozone. These plans must include "additional" measures to those that are already in place at national and/or regional level, they can ensure compliance with the limits set within the time established. The identification of these measures is based on a series of information and assessments such as characterization of the territory, identification of specific sources of emissions (emissions inventory and related projections), assessment of air quality and finally, development of emissions and air quality scenarios as a result of applying these measures. The Regions and Provincies Autonomous shall provide an annual summary of the information relating to these plans to the Ministry of Environment (MATTM) and ISPRA, within eighteen months of the end of the year during which exceedances of the limit value (LV) or target value (TV) were recorded, through the

[53] SOMO35 is a cumulative exposure index calculated as the sum of exceedances, from the threshold of 35 ppb, of the average daily maximum of eight hours calculated for the whole year. 35 ppb represents a minimum risk threshold above which there is a statistical increase in the associated mortality risk

[54] Source: ISPRA and ISTAT data processed by ISPRA

format established by Decision 2004/224/EC (Plans and Programs Questionnaire). The Ministry of the Environment then transmits this information to the European Commission within two years of the end of each year in which the exceedance has been recorded.

In 2010, the Autonomous Provinces of Trento and Bolzano and 15 Regions exceeded at least one of the limit values for air pollutants regulated by Leg. Decree No. 155/2010. To date[55], only 3 of these Regions have not complied with the transmission requirement for the year 2010 (Figure 3.20).

82% of the Regions/Provinces Aautonomous have complied with the requirement of transmission of recovery plans for the year 2010.

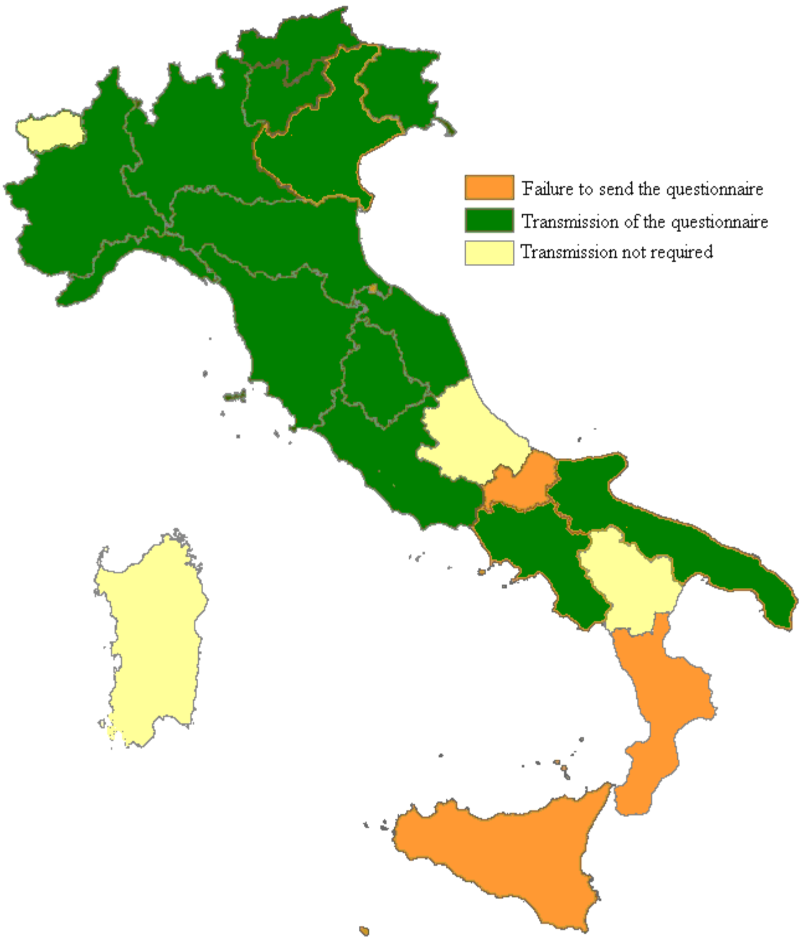


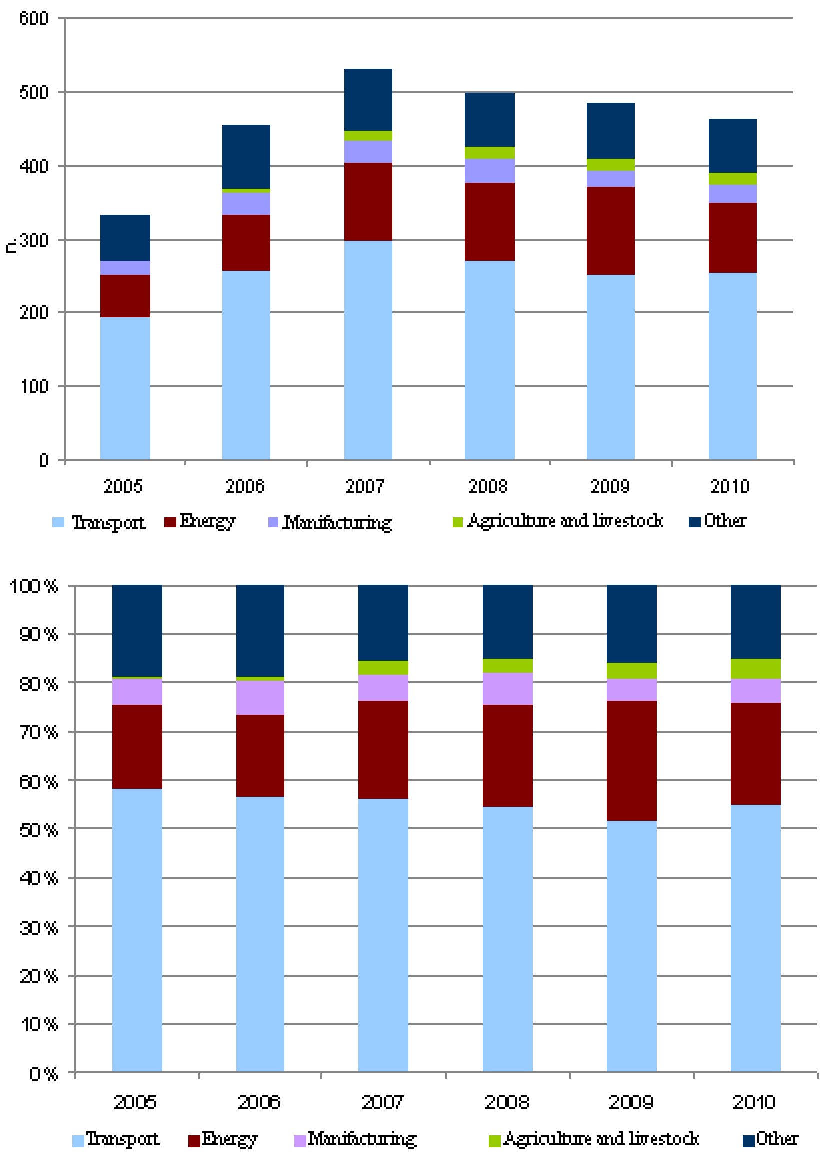
Figure 3.20: Transmission of informations on air quality plans (2010)[56]

Figure 3.21 shows the trend (2005-2010) of the different types of source sector affected by the measure: Transport, Energy, Production, Agriculture and livestock, and "Other." The "Other" category includes: action plans and updating of air quality plans, public information and communication measures, research projects and studies. From the analyses of the time series information received, even though most of the measures taken concern the "transport", over time an increase was recorded of those that fall into the "agriculture and livestock" and the "energy" categories.

Increase in measures adopted in the "agriculture and livestock" and in the energy sector.

[55] Data updated on 20th February 2013

[56] Source: ISPRA



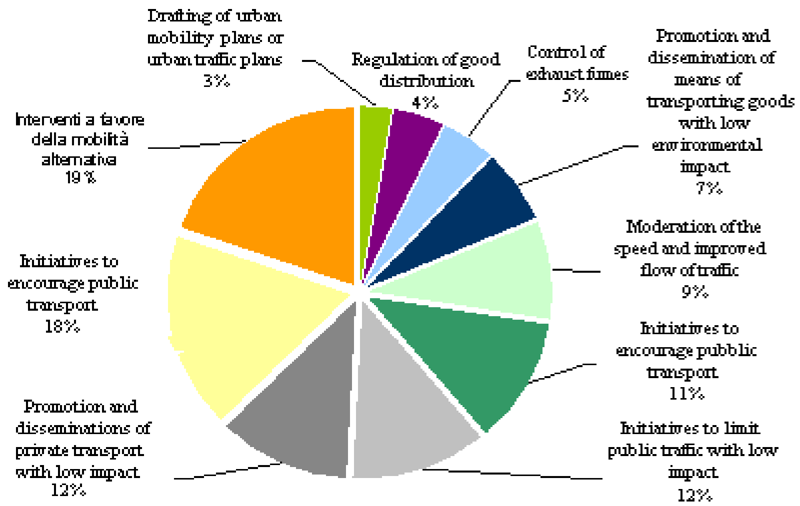
The measures concerning "agriculture and livestock " and "energy" increase even though the majority continue to affect the transport sector.

Figure 3.21: Measures adopted concerning Air Quality Plans by sector[57]

In 2010, the total number of measures taken is equal to 462, 55% of which relate to the Transport sector and 21% to the Energy sector. From Figure 3.22, which shows the measures related to the Transport sector in detail, it is clear that the most widely adopted measures in this area are those that encourage alternatives to the use of private transport, those that encourage the use of public transport and promote public transport with low environmental impact.

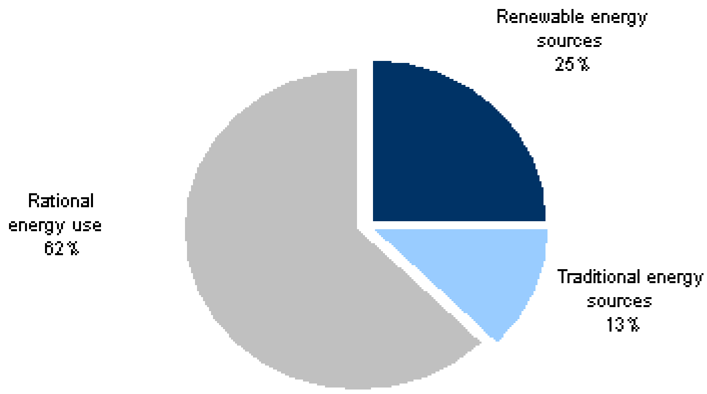
From Figure 3.23, which shows in detail the types of measures that fall within the Energy sector, we can deduce that the most frequently used measures are those that encourage rational energy use (62%), and those that encourage the use of renewable energy sources (25%).

[57] Source: ISPRA



The most adopted measures in the transport sector are those that encourage alternatives to the use of private transport, those that encourage the use of public transport and promote public transport with low environmental impact.

Figure 3.22: Measures adopted for the Transport sector by type of initiative (2010)[58]



The most frequently adopted measures in the energy sector are those that encourage rational energy use and encourage the use of renewable energy sources.

Figure 3.23: Measures adopted for the Energy sector by type of initiative (2010)[59]

In order to further characterize the recovery measures, other transmitted information was analysed[60], such as:

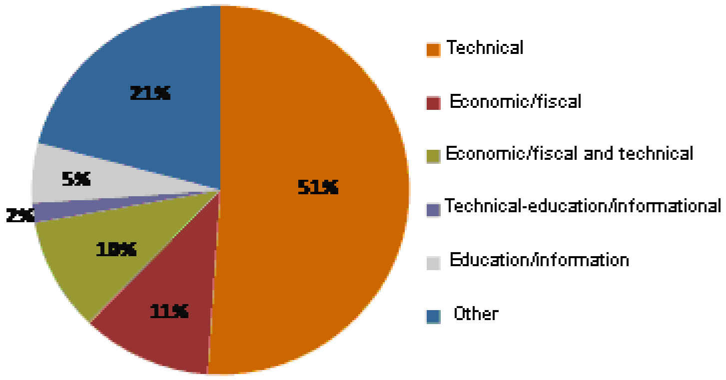
- the type of measure (technical, economic/fiscal or education/information) (Figure 3.24);
- the administrative level at which the measure is implemented (local, regional or national) (Figure 3.25);
- the time scale for reducing concentrations after applying the measure (short-term, medium-term or long-term) (Figure 3.26).

51% of remediation measures are technical, 39% are taken at both local and regional level, and 34% have an effect in the medium to long term.

From the above analysis, the measures reported for the year 2010 are:

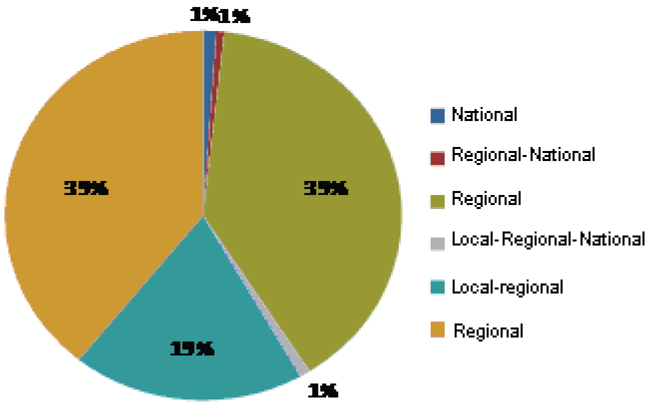
- 51% technical ;
- 39% adopted at local level and 39% at regional level;
- 34% in the medium to long term.

58 Source: ISPRA
59 Source: Ibidem
60 Source: Ibidem



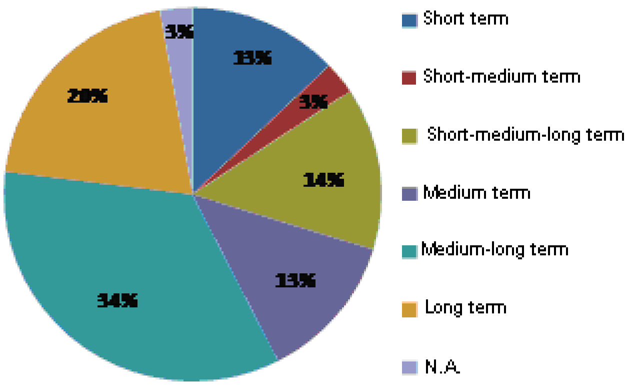
51% of the remediation measures are technical.

Figure 3.24: Actions taken by type of measure (2010)[61]



39% of remediation measures are adopted at both local and regional level.

Figure 3.25: Measures adopted by administrative level (2010)[62]



34% of the consolidation measures taken have an effect in the medium to long term.

Figure 3.26: Measures adopted by efficacy time scale (2010)[63]

Regional characteristics

ARPA Emilia-Romagna

The Emilia-Romagna Region, with D.G.R. (Regional Government Decree) No. 2069 of 28th December 2012, approved the guidelines for the preparation of a new integrated regional Plan for air quality, in accordance with articles 9, 10, 12, 13 and 14 of Leg. Decree no. 155/2010. The Plan, which will be approved in 2014, will cover a period up to 2020. The primary objective of the Plan is to bring the entire region back within the air quality limit values established by Leg. Decree 155/2010, thus reducing the impact of air pollution on the health

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[61] Source: ISPRA
[62] Source: Ibidem
[63] Source: Ibidem

of citizens and the environment. The Plan is to use modelling tools of Arpa Emilia-Romagna to assess the impact that different constructed trend emission scenarios have on air quality, based on the expected evolution of the socio-economic fabric, implementation of national and European regulations and what has already been hypothesized in the scenarios of the regional sectoral plans on energy, transport and rural development. On the basis of the Arpa integrated assessment tools, the reduction targets will be estimated for emissions of primary pollutants and precursors of pollution from PM_{10} and NO_2 required for compliance with the limit values. The regional plan will then identify the set of measures for the improvement of air quality, through a multi-sectoral and integrated approach to planning, balancing the air quality objectives at local, regional and Po basin level with those to reduce greenhouse gases, on a global scale. The priority areas for intervention will be the transport, energy, household heating, agriculture and production, with particular attention paid to the sustainable management of cities and places where the majority of the population exposed to air pollution resides.

ARPA Umbria

ARPA Umbria has worked on the assessments made in the SEA of the Regional Plan for air quality by analysing the data from the regional monitoring network for the years 2005 to 2010; the work has allowed the analyses to be updated for the main pollutants monitored such as sulphur dioxide, nitrogen dioxide, particulate matter, carbon monoxide, benzene, benzo(a)pyrene, heavy metals and ozone.

This analysis indicates the main problems posed by concentrations of particulate matter, particularly in the areas of Foligno, Perugia and Terni, where elevated concentrations of benzo(a)pyrene were also observed. Sufficiently high ozone values were recorded throughout the region, particularly in Perugia, Terni, Orvieto and Torgiano. Nitrogen dioxide concentrations are also to be kept under observation in urban areas of Perugia and Terni.

The predominant emission sources, that is those that have a greater influence on overall emissions levels of each pollutant, have been identified as:

- household heating, in particular <u>wood burning,</u> a sector that is a major contributor to airborne particulate matter emissions with a diameter less than 2.5 microns and 10 microns, and polycyclic aromatic hydrocarbons and contributes to volatile organic compound emissions, although to a lesser extent;
- the largest portion of nitrogen oxide emissions comes from <u>road transport,</u> which also plays a considerable role in the emission of airborne particles;
- nitrogen oxides and particulate matter also come from <u>cement and concrete production.</u>

The Regional Plan for air quality should therefore aim to adopt measures primarily aimed at reducing emissions of the pollutants mentioned and their precursors in the most critical areas to bring concentration within the values that the standards impose, and secondly to ensure the general improvement of air quality across the entire region.

GLOSSARY

Benzo(a)pyrene:
Benzo(a)pyrene is a Polycyclic Aromatic Hydrocarbon (PAH). Like other PAHs, benzo(a)pyrene is produced through combustion processes: the main sources are the steel industry and the use of biomasses in household heating; road transport and the waste combustion are also contributing factors. It is present in the atmospheric aerosol in very small concentrations. It is one of the primary substances that has been found to cause cancer in humans and is used as a marker for the carcinogenic risk of classes of PAHs; besides being carcinogenic it is also genotoxic.

Nitrogen dioxide:
Nitrogen dioxide (NO_2) is a gaseous pollutant with prevailing secondary component, as it is the product of the oxidation of nitrogen monoxide (NO) in the atmosphere; only a minor proportion is emitted directly into the atmosphere. It is a widely circulated pollutant that has negative effects on human health and, together with the nitrogen monoxide contributes to photochemical smog (it is a precursor to the formation of secondary pollutants such as tropospheric ozone and secondary fine particulate matter), eutrophication and acid rain. The main source of emissions of nitrogen oxides ($NO_x = NO + NO_2$) is road transport.

Exchange of Information (**EoI**):
This term refers to the mutual Exchange of Information and data from networks and stations for monitoring air pollution in Member States according to regulations (Decision 97/101/EC, Decision 2001/752/EC and Directive 2008/50/EC). The existing regulations establish that the information flow consists of metadata and hourly and daily data about the concentrations in the air of the main pollutants.

Ozone:
Tropospheric ozone (O_3) is a secondary pollutant formed through photochemical processes in the presence of primary pollutants such as nitrogen oxides and volatile organic compounds. It is the main representative of the complex mixture of substances called "photochemical smog". Photochemical smog, as well as being local, is a transboundary phenomenon that spreads out over large spatial scales. The highest ozone concentrations are found in the warmer months of the year and during the hours of peak solar radiation. In urban areas, ozone forms and is transformed very quickly, with behaviour that is highly complex and different from that of the other pollutants. The main sources of emissions of ozone precursor compounds are: road transport, household heating and energy generation. Ozone can cause serious problems to human health and the ecosystem, as well as to agriculture and material goods.

Atmospheric particulate matter:

The term particulate matter (PM) refers to the set of solid and liquid particles suspended in atmospheric air. PM_{10} identifies particles with an aerodynamic diameter less than or equal to 10µm; $PM_{2.5}$ indicates the so-called fine particulate matter with an aerodynamic diameter less than or equal to 2.5µm. The particulate has a particularly complex and variable chemical nature and the smaller its size the more deeply it can penetrate the human respiratory tract, and thus have negative effects on health. The PM in the atmosphere results from direct emissions (primary PM) and from emissions of particulate precursors (nitrogen oxides, sulphur dioxide, ammonia and organic compounds) which are partly transformed into particles by chemical reactions in the atmosphere (secondary PM). The PM can have either a natural origin (wind erosion on rocks, volcanic eruptions, burning of woods and forests) or an anthropogenic one (combustion and more). There are also plenty of gaseous substances of an anthropogenic origin that contribute to the formation of PM, such as sulphur and nitrogen oxides, volatile organic compounds and ammonia.

CHAPTER 4

INLAND WATERS QUALITY

Introduction

European Directive 2000/60 (Water Framework Directive, WFD), implemented at national level by Leg. Decree No. 152/06, and the technical standards deriving therefrom, defines the quality status of water bodies for surface water, through the study of the biological elements supported by hydromorphological, chemical and physico-chemical data.

According to existing legislation, there are three different types of monitoring: surveillance, operational and investigative, defined according to "risk" status, based on the assessment of a water body's capacity to reach the environmental quality targets established for 2015, namely achieving/maintaining "good" environmental status or maintaining "high" status where it is already in place.

For groundwater, Directive 2006/118/EC (Groundwater Directive), implemented by Leg. Decree No. 30/2009, has set the criteria for the identification and characterization of groundwater bodies, establishing standards and criteria for assessing the chemical status of groundwater, to identify and reverse the significant trends and sustained increase in pollution.

The reference directive for assessing water resources is Directive 2007/60/EC (Floods Directive), implemented by Leg. Decree No. 49/2010, which aims to reduce the destructive effects of floods by assessing and managing the risks associated with these events, adhering to deadlines set by that directive: a preliminary assessment of the flood risk by 2011; mapping of hazards and risk from flooding by 2013; drafting of management plans for flood risk for river basin districts by 2015.

Within the framework of European Community actions to protect water quality and quantity, Directive 91/676/EEC (Nitrates Directive) aims to protect waters from pollution caused by nitrates from agricultural sources.

This Directive, implemented in Italy by Leg.Decree No. 152/99 and then by Leg. Decree No. 152/2006, encourages the implementation of a series of measures such as the monitoring of waters (nitrate concentration levels and trophic state), identification of polluted waters or those at risk of pollution, designation of vulnerable zones (areas that drain into polluted waters or those at risk of pollution if action is not taken), development of codes of good agricultural practice and action programs aimed at preventing and reducing pollution from nitrates.

The status of inland water quality

The ecological status of a body of surface water is classified according to the lowest class resulting from the monitoring data concerning the biological, physico-chemical elements and the supporting chemical elements (other substances that do not belong to the priority list).

The ecological status of the surface water body is classified according to its biological elements, supporting physico-chemical elements and supporting chemical elements.

If the overall status is "high", it is necessary to provide confirmation by investigating the hydromorphological elements. If such confirmation is negative, the water body is downgraded to a "good" status.

For the classification of the chemical status, the body of water that meets all environmental quality standards of substances on the priority list, (point 2 A.2.6 Table 1/A, or 2/A of the Annex to Ministerial Decree 260/2010) is identified as having a "good chemical status" and in negative cases, it is classified as a water body that is not recognised as having a good chemical status.

Core Network.

In order to evaluate long-term variations due to both natural phenomena and to widespread human activity, the legislation involves selecting a set of fixed points called the Core Network: in the first case, water bodies identified as reference water bodies must be included, or otherwise water bodies with sites that are representative of such activities, in order to determine or confirm the impact.

The quality data for 2011, requested from the regions, refer to the Core Network, which, as it is by definition a fixed network, allows us to evaluate the temporal trends of the quality judgements.

The monitoring concerning the Core Network provides assessments of long-term variations due to both natural phenomena and to widespread human activity; currently the selection of water bodies that are representative of widespread anthropogenic pollution is not yet complete in all regions, while the selection of reference water bodies is complete at regional level, which by their very definition are high (or good) quality water bodies; this, at least for the first few years, will lead to a sort of "overvaluation" of the qualitative data.

For rivers and lakes, with regard to monitoring activities carried out during 2011, it is shown the data used for processing and submitted in due time by the regions, referring to the Core Network or where not yet defined, to the stations considered significant (Tables 4.1 - 4.2).

Table 4.1: Monitoring stations – rivers (2011)[1]

Autonomous Region/Province	Stations			
	Macrobenthos	Diatoms	Macrophytes	LIMeco
	No.			
Piedmont	11	11	0	11
Aosta Valley	12	11	8	12
Lombardy	32	23	4	38
Trentino-Alto Adige	11	11	0	26
Trent	*5*	*5*	*0*	*16*
Bolzano	*6*	*6*	*0*	*10*
Veneto	2	2	1	34
Friuli-Venezia Giulia	22	22	15	22
Liguria	10	10	8	10
Emilia-Romagna	9	9	7	9
Tuscany	6	7	0	6
Marche	14	9	9	16
Lazio	6	5	2	10
Abruzzo	11	11	9	1
Molise	0	0	0	7
Campania	2	0	0	28
Apulia	11	10	13	13
TOTAL	**159**	**141**	**76**	**243**

In 2011, there was an increase in the regions that sent data, 15 out of 20.

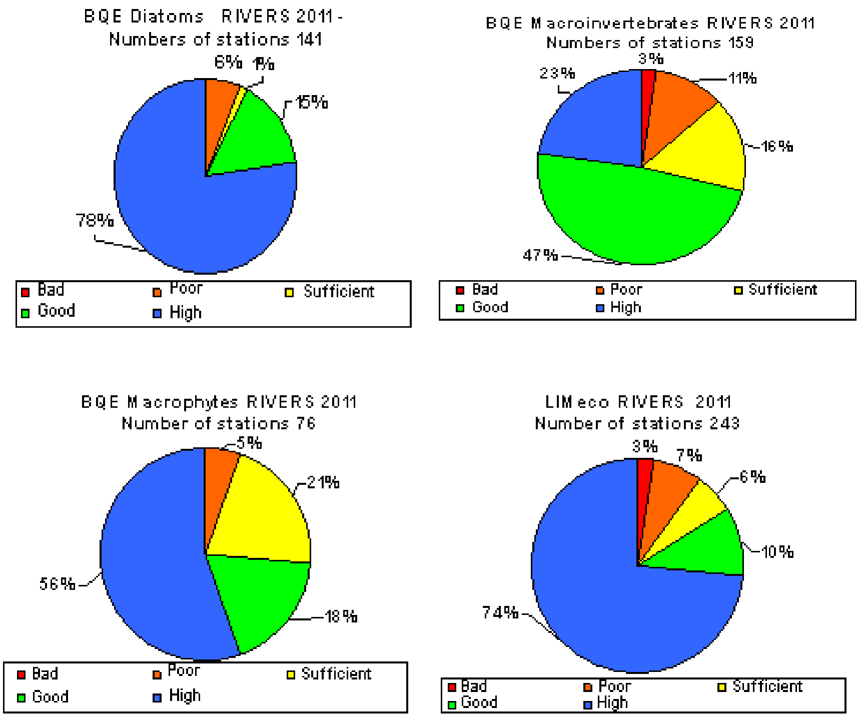


Figure 4.1: Quality classes of BQE and physico-chemical parameters (LIMeco) - Rivers (2011)[2]

Despite the lack of territorial homogeneity, in relation to the monitoring of rivers, the "good" class is prevalent for Macroinvertebrates, while for the Diatoms and Macrophytes the "high" class reaches higher percentages.

[1] Source: ARPA/APPA data processed by ISPRA
[2] Source: Ibidem

There was an increase in regions that submitted river monitoring data for 2011 (15 regions - Table 4.1), with more limited participation, still, from regions of Southern Italy, due both to failure to send said data and to the incomplete identification of the Core Network and/or monitoring networks. Although these data are not yet fully "comparable" as there is uneven regional coverage, it is clear that the "good" class is dominant for Macroinvertebrates, while for Diatoms and Macrophytes the "high" class reaches higher percentages as can easily be predicted given the fact that the data are mainly related to reference sites, which, by definition, are of good and excellent quality. For the purposes of classifying the ecological status of river water bodies, the supporting biological physico-chemical elements to be used are the nutrients (N-NH_4, N-NO_3, total phosphorus) and dissolved oxygen (% of saturation), integrated into a single descriptor, LIMeco (Level of Pollution from Macro-descriptors related to ecological status). Based on the data sent, the "high" class predominates, which, together with the "good" class reaches about 84% of the total.

For Macroinvertebrates the "good" class is predominant, while for Diatoms and Macrophytes the "high" class reaches the highest percentages.

About 84% of the stations have an ecological status that falls within the "high" or "good" class.

Table 4.2: Monitoring stations – lakes (2011)[3]

In 2011, only 7 regions submitted monitoring data relating to lakes.

Autonomous Region/Province	Stations	
	Phytoplankton	LTLeco
	No.	
Lombardy	11	12
Trentino-Alto Adige	2	2
Trent	*1*	*1*
Bolzano-Bozen	*1*	*1*
Veneto	2	2
Tuscany	2	4
Marche	5	5
Lazio	0	2
Abruzzo	1	1
Molise	0	1
Apulia	5	5
TOTAL	**28**	**34**

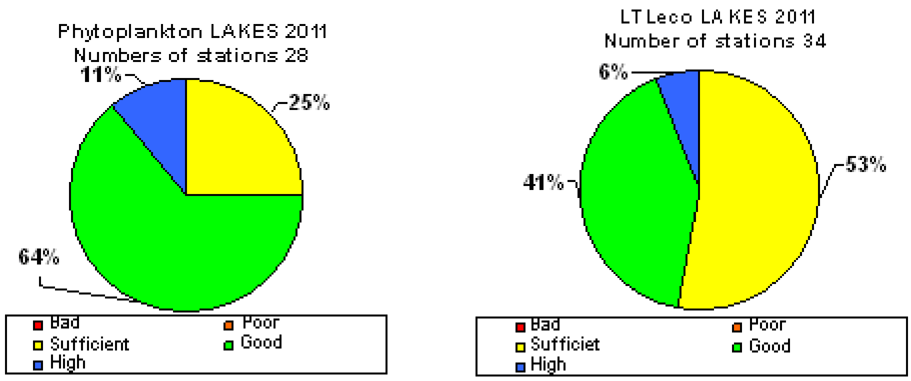


Figure 4.2: Quality classes of BQE and physico-chemical parameters (LTLeco) – lakes (2011)[4]

[3] Source: ARPA/APPA data processed by ISPRA
[4] Source: Ibidem

Only 7 regions (Table 4.2) submitted monitoring data for 2011 relating to lake water bodies and, in particular, among the BQE, only for phytoplankton in a significant manner; therefore the patchy coverage and the limited data do not allow them to be specifically analysed.
For the purposes of classifying the ecological status of lake water bodies, the biological supporting physico-chemical elements to be used are total phosphorus, transparency and hypolimnetic oxygen; these are integrated into one single descriptor, LTLeco (Trophic Level of Lakes related to ecological status), a synthetic index that describes the trophic status of lake waters.
To assess the Chemical status of surface waters, Environmental Quality Standards (EQS) shall be employed relating to the substances of the priority list (Table 1/A-water column, 2/A-sediments, 3/A-biota of the Environmental Ministerial Decree 260/2010). These standards represent concentrations that identify a good chemical status.

To assess the chemical status of surface waters, Environmental Quality Standards (EQS) shall be applied. In 2011, for river water bodies, only 10% of 233 stations are not in the "good" class of EQS.

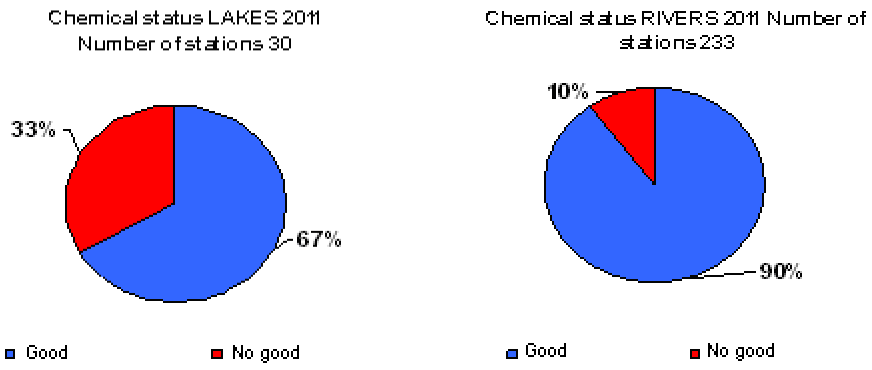
The EQS are defined as EQA-AA (Annual Average) and EQS-MAC (Maximum Allowable Concentration) for inland surface waters, rivers, lakes and artificial or heavily modified water bodies.
The EQS are verified on the annual average value of concentrations, based on the assessment of the worst data from a three-year period for operational monitoring and a one-year period for surveillance monitoring.
In 2011, in reference to the distribution into quality classes of the EQS, 13 regions submitted monitoring data for river water bodies (Table 4.3): of 233 stations, only 10% are not in the "good" class (Figure 4.3).
For lake water bodies only 8 regions submitted monitoring data (Table 4.3), therefore it is not possible to make any meaningful assessments.

Table 4.3: Measuring stations - EQS for rivers and EQS for lakes (2011)[5]

The monitoring data of river water bodies were sent by 13 regions, while only 8 regions sent data for lake bodies.

Autonomous Region/Province	River stations	Lake stations
	No.	No.
Piedmont	11	0
Aosta Valley	12	0
Lombardy	38	9
Trentino-Alto Adige	26	2
Trent	22	1
Bolzano	4	1
Veneto	34	2
Friuli-Venezia Giulia	22	0
Liguria	12	0
Emilia-Romagna	7	0
Tuscany	3	4
Marche	16	5
Lazio	10	2
Campania	28	0
Apulia	14	5
Abruzzo	0	1
TOTAL	**233**	**30**

[5] Source: ARPA/APPA data processed by ISPRA



In 2011, for river water bodies, 90% of stations are in the "good" class of EQS.

Figure 4.3: Chemical status of rivers and lakes (2011)[6]

The Chemical Status of Groundwater defines the quality of water resources.

Groundwater quality is represented by the SCAS index (Chemical Status of Groundwater) which highlights the areas in which there are critical environmental problems resulting from impacts of a chemical nature from human activities on groundwater bodies.

The chemical status of each groundwater body together with the quantitative status, determined by the groundwater levy system and by the natural recharging of the same (which depends largely on the climate regime) allow the overall status of the water body to be defined.

The impact on the chemical status of groundwater is quantified periodically by chemically analysing the water to identify pollutants and any increase in concentration over time.

There are many unwanted substances or pollutants in the groundwater that may compromise the valuable use of water resources, such as drinking water, but not all unwanted substances are man-made. In fact, there are many substances and chemical elements that occur naturally in aquifers and their geological origin cannot be considered due to human impact on groundwater resources. For example, in deep and confined lowland aquifers it is possible to naturally encounter metals such as iron, manganese, arsenic, or substances such as ammonium ion, even in very high concentrations, due to the effect of anaerobic degradation of the buried organic substance (peat).

In this setting, the presence of chlorides (water salinization) can be traced to the presence of "fossil" water of marine origin.

In a geological setting that is characterized instead by volcanic formations (Tuscany, Lazio, Campania) substances related to compounds of sulphur, fluoride, boron, arsenic, or mercury can occur naturally.

It is obtained by analysing the presence of both pollutants resulting from human activities, and natural chemical parameters present in the aquifers.

Although metals such as hexavalent chromium, in concentrations of a few ppb, can sometimes occur naturally in a geological metamorphism setting, both in the Alpine and Apennine regions, such as in Ophiolite areas (green stones). In contrast, the presence of pesticides, organic pollutants, nitrates with medium-high concentrations and saline intrusion point to the human impact of a chemical nature on groundwater bodies. Therefore, the chemical status of groundwater is influenced only by the human element of the unwanted substances found, once the natural element is discerned by quantifying its natural background value for each groundwater body.

[6] Source: ARPA/APPA data processed by ISPRA

The SCAS index is shown for each station for monitoring groundwater bodies, in two classes, "good" and "poor", as defined in Leg. Decree 30/09, which transposes the European Directives 2000/60/EC and 2006/118/EC for groundwater, and at the same time supplements and amends Leg. Decree No. 152/06.

The classification of the chemical status of groundwater provides for two classes, namely the "good" and "poor" status.

The "good" class of chemical status identifies waters in which pollutants or unwanted substances have a concentration below the quality standards set by the European Directives, such as for nitrates (50 mg/l) and pesticides (0.1 ug/L for each active ingredient and 0.5 ug/L for the summation) or thresholds set at national level for inorganic substances, metals, chlorinated solvents, hydrocarbons.

The "good" class includes all groundwater where there is no evidence of human impact and also those bodies where there are unwanted substances or contaminants that are of natural origin.

In contrast, the "poor" class includes all groundwater that cannot be classified in the "good" status and in which human impact is evident, due both to the concentration levels of contaminants and to significant and sustained upward trends sustained over time.

The chemical monitoring of groundwater is carried out with increasingly well-organized annual field surveys, arising from monitoring programs and networks (surveillance and operational) that are continuously improved upon in order to properly fulfil the guidelines set out by legislation for the calculation of the SCAS and for the monitoring of human impact.

The full implementation of those directives began with the monitoring in 2010; therefore it is expected that in a few years the problems related to the consolidation of the monitoring networks will be overcome, achieving a significant evolution of the SCAS over time.

Nationally, in 2011 70.3% of 4,009 stations fell into the "good" class, while the remaining 29.7% were in the "poor" class.

In 2011, of 4,009 stations 70.3% have a SCAS that falls under the "good" class.

The number of monitoring stations per region depends on its territorial extent, the number of water bodies and type of hydrogeological complexes present, their different intrinsic vulnerability and anthropogenic pressures present.

From the examination of the percentages of the SCAS classes of individual autonomous regions and provinces (Figure 4.4), taking into account the total number of sampling points for each geographical area, it appears that the Autonomous Province of Bolzano has all the monitoring stations in the "good " class, followed by the Autonomous Province of Trento, with 91.7% and Molise with 88.1%.

In contrast, the highest incidence of "poor" status is found in Sardinia, with 57.6%, followed by Sicily and Lombardy, with 36.8% and 35.7%, respectively.

The critical parameters that determine the "poor" class for each geographical area are often inorganic substances such as nitrates, sulphates, fluorides, chlorides, boron, along with metals, chlorinated substances and pesticides.

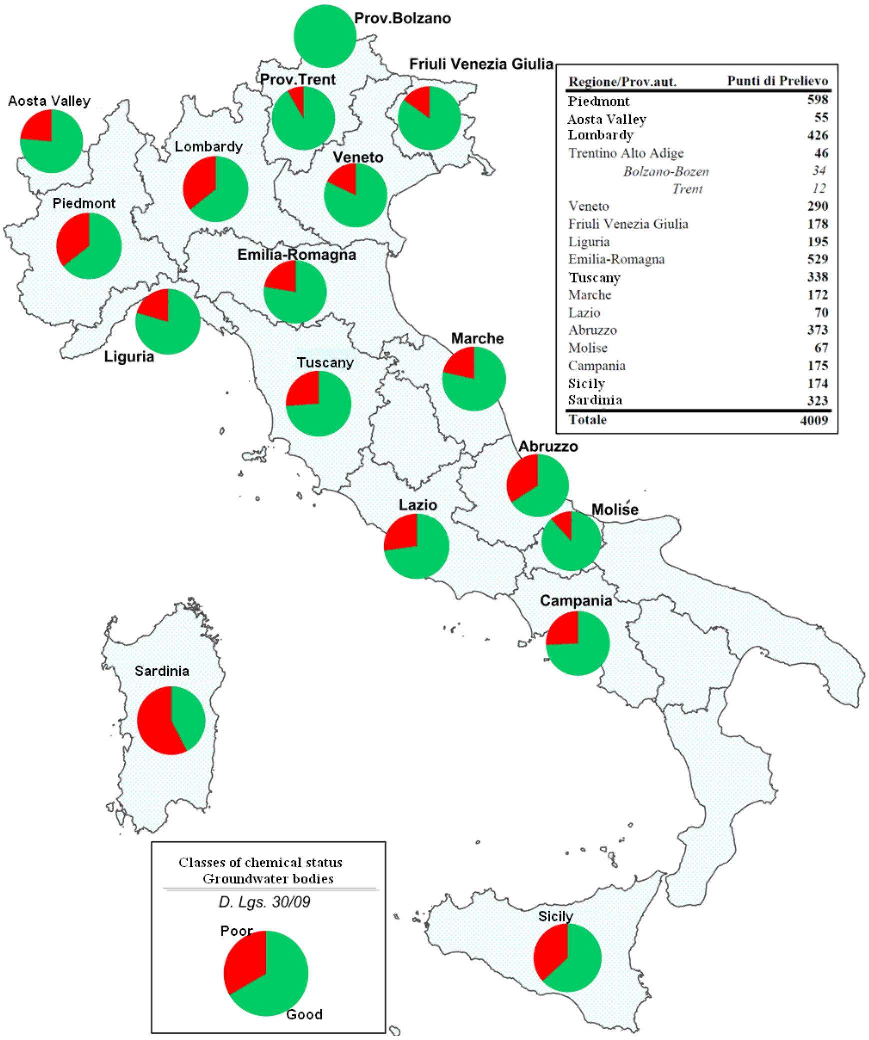
These data, however, should be evaluated keeping in mind that some regions have not yet assigned the natural origin of inorganic substances or metals to any station, when they are present in excess

of the threshold values, and this leads to an overestimation of the "poor" class to the detriment of the "good" class.
In this regard, for regions that submitted the corresponding information, the consistency of the SCAS "good" class was determined by the identification of threshold values for parameters of natural origin (Table 4.4).
The data for Lombardy, Veneto, Liguria, Emilia-Romagna, Tuscany, Campania and the Autonomous Province of Bolzano show that 23% of monitoring stations are characterized by the presence of chemical species of natural origin, which include ion ammonium, chloride, sulphate, boron, arsenic and other metals, in concentrations above the limits specified in Leg. Decree No. 30/09.
In the event that new thresholds are not defined, monitoring stations have been classified in a "poor" chemical status despite the chemical substances present in aquifers. have natural origin origin,
The identification of natural background values for all regions allows us to correctly classify the "good" chemical status determined by natural causes whose percentage impact is variable between the different regions, depending on the type of hydrogeological complexes present

Table 4.4: SCAS Index (2011)[7]

Autonomous Region/Province	SCAS Classes		TOTAL
	Good	Poor	
Piedmont	386	212	598
Valle d'Aosta	42	13	55
Lombardy	274	152	426
Trentino-Alto Adige	45	1	46
Bolzano-Bozen	34	0	34
Trento	11	1	12
Veneto	238	52	290
Friuli-Venezia Giulia	151	27	178
Liguria	155	40	195
Emilia-Romagna	411	118	529
Tuscany	250	88	338
Marche	135	37	172
Lazio	51	19	70
Abruzzo	246	127	373
Molise	59	8	67
Campania	130	45	175
Sicily	110	64	174
Sardinia	137	186	323
class TOTAL	**2,820**	**1,189**	**4,009**
%	**70.3**	**29.7**	

[7] Source: Data from regions, autonomous provinces and ARPA/APPA processed by ISPRA/ARPA Emilia-Romagna



Regione/Prov.aut.	Punti di Prelievo
Piedmont	598
Aosta Valley	55
Lombardy	426
Trentino Alto Adige	46
Bolzano-Bozen	*34*
Trent	*12*
Veneto	290
Friuli Venezia Giulia	178
Liguria	195
Emilia-Romagna	529
Tuscany	338
Marche	172
Lazio	70
Abruzzo	373
Molise	67
Campania	175
Sicily	174
Sardinia	323
Totale	4009

The Autonomous Province of Bolzano has all its monitoring stations in the "good" class, followed by the Autonomous Province of Trento, with 91.7% and from Molise with 88.1%. However, the greatest incidence of the "poor" status, is found in Sardinia with 57.6%, followed by Sicily and Lombardy, with 36.8% and 35.7% respectively.

Note
Quality judgement attributed to the classes (Leg. Decree No. 30/2009)
Good - the chemical composition of the groundwater body is such that the concentrations of pollutants do not display any effects of saline intrusion, do not exceed the environmental quality standards and the established threshold values and, ultimately, are not such as to prevent the environmental objectives established for surface waters from being achieved, do not lead to any significant deterioration of the ecological or chemical quality of these bodies or cause any significant damage to terrestrial ecosystems which depend directly on the groundwater body.
Poor - When the conditions of a good chemical status of the groundwater body are not determined

Figure 4.4: Percentage of SCAS classes on total sampling points per territorial area (2011)[8]

The measurement and analysis of hydro-meteorological variables play a key role in the knowledge of the territory, the processing of the hydrological balance and prevention of extreme events.

The systematic measurement and analysis of the hydro-meteorological variables such as temperature, precipitation and flow rate, play a key role in the cognitive action of the territory, in the preparation of the water balance, in the study and prevention of extreme events and induced phenomena (floods, droughts, landslides, etc.), and more generally in assessing the progress of the climatic situation.
The monitoring also responds to specific obligations set out by environmental law. One example is the monitoring of the flow of rivers, which allows us to provide an assessment of the responsiveness of a basin to a rainfall event, which is essential

[8] Source: Data from regions, autonomous provinces and ARPA/APPA processed by ISPRA/ARPA Emilia-Romagna

for protecting soil and fulfilling obligations under Leg. Decree No. 49/2010, implementing the "Floods" Directive, and necessary in assessing the hydrological balance and ecological status of water bodies, as indicated in Leg. Decree No. 152/2006 and in the Water Framework Directive.
These measures are generally carried out by the regional facilities which took over from the Regional offices of the National Hydrographic and Tidal Service (SIMN), as well as the Air Force, regional meteorological services and agro-meteorological network operators.
Quantitative monitoring is done according to established standards, protocols and procedures, such as those published by SIMN in the booklet "Technical standards for collecting and processing hydrometeorological data - Part I and Part II", and in accordance with the standards of the World Meteorological Organization (WMO).
Regarding the flows of 2011, the annual volumes recorded for the four sections of the end of Tevere a Ripetta, Adige a Boara Pisani, Po a Pontelagoscuro and Reno a Casalecchio, although lower than the previous year, are comparable to the averages calculated from the decade used for comparison 2002 - 2011 (Figure 4.5).
However, in order to have flow data that can be compared with the past, it is necessary to take into account the human actions carried out over the years on the water system, such as withdrawals, derivations and invasive works.
To characterize variations in outflows of a waterway compared to the reference period, it is necessary to analyse the normalised value of the monthly average flow rate, derived from the ratio between the average monthly flow rates recorded in 2011 and those obtained by averaging the values of the prior decade.
In this case we can note how in 2011 the flow’s monthly averages, have had substantial fluctuations around the average values of comparison, exceeding them in March and most of the summer, and remaining far below the values of comparison in April and May and in the winter (Figure 4.6).

In 2011, the flow rates recorded in the end sections of Tevere a Ripetta, Adige a Boara Pisani, Po a Pontelagoscuro and Reno at Casalecchio, lower than the previous year, can be compared to those averages calculated in 2002-2011.

In 2011, the average monthly flow rates underwent substantial fluctuations around the average values of the previous decade, exceeding them for most of the summer and remaining far below them in the winter.

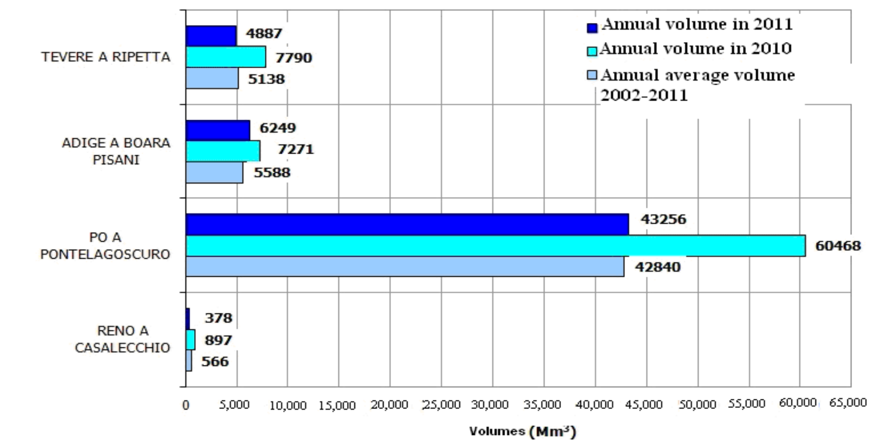


Figure 4.5: Comparison of annual flow volumes in 2011 and those in the year and in the previous decade respectively[9]

In 2011, the flow rates in the end sections, although lower than the previous year, are comparable to those averages calculated in the decade 2002-2011.

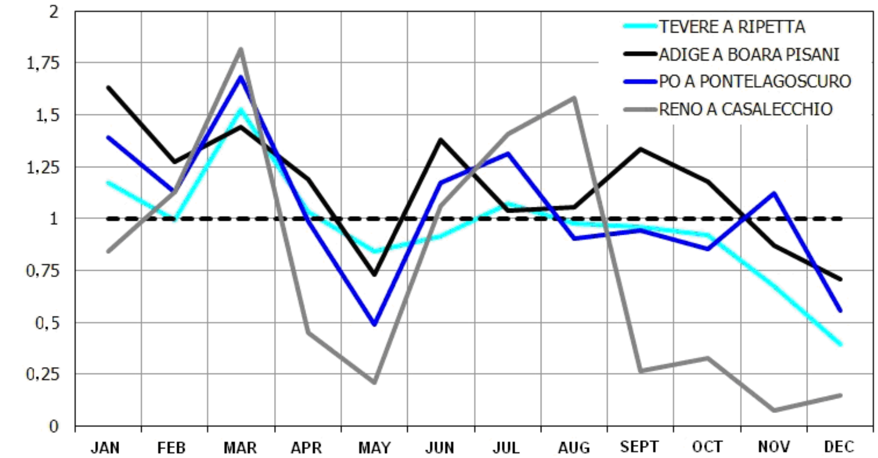


Figure 4.6: Trend of daily average flow rates recorded in the sections of Tevere a Ripetta, Adige a Boara Pisani, Po a Pontelagoscuro and Reno a Casalecchio (continuous lines) and the average monthly flow rate calculated for the decade 2002-2011 (dashed line)[10]

In 2011, the average monthly flow rates underwent substantial fluctuations around the average values of the decade, exceeding them for most of the summer and remaining far below them in the winter.

Knowledge of meteoric accretion is necessary for studying and preventing extreme events (floods, landslides), for performing the hydrological balance and, more generally, to obtain the trend of the climatic situation.

The thematic map of total annual precipitation for 2011, realized through spatial interpolation on a 1 km spatial grid of the values measured from 1,477 stations that are not evenly distributed in the area (Figure 4.7), provides information, on a national scale, about water's volumes flowing into Italian basins.

As can be seen from Figure 4.8, 2011 was characterized by cumulative values of rainfall that were lower than the thirty-year average from 1961-1990 for most of Italy, particularly along the north-central Apennines (Tuscan-Emilian and Umbria-Marche Apennines), the Po Valley, inland areas of Sardinia and southern Campania.

Above average rainfalls have affected the east coast of Calabria and Sicily.

In 2011, a large part of Italy was characterized by below-average rainfall for the period 1961-1990. In particular, along the north-central Apennines, the Po Valley, inland areas of Sardinia and southern Campania.

[9] Source: ARPA/APPA, Regional Monitoring Centres for Civil Protection

[10] Source: Ibidem

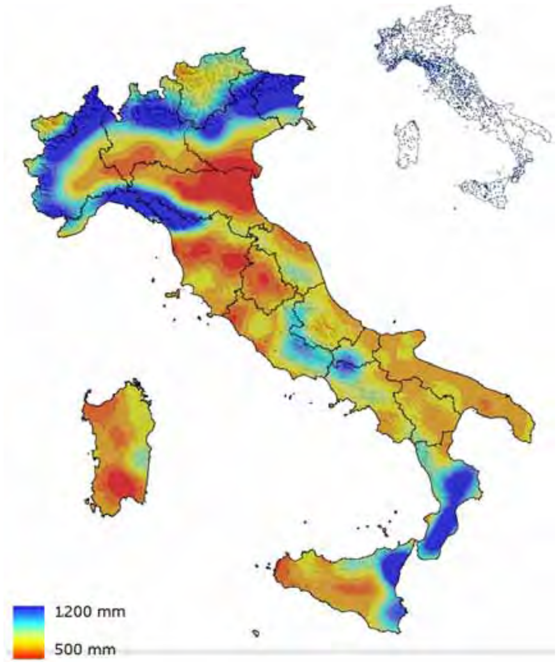


Figure 4.7: Total annual rainfall for 2011 and rain gauge stations used[11]

In 2011, a large part of Italy was characterized by below-average rainfall for the period 1961-1990. In particular, along the north-central Apennines, the Po Valley, inland areas of Sardinia and southern Campania. In contrast, above average rainfalls have affected the east coast of Calabria and Sicily.

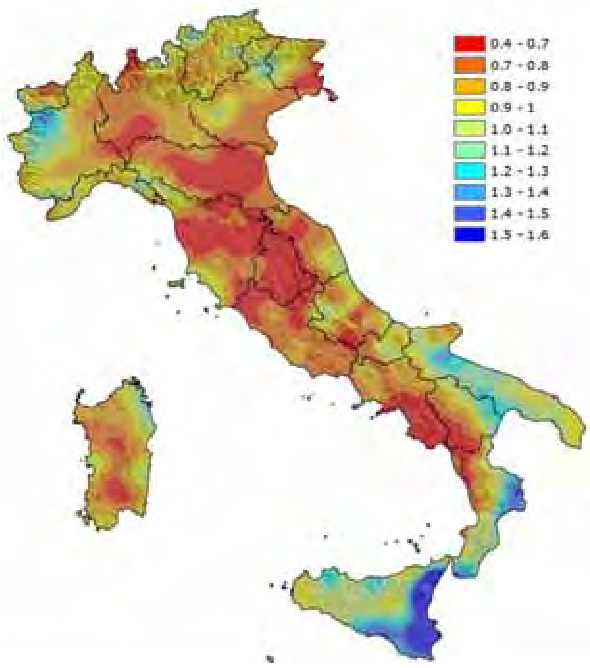


Figure 4.8: Ratio between total annual rainfall for 2011 and the average total annual rainfall for 1961-1990[12]

Hydrological drought.

Drought, unlike aridity which indicates a condition of permanent shortage of water resources, is a temporary condition related to water scarcity defined as a deviation from the average climatic conditions of a certain place of interest. The effects on the environment are therefore linked to persisting conditions of drought.

An extended period without rain for many months (6-12 months) will have effects on river flows, while for longer periods (one or two years) it will have an impact on the availability of water in the aquifers.

[11] Source: ARPA/APPA, Regional Monitoring Centres for Civil Protection

[12] Source: Ibidem

In light of the European Commission's Communication on the problems of drought and water scarcity (COM(2007)414), the latter (through the Joint Research Centre) in collaboration with Member States has developed the European Drought Observatory (EDO[13]) and established a set of indexes and tools to assess, monitor and forecast drought on a European scale.

One of the indexes used by the EDO bulletin for monitoring drought is the Standardized Precipitation Index (SPI).

The Standardized Precipitation Index (SPI) is used to monitor and quantifies the deficit or surplus of precipitation compared to the corresponding climatological average.

This index is commonly used at both international and national level to statistically quantify the deficit or surplus of precipitation compared to the corresponding climatological average on a particular temporal and spatial scale.

However, the monitoring provided by EDO, based on a sub-sample on a European scale of rain gauge stations cannot fail to consider monitoring at national and regional level, in such a way as to provide greater detail on the situations of drought.

Some ARPAs (e.g., ARPA Emilia-Romagna, ARPA Piedmont and ARPA Sardinia) have included hydrological drought monitoring through the use of SPI in their newsletters for some time.

At national level, ISPRA provides monthly monitoring of droughts in the country (and even in other particular areas of the continent and the Mediterranean) by calculating SPI maps at 3, 6, 12 and 24 months, using, as precipitation data, the reanalysis of the 2.5° grid from the National Centers for Environmental Prediction/Department of Energy (NCEP/DOE reanalysis).

The 12-month SPI maps did not show hydrological drought in the early part of 2011.

During January, June and July 2011, a precipitation surplus was detected in central - north Italy.

During January, June and July a precipitation surplus (1.5 <SPI <2.0) is detected in central and north Italy compared to the climatological average (Figure 4.9).

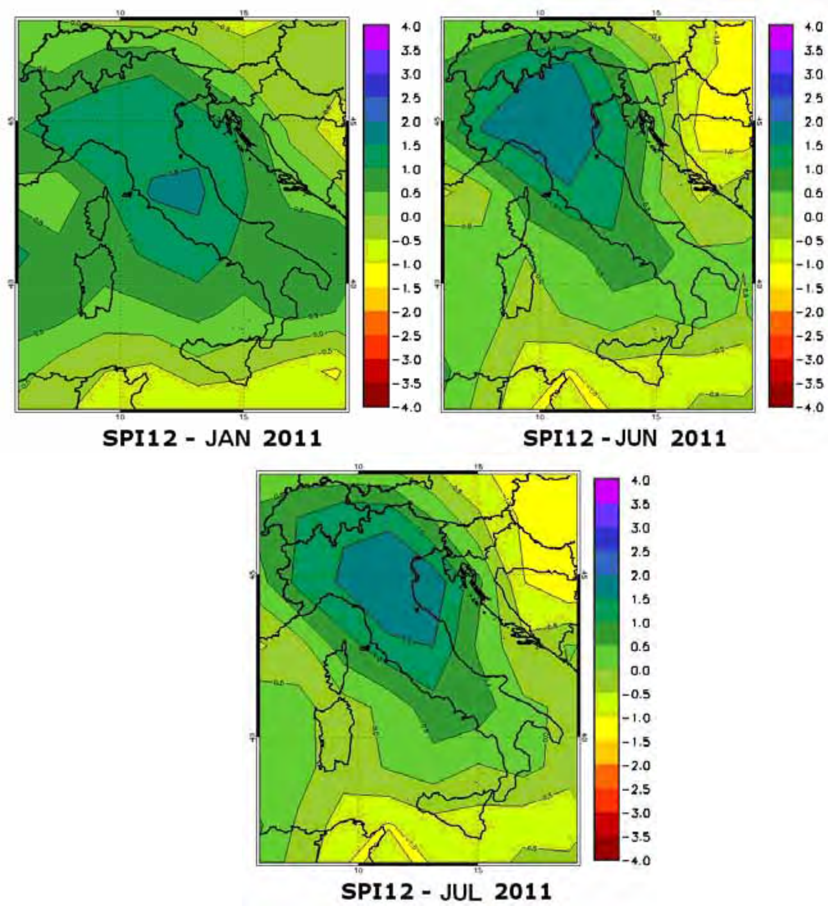
Instead, the situation changed in the last months of the year, when several regional hydro-meteorological networks experienced a decrease in rainfall compared to the climatological average from 1948-2010 (Figure 4.10).

However, in 2012 there was a moderate drought (-1.5 <SPI <-1.0) in March for North-eastern Sardinia and in August for the areas between Tuscany and Emilia-Romagna, in Veneto and on the Adriatic coast of central Italy (Figure 4.11).

By examining the 3-month SPI maps on the ISPRA Drought bulletin for the first few months of 2012, we can note that the drought situation affected all of North Italy in the short term, while in August the drought affected the entire Adriatic and Ionian coasts.

Rains that have fallen since the summer brought the total precipitate situation within the normal range during the year, with a slight surplus of rain in southern Italy (Figure 4.12).

[13] http://edo.jrc.ec.europa.eu/

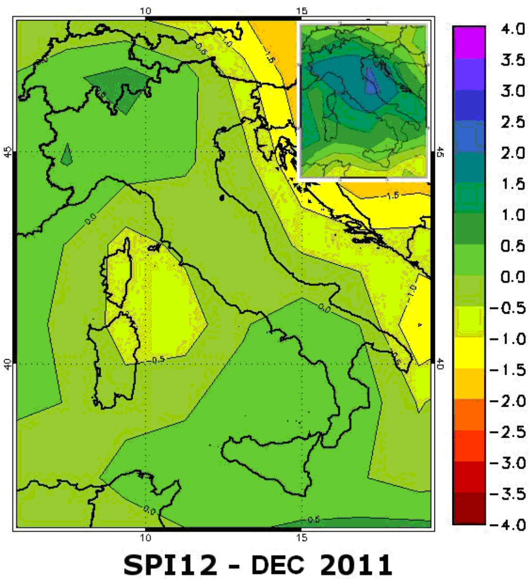


During January, June and July a precipitation surplus (1.5 <SPI <2.0) is detected in central and north Italy compared to the climatological average.

Key

>2 extremely wet; from 1.5 to 1.99 very wet; from 1.0 to 1.49 moderately wet; from -0.99 to 0.99 close to normal; from -1 to 1.49 moderate drought; from -1.5 to 1.99 severe drought; <-2 extreme drought

Figure 4.9: 12-month Standardized Precipitation Index (January, June and July 2011)[14]



In the last months of 2011, when several regional hydro-meteorological networks experienced a decrease in rainfall compared to the climatological average from 1948-2010.

Figure 4.10: 12-month SPI December 2011 compared to December 2010 (miniature in upper right)[15]

[14] Source: NCEP Reanalysis II data processed by ISPRA

[15] Source: Ibidem

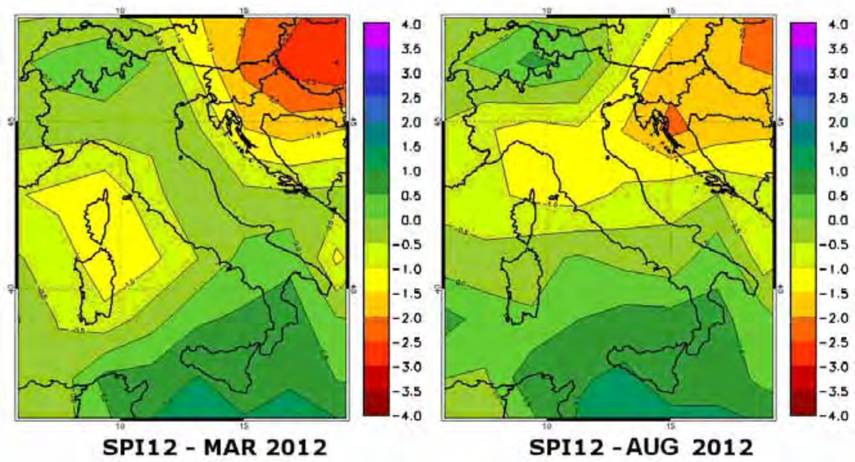


Figure 4.11: 12-month SPI March and August 2012[16]

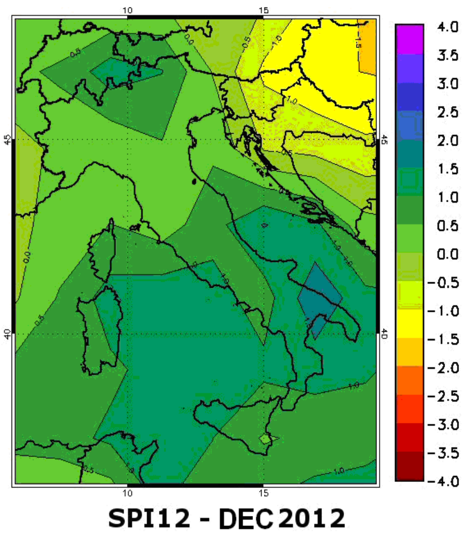


Figure 4.12: 12-month SPI - December 2012[17]

In the first few months of 2012, the drought situation affected all of North Italy in the short term, while in August the drought affected the entire Adriatic and Ionian coasts. Rains that have fallen since the summer brought the total precipitate situation within the normal range during the year.

[16] Source: NCEP Reanalysis II data processed by ISPRA
[17] Source: Ibidem

Main causes of alteration

The water used in domestic, agricultural, livestock and industrial sectors frequently contains substances that alter the ecosystem, so that it cannot be drained directly into waterways and soil. The most common water pollutants are faecal pollutants, inorganic, toxic and harmful substances, non-natural organic substances, oils and emulsifiers, suspended solids, heat, etc. The mass human settlement and industrialization of urban areas often lead to non-purified civil discharges of sewage, discharges of waste from raw materials, intermediate and end products from industry, run-off of wastes and pollutants from cemented areas which were subject to service activities. In some cases, catchment and purification systems are inadequate and unsuitable (capacity, treatment levels, absence of rain water tanks) to break down the pollution load in the volumes of wastewater and industrial products from extensive built-up areas. In addition to this, there is also the difficulty of controlling timely discharges in the industrial sector and the lack of awareness about these issues by some operators in the various productive sectors.

Water pollution comes mainly from human activity.

Big industry also specifically causes both pollution from inorganic toxic and harmful substances (ions of heavy metals such as Cr^{6+}, Hg^{2+}, Cd^{2+}, $Cu^{2+,}$ CN^{-}, phosphates and polyphosphates) and from non-natural organic substances (acetone, trichlorethylene, benzene, toluene, etc.), as well as thermal pollution that, with a change in water temperature, alters the chemical and biochemical balance of the water bodies by decreasing the solubility of the dissolved oxygen, thus causing pathological changes or the disappearance of some species, or the development of others that are normally absent.

Chemical and thermal pollution comes from industry.

Industrialisation is also responsible for acid rain, caused by the contamination of rainwater by gases present in the atmosphere (carbon dioxide, sulphur dioxide, nitrogen dioxide, etc.), which have detrimental effects on aquatic ecosystems. The effects on aquatic organisms may be either direct, due to the water toxicity, or indirect, due to the disappearance of plants or prey that are more sensitive to acidification and which form part of the food chain. In fact, acidity of rivers and lakes can change populations of diatoms and brown algae and can also alter the distribution and variety of fish fauna. Furthermore, it can indirectly cause harm to human health if food from acidic water is consumed, e.g. fish that have accumulated large amounts of toxic metals (aluminium, manganese, zinc, mercury and cadmium) in their body.

Gases that pollute the air lead to "acid rain", with direct and indirect consequences for aquatic organisms, as well as causing damage to human health.

Also, excessive water abstraction can affect the quality of water resources. Heavily populated areas are a critical issue due to the high demand for water for domestic, industrial, agricultural and recreational purposes. Ultimately excessive groundwater abstraction in coastal areas can result in an intrusion of sea water into the groundwater itself, salinating the water and making it no longer suitable for legitimate purposes.

Heavily populated areas are a critical issue due to the high demand for water.

The presence of intensive livestock farms causes intense pressure due to the sewage produced and manure run-off. The extensive use of fertilizers and pesticides in agriculture can impact aquatic life and cause changes in drinking water, whether on the surface or underground.

Waste from animal farming and the extensive use of pesticides and fertilizers in agriculture can impact aquatic life.

Another important cause of water quality impairment is pollution from nitrates from agriculture. As defined by Leg. Decree No. 152/1999, and then by Leg. Decree No. 152/2006 which implemented Directive 91/676/EEC (Nitrates Directive), it is necessary to implement a series of measures needed to protect waters from pollution such as: monitoring of waters (nitrate concentration and trophic state); identification of polluted waters or those at risk of pollution; designation of vulnerable zones (areas that drain into polluted waters or those at risk of pollution if action is not taken); development of codes of good agricultural practice and action programs (measures aimed at preventing and reducing nitrate pollution).

Pollution caused by nitrates from agriculture is another cause of water quality impairment.

Information regarding nitrate pollution levels of surface water and underground water in a particular area are provided in summary by an index encoded with a rational number between 0 and 1. This index expresses the following information simultaneously: the general state of water in a particular area with respect to nitrate pollution from agriculture; the pollution quality, expressed in terms of percentage classes of exceeding thresholds of "heavy pollution", "danger" and "caution" respectively, as defined at European Community level under the Nitrates Directive, with surface water and underground water separate.

Information regarding nitrate pollution levels is provided by a summary "index".

Regarding nitrate pollution of underground water, in the period 2008-2011, the index confirms the same values as the previous four years (Table 4.5) in 8 autonomous regions/provinces (Abruzzo, Bolzano, Emilia-Romagna, Lombardy, Piedmont, Sardinia, Trent and Valle d'Aosta).

The autonomous provinces of Bolzano and Trent, and Aosta Valley d'Aosta present a generally positive situation, with very good index values (close to one). Abruzzo, Emilia-Romagna, Piedmont, Sardinia have a pollution level with room for improvement.

In Friuli-Venezia Giulia, Lazio, Umbria and Veneto, the index has improved, while in 7 regions it has worsened (Basilicata, Campania, Liguria, Marche, Apulia, Sicily, Tuscany).

Regarding nitrate pollution of surface water, it can be observed (Table 4.6) that in 11 autonomous regions/provinces (Abruzzo, Bolzano, Calabria, Campania, Lazio, Liguria, Marche, Apulia, Sicily, Tuscany and Veneto) the index has improved. In 6 autonomous regions/provinces (Basilicata, Friuli-Venezia Giulia, Lombardy, Piedmont, Trent, Aosta Valley) the index worsened and in two regions (Emilia-Romagna, Umbria) it remained stationary in the two four-year periods.

For underground water in the period 2008-2011, in Abruzzo, Bolzano, Emilia-Romagna, Lombardy, Piedmont, Sardinia, Trento and Valle d'Aosta the nitrate pollution index is confirmed to be at the same values as the previous four years. For surface waters in the period 2008-2011, in 11 autonomous regions/provinces (Abruzzo, Bolzano, Calabria, Campania, Lazio, Liguria, Marche, Puglia, Sicily, Tuscany and Veneto) the index has improved.

Table 4.5: Summary index of nitrate pollution, underground water (2004-2007; 2008-2011)[18]

Autonomous Region/Province	2004-2007								
	Distribution of stations by concentration threshold°					P2*	P3**	P4***	INDEX
	0-24.99 mg/l NO_3	25-39.99 mg/l NO_3-	40-50 mg/l NO_3	>50 mg/l NO_3	TOTAL				
	No.					%			
Abruzzo	300	42	20	86	448	9.38	4.46	19.20	0.798
Basilicata	53	17	6	18	94	18.09	6.38	19.15	0.787
Bolzano	38	1	0	0	39	2.56	0.00	0.00	0.999
Calabria	43	7	2	7	59	11.86	3.39	11.86	0.898
Campania	127	26	6	24	183	14.21	3.28	13.11	0.898
Emilia-Romagna	379	88	48	70	585	15.04	8.21	11.97	0.888
Friuli-Venezia Giulia	43	16	2	1	62	25.81	3.23	1.61	0.996
Lazio	158	10	6	40	214	4.67	2.80	18.69	0.799
Liguria	128	2	4	2	136	1.47	2.94	1.47	0.999
Lombardy	330	87	27	16	460	18.91	5.87	3.48	0.987
Marche	139	17	6	17	179	9.50	3.35	9.50	0.898
Molise	-	-	-	-	-	-	-	-	-
Piedmont	889	245	94	137	1365	17.95	6.89	10.04	0.887
Apulia	70	82	16	9	177	46.33	9.04	5.08	0.984
Sardinia	50	12	5	19	86	13.95	5.81	22.09	0.788
Sicily	102	6	4	12	124	4.84	3.23	9.68	0.899
Tuscany	160	16	4	9	189	8.47	2.12	4.76	0.998
Trent	29	0	0	0	29	0.00	0.00	0.00	0.999
Umbria	206	111	68	148	533	20.83	12.76	27.77	0.687
Aosta Valley	71	0	0	0	71	0.00	0.00	0.00	0.999
Veneto	234	70	26	34	364	19.23	7.14	9.34	0.887
ITALY	**3,549**	**855**	**344**	**649**	**5,397**	**15.84**	**6.37**	**12.03**	**0.887**

Autonomous Region/Province	2008-2011								
	Distribution of stations by concentration threshold°					P2*	P3**	P4***	INDEX
	0-24.99 mg/l NO_3	25-39.99 mg/l NO_3-	40-50 mg/l NO_3	>50 mg/l NO_3	TOTAL				
	n.					%			
Abruzzo	241	28	12	60	341	8.2	3.5	17.6	0.798
Basilicata	71	16	7	33	127	12.6	5.5	26.0	0.688
Bolzano	32	1	0	0	33	3.0	0.0	0.0	0.999
Calabria	-	-	-	-	-	-	-	-	-
Campania	210	30	31	20	291	10.3	10.7	6.9	0.888
Emilia-Romagna	392	66	36	55	549	12.0	6.6	10.0	0.888
Friuli-Venezia Giulia	128	35	7	3	173	20.2	4.0	1.7	0.997
Lazio	84	8	3	16	111	7.2	2.7	14.4	0.898
Liguria	177	6	3	13	199	3.0	1.5	6.5	0.899
Lombardy	290	83	37	20	430	19.3	8.6	4.7	0.987
Marche	151	24	18	35	228	10.5	7.9	15.4	0.788
Molise	-	-	-	-	-	-	-	-	-
Piedmont	374	123	41	50	588	20.9	7.0	8.5	0.887
Apulia	207	89	41	112	449	19.8	9.1	24.9	0.787
Sardinia	210	48	33	97	388	12.4	8.5	25.0	0.788

continues

[18] Source: Data from autonomous regions/provinces processed by ISPRA

follows on

Autonomous Region/Province	2008-2011								
	Distribution of stations by concentration threshold°					P2*	P3**	P4***	INDEX
	0-24.99 mg/l NO_3	25-39.99 mg/l NO_3-	40-50 mg/l NO_3	>50 mg/l NO_3	TOTAL				
	n.					%			
Sicily	301	45	16	62	424	10.6	3.8	14.6	0.898
Tuscany	370	43	18	27	458	9.4	3.9	5.9	0.898
Trent	12	0	0	0	12	0.0	0.0	0.0	0.999
Umbria	137	58	17	64	276	21.0	6.2	23.2	0.787
Aosta Valley	47	0	0	0	47	0.0	0.0	0.0	0.999
Veneto	255	47	18	21	341	13.8	5.3	6.2	0.888
ITALY	**3,689**	**750**	**338**	**688**	**5,465**	**13.7**	**6.2**	**12.6**	**0.888**

Notes
° Distribution refers to the allocation of the four-year average of concentrations in different concentration classes
* Percentage of stations with four-year average of concentration that falls within the warning threshold
** Percentage of stations with four-year average of concentration that falls within the danger threshold
*** Percentage of stations with four-year average of concentration that falls within the strong pollution threshold

Table 4.6: Summary index of nitrate pollution, surface water (2004-2007; 2008-2011)[19]

Autonomous Region/Province	2004-2007								
	Distribution of stations by concentration threshold°					P2*	P3**	P4***	INDEX
	0-1.99 mg/l NO_3	2-9.99 mg/l NO_3-	10-25 mg/l NO_3	>25 mg/l NO_3	TOTAL				
	n.					%			
Abruzzo	42	78	43	15	178	43.82	24.16	8.43	0.875
Basilicata	1	4	2	0	7	57.14	28.57	0.00	0.963
Bolzano	6	12	0	0	18	66.67	0.00	0.00	0.992
Calabria	161	33	33	25	252	13.10	13.10	9.92	0.888
Campania	0	1	5	2	8	12.50	62.50	25.00	0.738
Emilia-Romagna	17	39	28	5	89	43.82	31.46	5.62	0.865
Friuli-Venezia Giulia	37	10	0	0	47	21.28	0.00	0.00	0.997
Lazio	50	67	51	35	203	33.00	25.12	17.24	0.766
Liguria	21	29	0	0	50	58.00	0.00	0.00	0.993
Lombardy	76	58	0	0	134	43.28	0.00	0.00	0.995
Marche	16	56	32	19	123	45.53	26.02	15.45	0.764
Molise	40	14	2	0	56	25.00	3.57	0.00	0.997
Piedmont	44	326	91	1	462	70.56	19.70	0.22	0.972
Apulia	0	14	7	2	23	60.87	30.43	8.70	0.863
Sardinia	92	116	59	68	335	34.63	17.61	20.30	0.776
Sicily	17	16	3	0	36	44.44	8.33	0.00	0.985
Tuscany	54	167	24	2	247	67.61	9.72	0.81	0.982
Trent	3	20	0	0	23	86.96	0.00	0.00	0.99
Umbria	5	75	22	0	102	73.53	21.57	0.00	0.972
Aosta Valley	58	0	0	0	58	0.00	0.00	0.00	0.999
Veneto	17	189	145	19	370	51.08	39.19	5.14	0.854
ITALY	**757**	**1,324**	**547**	**193**	**2,821**	**46.82**	**19.34**	**6.82**	**0.874**

continues

[19] Source: Data from autonomous regions/provinces processed by ISPRA

follows on

Autonomous Region/Province	2008-2011 Distribution of stations by concentration threshold° 0-1.99 mg/l NO_3	2-9.99 mg/l NO_3-	10-25 mg/l NO_3	>25 mg/l NO_3	TOTAL	P2*	P3**	P4***	INDEX
	n.					%			
Abruzzo	27	66	28	2	123	53.66	22.76	1.63	0.974
Basilicata	6	16	8	4	34	47.06	23.53	11.76	0.874
Bolzano	10	11	0	0	21	52.38	0.00	0.00	0.994
Calabria	130	41	4	0	175	23.43	2.29	0.00	0.997
Campania	23	85	29	7	144	59.03	20.14	4.86	0.973
Emilia-Romagna	36	81	68	10	195	41.54	34.87	5.13	0.865
Friuli-Venezia Giulia	62	238	29	5	334	71.26	8.68	1.50	0.982
Lazio	80	48	22	3	153	31.37	14.38	1.96	0.986
Liguria	97	47	5	1	150	31.33	3.33	0.67	0.996
Lombardy	5	89	69	22	185	48.11	37.30	11.89	0.854
Marche	95	27	12	1	135	20.00	8.89	0.74	0.987
Molise	-	-	-	-	-	-	-	-	-
Piedmont	62	116	19	0	197	58.88	9.64	0.00	0.983
Apulia	48	27	3	0	78	34.62	3.85	0.00	0.996
Sardinia	322	161	39	6	528	30.49	7.39	1.14	0.986
Sicily	120	118	82	103	423	27.90	19.39	24.35	0.776
Tuscany	197	223	28	2	450	49.56	6.22	0.44	0.984
Trent	16	80	6	1	103	77.67	5.83	0.97	0.981
Umbria	8	45	14	0	67	67.16	20.90	0.00	0.972
Aosta Valley	44	14	0	0	58	24.14	0.00	0.00	0.997
Veneto	73	177	128	13	391	45.27	32.74	3.32	0.964
ITALY	**1,461**	**1,710**	**593**	**180**	**3,944**	**43.36**	**15.04**	**4.56**	**0.985**

Notes
° Distribution refers to the allocation of the four-year average of concentrations in different concentration classes
* Percentage of stations with four-year average of concentration that falls within the warning threshold
** Percentage of stations with four-year average of concentration that falls within the danger threshold
*** Percentage of stations with four-year average of concentration that falls within the strong pollution threshold

Initiatives to protect water quality

Among the measures to achieve the quality and water protection objectives, EU Directive 91/271/EEC provides for the obligation to create collection and processing systems (sewerage networks) of wastewater for all built-up areas according to their size and location, in accordance with the time limits that vary depending on the degree of environmental risk in the area where the discharge happens and on the capacity of the plant or discharge, expressed in equivalent inhabitants.

Creation of treatment and wastewater collection systems for all built-up areas in order to achieve the quality and water protection objectives provided for by Directive 91/217/EEC.

31/12/2005 was the last date set by the Directive to adapt plants that treat urban waste water and sewerage networks for all agglomerations above 2,000 p.e. and to include an appropriate treatment system for smaller built-up areas.

The compliance data of the sewerage networks refer to 2009. In 12 regions and in the Autonomous provinces of Trento and Bolzano, the degree of coverage of the catchment systems reached 100%; 99% in six regions and 97% in just one case (Campania).

In 2009, the degree of coverage of the catchment systems reached 100% in 12 regions and in the autonomous provinces of Trento and Bolzano.

In this regard, it should be noted that the percentage of territorial coverage of the catchment systems was calculated by adding the percentage of the organic load entering the sewerage network in the area to that treated by "individual or appropriate systems"[20].
At national level, 94% of the total load produced by built-up areas (equal to 76,329,384 p.e) is conveyed into the drainage system, while 5% (equal to 3,725,011 p.e.) is treated with individual systems (Figure 4.13).

In 2009, at national level, 94% of the total load produced by built-up areas (equal to 76,329,384 p.e) is conveyed into the drainage system, while 5% (equal to 3,725,011 p.e.) is treated with individual systems.

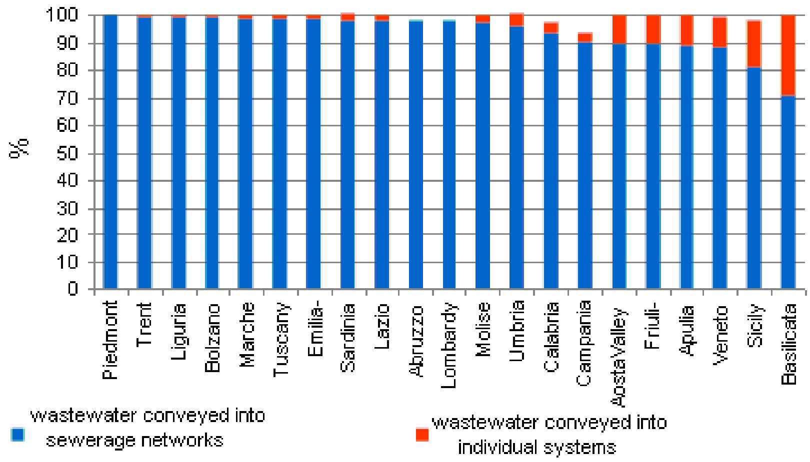
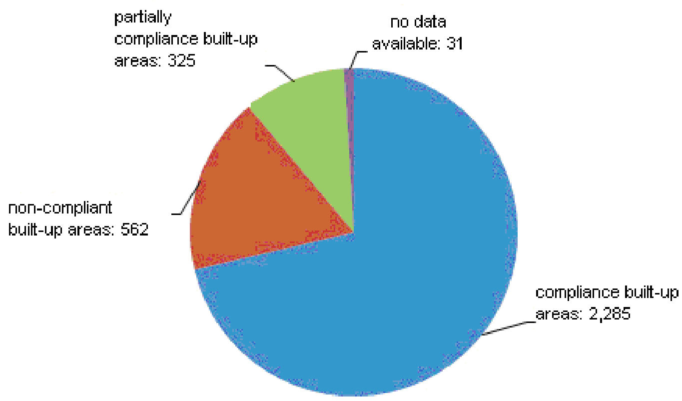


Figure 4.13: Percentage of organic load collected - regional breakdown (2009)[21]

It has also been possible to complete the national reference framework for compliance of urban wastewater purification systems. The national compliance index was 79%, unchanged from the previous two years. There are 3,203 built-up areas, of which 2,285 are compliant, 325 are partially compliant and 562 are non-compliant (Figure 4.14). It was impossible to assess compliance for only 31 built-up areas, as monitoring data from the plants were not disclosed. Regarding the regional breakdown, in 7 regions and in the Autonomous provinces of Trento and Bolzano, the conformity index is greater than 90%, in 8 regions it is between 70% and 90%, while in 3 it is between 50% and 70%. Only in Sicily was a particularly low value of the compliance index detected, 38%. However, it should be noted that in Sicily the compliance index rose from 28% (in 2007) to 38% (in 2009), an increase of ten percentage points (Figure 4.15).

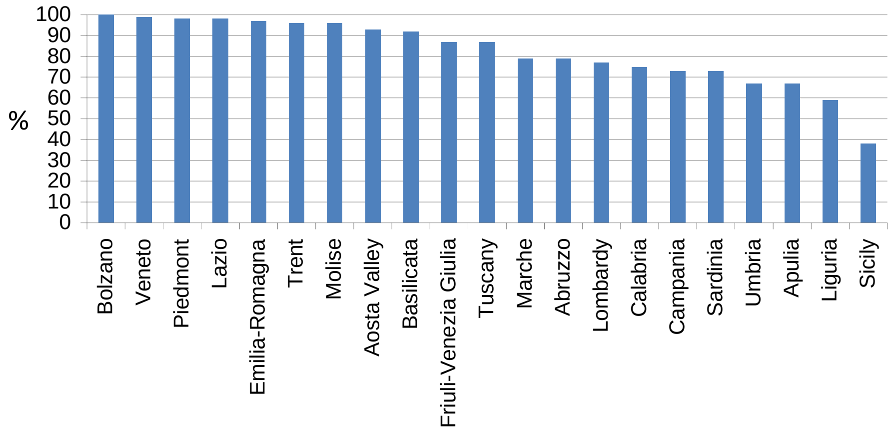
In 2009, the national compliance index of urban wastewater purification systems was found to be 79%.

[20] Directive 91/271/EEC
[21] Source: ARPA/APPA and regional data processed by ISPRA (UWWTD 2011 Questionnaire)



At national level in 2009, about 79% of wastewater treatment systems were compliant.

Figure 4.14: Compliance of purification systems relating to built-up areas of more than 2,000 p.e. (2009)[22]



In 7 regions and in the Autonomous provinces of Trento and Bolzano, the conformity index is greater than 90%, in 8 regions it is between 70% and 90%, while in 3 it is between 50% and 70%. It was only particularly low (38%) for Sicily, although it increased by 10 percentage points since 2007.

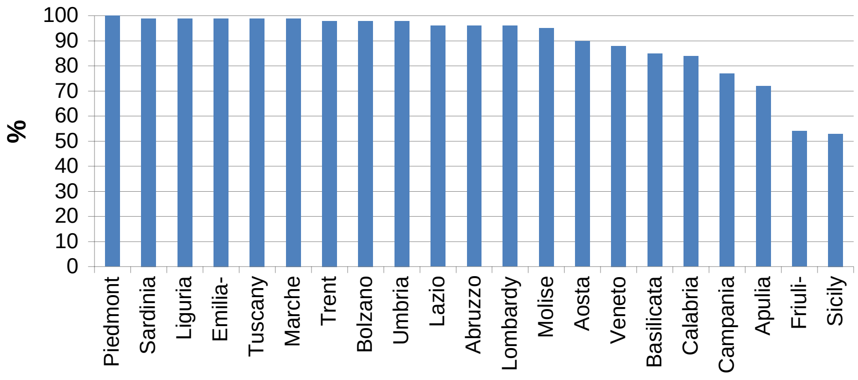
Figure 415: Degree of compliance of purification systems relating to built-up areas of more than 2,000 p.e. - regional breakdown (2009)[23]

The organic load produced from built-up areas with more than 2,000 population equivalent (p.e) in the country, in 2009, it amounted to 81,060,416 p.e., while the fraction conveyed to the treatment plants in 2009 was 71,284,418 p.e. (around 88%).

In 2009, 88% of the organic fraction is conveyed to treatment plants.

In the breakdown, 12 regions and the autonomous provinces of Trento and Bolzano have a percentage of purified load greater than or equal to 90%, while in 5 regions it reaches values between 70% and 90%, only in Sicily and Friuli-Venezia Giulia is it less than 70%, 53% and 54%, respectively (Figure 4.16).

[22] Source: ARPA/APPA and regional data processed by ISPRA (UWWTD 2011 Questionnaire)
[23] Source: Ibidem



12 regions and the autonomous provinces of Trento and Bolzano have a purified load percentage greater than or equal to 90%, while 5 regions reach values between 70% and 90%.

Figure 4.16: Percentage of purified organic load relative to built-up areas of more than 2,000 p.e. - regional breakdown (2009)[24]

The evolution of the tools for protecting the quality and quantity of water should be read in the context of the overall adaptation process of national legislation to the requirements of European Community legislation, in particular the WFD.

The fundamental element of the WFD is integrated water management at river basin level, through an approach designed to overcome the logic of administrative boundaries, in a system vision that pays particular attention to biological aspects.

The District management plan is the instrument through which it is necessary to plan, implement and monitor measures for protection, rehabilitation and improvement water bodies.

In this context, the directive defines a rigorous process in stages, culminating in the adoption of a particular instrument for the government of river basins, to be checked and updated regularly: the District management plan.

This represents the operating instrument through which it is necessary to plan, implement and monitor measures for protection, rehabilitation and improvement of surface and underground water bodies and to facilitate the sustainable use of water resources.

Innovative aspects of the Management plan.

The most innovative aspects, compared to more traditional approaches, consist essentially in the fact that the Management Plan:

- encompasses and harmonizes actions required by other directives in other fields and other sectors (agriculture, soil conservation, protected areas, etc.) into one single instrument;
- it requires an accurate assessment of the technical and, above all, economic viability of choices made by using specific tools such as an economic analysis, cost-benefit analysis and cost-effectiveness analysis;
- it is processed through the activation of public participation mechanisms.

Leg. Decree No.152/06 as amended, which transposed the Directive, divided the country into 8 river basin districts (Eastern Alps, Po, Northern Apennines, River Serchio, Central Apennines, Southern Apennines, Sardinia, Sicily) and planned the drafting of a Management plan for each of them.

[24] Source: ARPA/APPA and regional data processed by ISPRA (UWWTD 2011 Questionnaire)

In this context, on the basis of the objectives set at river basin district scale by the Basin district Authorities, the regions define the measures aimed at ensuring achievement or maintenance of the quality objectives for the water bodies and the measures necessary for the qualitative and quantitative protection of the regional water supply.
To date, all river basin districts are equipped with a District management plan The first update of the management plans is planned for 2015, and every six years thereafter.

To date, all river basin districts are equipped with a District management plan.

Regional characteristics

ARPA Friuli-Venezia Giulia

ARPA FVG provides observations and instructions for new hydroelectric plant proponents based on ecological and hydromorphological knowledge which is constantly changing, pursuing its experimentation activities as well as conducting monitoring and control activities so as to ensure the production of hydroelectric energy without compromising the delicate river ecology of mountain basins, which are already naturally stressed by the torrential rainfall to which it is subject.
With regard to the lowland area we have identified two Nitrate Vulnerable Zones of agricultural origin and the Programme of Action (PoA) is in force, approved with Presidential Decree 24-5-2010 n. 0108_Pres. The provisions of the PoA are inherent to prohibitions and restrictions on the use of nitrogen fertilizers, preparation of deposits for manure from farms, and encourage integrated strategies for rebalancing the relationship between agriculture and the environment.

ARPA Calabria

In 2009, ARPA Calabria launched a project to monitor and control the Calabrian coastal purification system through an on-line network of automatic samplers that transmits a series of chemical and physical parameters in real time to a data collection centre and allows for the launching of remote sampling.
The goal of establishing the on-line network of sampling is to launch a control strategy for discharges that is not only repressive but, above all preventive, so as to protect coastal areas that have always been a very important part of the heritage of Calabria.
The project involves installing 103 on-line sampling stations on the same number of coastal treatment plants.

GLOSSARY

Population equivalent:
Amount of biodegradable organic substances derived from a civil or equivalent user conveyed into the sewer system over a period of one day (24 hours) which corresponds to a biochemical oxygen demand in five days of 60 grams of O_2 per day.

Water acidification:
Caused by rainfall made acidic by nitrogen oxide and sulphur oxide emissions that combine with water vapour in the atmosphere to produce acid rain which washes away the nutrients from the soil and disrupt aquatic ecosystems.

Hydrological balance:
Comparison in the time period in question and with reference to a certain basin or sub-basin, surface or underground, between natural inflows and outflows, or outflows that occur in the absence of human pressure" (Ministerial Decree 28th July 2004).

Organic load:
Amount of biodegradable organic substances produced daily by a civil or equivalent user. It is measured indirectly through the amount of O_2 required for aerobic bacteria to be able to degrade the biodegradable organic substances present in the sewage over a period of 5 days (BOD_5).

Reference conditions:
Conditions that reflect human or negligible impact compared to the natural physico-chemical and hydromorphological characteristics for each type and for each biological quality element (BQE).

BQE – Biological quality element:
Biological quality elements (phytoplankton, benthic macroinvertebrates, macroalgae, angiosperms) play a key role in assessing ecological status.

District management plan:
Technical instrument of governance of the river basin districts introduced by the Water Framework Directive.

Acid rain:
Contamination of rainwater by gas present in the atmosphere.

Flow rate:
Water volume (cubic meters) passing through a given section of a waterway in the unit of time (second).

Core Network:
Subset of the fixed points selected in order to evaluate both natural and anthropogenic long-term changes (Leg. Decree No. 260/2010).

CHAPTER 5

THE SEA AND COASTAL ENVIRONMENT

Introduction

The previous edition devoted much attention to the physical, chemical and biological characteristics of coastal areas and the sea. The natural evolution of the marine-coastal environment was described, together with examples of the impact of human activity on the coastline; the driving forces of the marine environment were considered, along with the make-up of the territory and the quality of marine-coastal waters, plus possible responses in terms of territorial planning and initiatives on the national and regional levels.
The factors that describe the coastal environment are not subject to change over the short term, with any updating of the information calling for a multiyear timeframe.
Evidence of variations in the geography and morphology of coastal areas emerges only slowly, and the same holds true for systems of protection and for the outcome of any initiatives taken, plus the rate at which port infrastructures and facilities for production and recreation render the coastline increasingly "artificial", plus the extent to which the land is occupied by urbanisation, meaning that monitoring must be performed at intervals of at least five or ten years to be significant. And in order to obtain an updated overview of the situation on a national scale, new, high-resolution territorial coverage must be obtained, in place of what is currently available.
As regards the marine environment, the driving forces behind its physical condition are continually observed through monitoring networks, study and research, while new advances are continually made in systems of marine-weather forecasting.
The monitoring of the quality of bathing waters and of the ecological status of coastal waters (the latter is required under Water Framework Directive) are the activities currently able to provide chemical and biological parameters on marine and coastal waters, plus, at full operating capacity, a periodically updated national overview of the quality and the ecological status of the waters.
As for knowledge and evaluation of the ecological status of the sea in different basins of water, meaning beyond the limits of the coastline, enactment of the Marine Strategy in Italy, and compliance with the resulting requirements, is expected to stimulate additional activity.
In this edition, therefore, topics pertinent to the physical characteristics of the sea and the coastal environment shall be touched on, while a number of noteworthy events of the last year involving the weather and the sea will be illustrated.
Other topics examined shall include the quality of the water and observation of marine algae, highlighting certain changes in the marine-coastal environment, many with anthropic causes, though all too often they are perceived as problems only in the summer season, in relation to tourist and swimming activity.

The situation

The morphology of the Italian peninsula divides the Mediterranean into two main basins that can be considered partially closed. The first is the western Mediterranean, bound by the Canal of Sicily and featuring extensive abyssal plains, while the second, the eastern Mediterranean, is much more irregular, being dominated by the Mediterranean ridge.

The Italian coastline has an overall length of 8,300 km[1]. Today more than 9% of the coast is artificial, being bound by works built right on the shore (3.7%), by ports (3%) and by structures that partially overlap the coastline (2.4%).

The Italian coastline has a total length of approximately 8,300 km.

7,500 km of natural coastline.

The natural coastline measures approximately 7,500 km. More than a third consists of mountainous coasts presenting a variety of morphologies, often with the type of intricate, craggy outcroppings most frequently found in Italy’s two largest islands, Sardinia and Sicily, and in the regions of Liguria, Tuscany and Campania along the Tyrrhenian seaboard. Low-lying shores of sand or rock can be found throughout the coastline, often between high, cliff-like zones or in the middle of two promontories, except along the Adriatic coast, which consists almost exclusively of long, straight stretches of sandy beach or river deltas, plus the country’s most extensive lagoon areas.

Approximately 70% of the low-lying coastland consists of beaches of sand or gravel, for an overall length of 3,270 km and a total surface area of more than 120 km^2. Italian beaches generally extend fairly far inland (dozens of metres), with this being especially true on the Adriatic shore. The regions of Emilia-Romagna and Veneto have the largest beaches; Sicily is the region with the most kilometres of sandy shoreline, while Calabria has the most square kilometres of beach area.

70% of Italy’s low-lying coastland consists of beaches of sand or gravel, for a total length of 3,270 km and a surface area of 120 km^2.

Coastal dynamics.

The coastal environment is a dynamic system in which natural and anthropic processes combine and interact, modifying geomorphological, physical and biological features, with the sandy seacoasts being the most accessible – and, therefore, most vulnerable – areas, meaning those where change are most apparent. The way in which the sea continuously shifts sediment (with its currents, tides, waves and storms) subjects the coastland to constant change, as shown by the way new layouts of the shoreline can appear, with portions of land emerging from or being immersed by the sea, even in the space of a single season. The action of the sea is countered primarily by the silt carried downstream by rivers, which provides natural replenishment of coastal areas of sand or gravel, plus all the initiatives, such hydraulic and maritime projects, designed to block the built-up of sediment and keep it from flowing along the shore. In recent decades, Italy’s coasts have undergone a noteworthy geomorphological evolution, with most of the coastal erosion being of anthropic origin.

From 1950 to 1999, 46% of the low-lying coastlands underwent modifications of more than 25 metres, and even accounting for beach

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[1] ISPRA processing of territorial coverage provided by the ortophotos of the IT2006 flight. The calculation of the length also took into consideration the straight portions of coastline introduced at river mouths and by port and maritime structures (“spurious” coastline), plus the portions of artificial shoreline consisting of permanent structures built along the coast

areas that advanced, thanks to land-fill efforts that regained from the sea terrain partially returned to its natural state in ensuing years, the sections of eroded coastline (1,170 km) were greater than the portions that advanced.

From 1950 to 1999, 46% of the low-lying coastlines underwent changes of more than 25 metres. During the period between 2000 and 2007, 37% of the shoreline was subject to variations of more than 10 metres, while the eroding coastal areas (897 km) were still greater than the advancing ones (851 km).

Table 5.1: Variations in the layout of the shoreline, for low-lying coastland only, in the periods 1950/1999 and 2000/2007[2]

Coastland	1950/1999 (variations >+/-25m)		2000/2007 (variations >+/-10m)	
	km	%	km	%
Stable	2,387	49%	2,832	60%
Modified	2,227	46%	1,747	37%
Eroded	*1,170*	*24%*	*897*	*19%*
Advanced	*1,058*	*22%*	*851*	*18%*
Undefined	248	5%	143	3%
TOTAL	**4,862**	**100%**	**4,722**	**100%**

An analysis of the variations in the shoreline between 2000 and 2007 confirmed this trend: 37% of the shoreline underwent variations of more than 10 metres, while the portions of eroded coastland (897 km) were still greater than those recovered through replenishment (851 km). Figure 5.1 shows examples of variations in the periods analysed along a portion of shoreline characterised by a gradual but unmistakable state or erosion.

The variations in the layout of the shoreline and the position of the beach show a gradual but unmistakable state of erosion.

Figure 5.1: History of the erosion of a section of coastline (Trigno - Molise)[3]

[2] Source: ISPRA. The difference in the total length of the low-lying coastline is caused by the variations in the layout of the shoreline, by the exclusion of the areas of fill considered in 1999, though they are natural in part, and by the additional maritime works and breakwaters built between 2000 and 2007, plus the exclusion of other "masked" areas revealed by the ortophotos of flight IT2006

[3] Source: ISPRA processing of the aerial photographs of flight IT2006 and overlay of the shape of the shoreline arrived at by combining the 1:25,000 IGM charts and the ortophotos of the beaches taken during flights IT2000 and IT2006

In terms of surface area, between 1950 and 1999 a full 54 km^2 underwent significant erosion (more than 25 m), with the overall balance between receding and advancing areas proving negative, for a net loss of approximately 5 km^2 of coastal territory. The withdrawal of shoreline and the loss of marine-coastal surface area was particularly evident and far-reaching by the mouths of rivers. Entire beach areas have receded to a significant extent, causing a loss of land with both environmental and economic repercussions, while there are many instances in which the erosion of the shoreline could jeopardise the safety of homes, roads and railways, especially in the event of storm surges. Despite numerous efforts to preserve and replenish the shoreline, beaches have continued to lose ground. Between 1999 and 2007 Italy's beaches lost 16 km^2, compared to advances of 15,2 km^2. The balance of the contrasting variations (advances and withdrawals) remains negative, as does the stability of the shoreline (Table 5.2), while the difference between the total surface area of Italian beaches in Italy in 1999 (122.2 km^2) and in 2007 (121,6 km^2) points to the loss of an additional 600,000 m^2 of beach area. Certain beaches have continued to shrink, while a number, as shown in Figure 5.1, have moved further inland.

Despite efforts to preserve and replenish the shoreline, between 1999 and 2007 Italy's beaches lost a total of 16 km^2 compared to advances totalling 15.2 km^2.

Table 5.2: Variations in beaches during the period 1999/2007[4]

	km	%	km^2
Beaches	3,271	100%	121.6
Stability	1,499	46%	
Withdrawal	882	27%	16.0
Advances	851	26%	15.2
Undefined	39	1%	

The balance of the contrasting variations (advances and withdrawal) and the stability of the shoreline are still negative.

The situation illustrated holds only through 2007, as a more up-to-date analysis would require new data, such as high-resolution coverage on national scale to replace the ortophotos of flight IT2006. The coastal areas are those most heavily occupied by urban development and economic and production activities; in recent decades the elevated population density and high levels of activity have focussed increasing attention on evolving status of the shoreline, especially with regard to erosion. Population density in coastal areas stands at more than double the national average, without even taking into account seasonal flows and tourist stays. Data from Italy's ISTAT statistics institute shows that 30% of the country's population resides in its 646 coastal municipalities, meaning in a total area of 43,000 km^2, or roughly 13% of the national territory. And the elevated population density brings with it extensive urban, economic and production development that, in many areas, has significantly altered the surrounding natural and environmental characteristics. The main land transport infrastructures have developed, in part due to the geographic make-up of the land, just a short distance from the coast, while Italy's strategic position in the Mediterranean has historically favoured seagoing transportation and trade.

Roughly 30% of the Italian population lives in the country's 646 coastal municipalities.

[4] Source: ISPRA

Italy's rate of land occupation is higher in coastal areas than in the rest of the national territory; an analysis of the data in *Corine Land Cover*, updated to 2006, showed that the percentage of the territory within 10 km of the shore occupied by urban structures is 9.2%, while the figure for the rest of the national territory is 5.8%. The portion of the shoreline rendered "artificial" by structures for residential use and transportation has continued to rise, with an overall increase in all the European countries, between 2000 and 2006, of 5% in areas within 10 km of the shore[5].

In Italy, in 2006, 9.2% of the territory within 10 km of the shore was occupied by urban structures, while the figure for the rest of the national territory was 5.8%.

Looking at the incidence of urban development in the areas closest to the coast, the percentages of land utilised and occupied rise exponentially. Of the national territory falling within 300 m of the shore, an area classified under the pertinent legislation as protected for its landscape value (Legislative Decree 42/2004, as subsequently amended), 34% is urbanised, for a total surface area of 696 km^2. In the central Adriatic areas, where the bulk of the urban development has taken place over the last 50 years, more than half the territory within 300 metres of the shore is occupied for use (Abruzzo - 62%, Marche - 59%, Emilia-Romagna - 55%). Other zones in Italy present more varied situations, with large residential zones that are normally connected to major urban agglomerations by the sea (Trieste, Naples, Catanzaro, Catania) but also include stretches of natural seacoast free of buildings and works, a type of development found most frequently in Sardinia, the region with the lowest overall concentration of residential areas and centres along the coast.

Figure 5.2: Beach with internal boundary partially occupied by residential structures (Molise)[6]

As shown by the illustration, the anthropic actions have led to increasing interference with the natural processes of the shore. The hardening of the inner boundaries of beaches with permanent artificial structures, whether for urban development or maritime activities, has affected the dynamics and the environmental characteristics of many shore areas.

As shown by Figure 5.2, anthropic actions increasingly interfere with the shoreline processes, whether to obtain some advantage or safeguard resources at risk. The hardening of the internal boundaries of beaches with permanent artificial constructions for urban

[5] EEA, Report *The European Environment – State and outlook 2010*

[6] Source: ISPRA

development or maritime operations has affected the dynamics and environmental characteristics of many shore areas. Today 53% of internal beach boundaries are artificial, with 87% of those consisting of the dense urban fabric of residential agglomerations, for the most part scattered homes that often serve as second residences or are used for seaside tourism (Figure 5.3).

53% of inner beach boundaries are artificial.

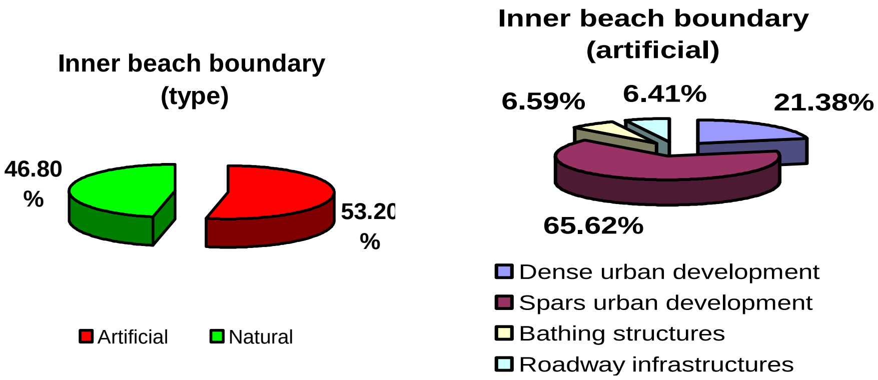

Figure 5.3: Break-down of inner beach boundaries by type (a) and break-down of artificial types (b)[7]

More than 300 km of Italy's coastline is occupied by 700 ports and minor maritime works.

Furthermore, over 300 km of Italy's coastline is occupied by approximately 700 ports and minor maritime facilities, such as simple jetties and pontoons used as small-scale tourist docks.

The maritime works of the national port system provide a total of approximately 2,250 km of facilities, of which 615 km (27%) are set aside for commercial and industrial structures, while approximately 1,415 km (63%) consist of ports, smaller wharfs, canals etc.

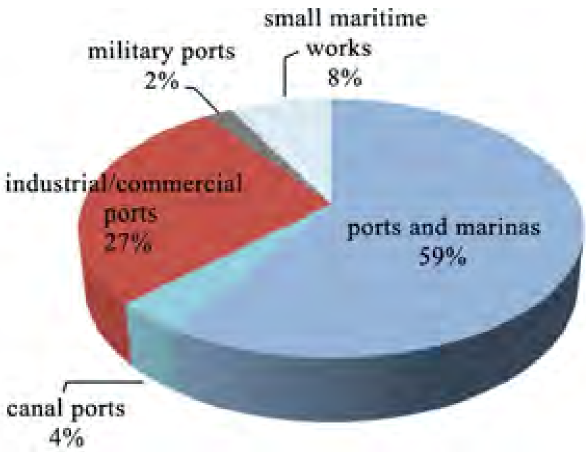

Figure 5.4: Length of maritime facilities in km by type[8]

27% of maritime e facilities consist of industrial and commercial ports and 63% of ports, smaller ports and canal ports.

The total length of the maritime facilities connected with the national port system (the sum total of the wharfs, jetties, quays and breakwaters) is approximately 2,250 km, of which 615 km (27%) are set aside for commercial and industrial structures utilised solely for the movement of cargo, as well as shipbuilding activities and ancillary industrial operations, while approximately 1,415 km (63%) consist of ports, smaller wharfs and canal ports that serve as docking points for ferries and cruise ships, or as fishing or leisure craft ports, with these functions often being combined in multipurpose structures.

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[7] Source: ISPRA
[8] Source: Ibidem

Between 2000 and 2007, 34 new ports were built and completed, occupying 13 km of coastline, for a total of 70 km of facilities offering an additional 7,500 berths[9].

Between 2000 and 2007, 34 new ports were built and completed.

The new port facilities are utilised primarily to house pleasure craft; indeed, 21 are strictly tourist ports, 9 are set aside for pleasure and fishing boats, and only the remainder are devoted exclusively to fishing, cargo trade or passenger transport.

At the same time, 181 of the existing port areas were expanded or restructured during this same period, including some of Italy's major complexes, such as the port systems of Genoa, Naples, Civitavecchia and Ancona, and a number of projects are still underway.

181 existing port areas have been expanded or restructured.

These initiatives contemplate a wide variety of works, ranging from the expansion of small ports to the transformation of large structures to a completely different use (for example, the conversion of the former NATO base in Maddalena island to a hub for tourist activity).

It is interesting to note that the work done in the sea has primarily regarded the restructuring needed to make space for new tourist marinas (Genoa, Cagliari, Ravenna etc.), to improve the docking sites of ferries and cruise ships (Palermo, Civitavecchia etc.) and to increase cargo traffic.

Anthropic action in coastal areas, in the form of maritime works, urban development and production activities, gives rise to increasing interference with the natural processes of the shoreline.

On the other hand, certain circumstances inherent to coastal environments, such as shoreline erosion, flooding and exceptional marine weather events, pose a threat to urban agglomerations close to the coast, placing habitations, infrastructures and economic and recreational activities at risk.

For the most part, risks in the coastal zones of Italy are tied to instances of erosion and to events involving storms and flooding, factors of particular relevance along low, sandy coastlines and in coastal floodplains, as shown by the preliminary efforts of flood risk assessment and management carried out under the decree of implementation of the Directive 2007/60/EC on floods.

Risks in Italy's coastal zones are tied primarily to instances of erosion and to storm and flooding events. Protective initiatives have been taken to mitigate erosion and safeguard homes and infrastructures.

Over the years, numerous initiatives have been taken locally to mitigate processes of erosion and protect homes and transportation infrastructures.

In the most serious cases, rigid works have been built right on the shore, while in others alternative solutions have been tried, such as groynes, breakwaters or mixed solutions, all with the primary goal of interfering with the shoreline dynamics underway, so as to favour sedimentation or limit the destructive force of storm surges along the coast. The geomorphological characteristics of the shoreline, its exposure to marine-weather events and the intensity of storm surges are the parameters that influenced the type of initiatives chosen and the resources employed.

[9] Source: http://www.pagineazzurre.com/italian/porti

Table 5.3: Coastline with protective works, situation as of 2007[10]

Region	Length of coast	Protected coast	Protected coast
	km	km	%
Veneto	216	81	37.3
Friuli-Venezia Giulia	116	42	36.3
Liguria	378	132	35.1
Emilia-Romagna	174	70	40.4
Tuscany	646	73	11.3
Marche	176	116	65.9
Lazio	380	73	19.3
Abruzzo	129	71	54.8
Molise	37	24	66.5
Campania	502	114	22.6
Apulia	957	118	12.3
Basilicata	66	1	1.5
Calabria	734	112	15.2
Sicily	1,603	208	13.0
Sardinia	2,160	95	4.4
Italy	**8,274**	**1,331**	**16.1**

More than 1,300 km of coastline are protected with various types of defensive works.

An analysis of the data shows that lengthy sections of shoreline in the coastal regions are protected with rigid works, while the regions of the central Adriatic are almost completely protected by defensive works placed right on the shore or only a few hundred metres away. Looking at Italy's coastline as a whole, approximately 270 km of breakwaters have been built, compared to the more than 1,300 km of shoreline protected with other types of defensive works (Table 5.3). More than 500 km of coastline are protected with works placed directly on the shore, as a final line of defence. The remainder is protected by groynes, reinforced river mouths and combined works, with these last consisting of protective works that, over time, have lost their distinguishing characteristics as a result of expansion or restructuring.

The central Adriatic regions are almost completely protected by defence works placed right on the shore or only a few hundred metres away.

The quantity of shore areas stabilised artificially has continued to grow, despite the use in recent years of the practice of restoring beaches through artificial replenishment, by adding sand taken from river beds or deposits under the sea. Between 2000 and 2007, additional protective works were constructed (250 groynes, reinforced river mouths and combined works), works placed directly on the shore (more than a kilometre) and new breakwaters (16 km).

Artificially stabilised shoreline has continued to increase: between 2000 and 2007, additional protective initiatives were taken and new breakwaters were built.

The defensive projects, whose main objective was to prevent the growing erosion and stabilise the beaches, have not always achieved that result, often simply transferring the erosion to adjoining portions of shore or, in many cases, contributing to the ongoing artificialisation and deterioration of the marine-coastal habitats.

In certain cases, as illustrated in Figure 5.5, a number of defensive works were replaced with newly constructed facilities to favour the exchange of coastal waters and to reduce the impact on their quality, or to improve the efficiency of the systems of protection.

[10] Source: ISPRA

A number of works have been replaced with newly constructed facilities.

Figure 5.5: Protective works replaced with new facilities between 2000 and 2006 (Nettuno)[11]

Replenishment is a alternate technique for restoring eroded beaches.

An alternate technique able to provide an excellent response to coastal erosion, in both environmental and economic terms, is replenishment. Eroded beaches are rebuilt by filling them with suitable material (in terms of both grain size and composition). In years past, the material was taken from land quarries, and only in certain cases from river or marine deposits. More recently, the search for new sources of material to use in the replenishment of eroded beaches has stressed exploration of the sea floor. Deposits of relict sands (generally the remains of old beaches) can be found on the continental shelf and used for replenishment. There are a number of advantages to using relic sand for this type of operation, such as the availability of large quantities of sediment (millions of m^3), the fact that its composition resembles that of our coastlands, the limited effect of the environment and the modest cost. These materials, found along the continental shelf at depths of between 30 and 130 metres, are recovered through dredging operations.

The first replenishment operations in Italy date to 1994.
More recent relic-sand dredging activities were undertaken in a quarry in Anzio and in two other deposits.

The first dredging of relic sand in Italy was carried out in 1994 for the replenishment of the Cavallino and Pellestrina beaches (Venice). Approximately 6,000,000 m^3 of sand has been used from 1994 to the present, having been taken from an offshore deposit located between the mouths of the Tagliamento and Adige rivers, at a depth of approximately 20 m. Other offshore dredging was performed by the ports of Ravenna (2002 and 2007) and Civitanova Marche (Province of Macerata) (2006). The first such activities in the Tyrrhenian Sea involved the quarrying of a deposit of relic sands found off of Anzio (Province of Rome) and used to replenish the Ostia shore in 1999. The Lazio Region then undertook a series of relic-sand dredging operations for the purpose of replenishment, utilising up through 2010, and more recently in 2012, both the Anzio quarry referred to above and two other deposits found, respectively, off of Montalto di Castro (Province of Viterbo) and off of Torvaianica (Province of Rome). As shown by the above overview, any operation involving the

[11] Source: ISPRA

sea or a coastal environment must necessarily be approached with a solid, hands-on knowledge of the physical and biological processes at work in these environments.

The level of the sea, the height and period of the waves, the currents, the atmospheric pressure, the wind and the temperature are the basic parameters for characterising the tide and wave systems of Italian seas and marine dynamics along the country's coasts. The data collected by the ISPRA's networks for measuring sea level (RMN) and waves (RON), appropriately processed and subjected to statistical analysis, provides a large quantity of local and regional information on the state of the sea, such as variations in tides, plotting of the prevalent directions of sea-surge waves, distribution of maximum heights, statistical processing of past storm surges, plus estimates of the probability of the wave heights expected for each individual location, all leading to a risk assessment.

The state of the sea is determined from physical parameters, such as: the level of the sea, the height and period of the waves, currents, atmospheric pressure, wind and temperature.

In the Mediterranean Sea, the average maximum tidal range is 45 cm, unlike the countries of northern Europe, were it can exceed 10 metres, while the tide cycles follow a mixed, semi-diurnal pattern, with two high tides and two low tides each day, at tide levels that vary during a given month. The tides in the sea basins along Italy's coastline alternate at an average interval of 6 hours between each high and low tide, with fairly limited average height differences of 30-70 cm.

The average maximum tidal range in the Mediterranean is 45 cm.

The Mediterranean's highest figures for tides are registered in the Adriatic, a semi-closed basin. In the upper Adriatic, the tidal range can occasionally be more than a metre, and under certain astronomical and meteorological conditions, such as a strong Scirocco wind from North Africa, there can be exceptional rises in the level of the sea, both on account of the local lay of the land and the city's noted tendency to sink, allowing the waters of the Venice lagoon to invade the city proper for a few hours, giving rise to the condition of high water in Venice.

The Adriatic presents the highest figures for tides.

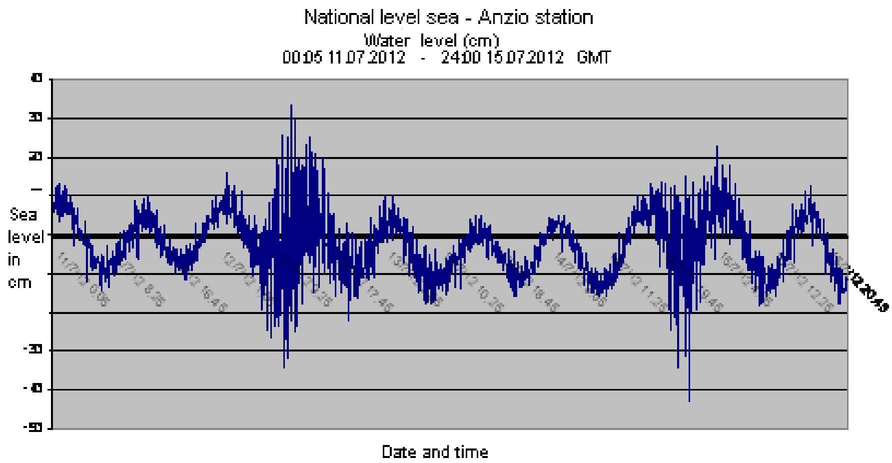
The morphology of the Italian peninsula is especially well suited to collecting useful, significant data on seas, not only for determining tide patterns along its coasts, but also for studying and interpreting other natural events that occur in the Mediterranean basin. *Seiches*[12] are among the most worthy of note (with the best known example being that of the Adriatic Sea), together with anomalous waves caused by seismic events or weather conditions.

Data on tides is also pertinent to other natural occurrences, such as Seiches *and anomalous waves.*

One such event occurred on 12 July 2012, when a variation in the sea level was observed along the coasts of Lazio and Calabria for a number of hours. The episode was recorded by the National Sea Level Network, whose Anzio station registered a total sea-level variation of approximately 20-30 cm (Figure 5.6), a change that recurred (or possibly came to a conclusion) on July 14th.

Variation in the level of the sea registered on July 12, 2012.

[12] Freestanding fluctuations of an entire basin, with the effects potentially augmenting those of the tides



Tide readings at the Anzio station showing a meteorological tsunami.

Figure 5.6: Tide level registered by the Anzio tide gauge that recorded the meteorological tsunami of July 2012[13]

The event was also observed and documented by the Harbourmasters' Offices and by people at the beach.

Based on ISPRA's data, and following consultation with the bodies responsible for monitoring the locations in question, seismic or volcanic activity in the area was ruled out as a possible explanation of the event. The causes are still being studied by experts in the field, but for now the hypothesis with the most support points to the effect of an atmospheric perturbation that originated in North Africa. When the harbourmasters' offices were asked for reports of any repercussions of the anomaly or possible interference with normal port and tourist activities, the Anzio office told of a hydrofoil vessel that was leaving port at the time of the event and had difficulty due to the low level of water in the navigation canal at the time of the event, which created a whirlpool. The Harbourmaster's Office of Gaeta also received numerous reports from people at the beach, and in particular from the Serapo Beach, whose limited incline resulted in a noteworthy - albeit temporary - withdrawal of the water towards the open sea.

Sudden variations in the level of the sea are a fairly common occurrence along certain stretches of the Italian coast.

Though not a normal occurrence for the Tyrrhenian coasts of central-southern Italy, sudden variations in sea level are fairly frequent along certain stretches of the Italian coast, such as the Canal of Sicily, where they are referred to as "*marrobbio*" and associated with certain conditions of weather and climate. The case recorded in July, however, was most likely a "weather-tsunami" set off by sudden variations in atmospheric conditions, such as the passing through of pressure fronts.

Variation in the sea level caused by the marine-weather event of 28 November 2012.

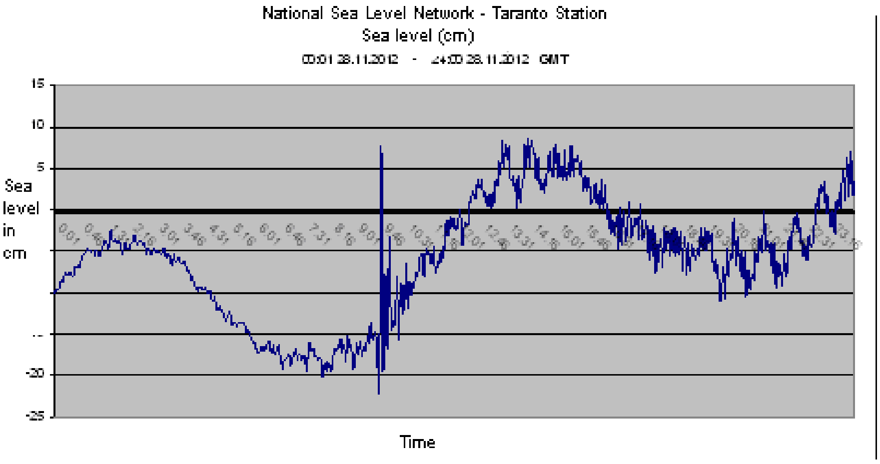
Another anomalous event recorded by the National Sea Level Network was the twister that touched down in the Gulf of Taranto on 28 November 2012, hitting both the city and the surrounding province: an event that made the news not only as an extraordinary marine weather event, but primarily on account of its devastating consequences in terms of human lives and the damage done to port and industrial activities. According to the readings of the Taranto tide gauge (Table 5.4), the twister hit the port area in the interval of time between 9:45 pm and 9:55 pm GMT (10:45 pm – 10:55 pm solar time), triggering a sudden jump in the sea level, which rose by 30 cm in the space of 5 minutes, returning to its normal level after approximately 3 minutes. Figure 5.7 also indicates the fluctuations that occurred inside the port basin as a result of the twister.

[13] Source: ISPRA

Table 5.4: Sea level registered by the Taranto tide gauge[14]

Date	Time	Sea level (cm)
28 Nov. 2012	9:45	-22.3
28 Nov. 2012	9:46	-17.9
28 Nov. 2012	9:47	-6.2
28 Nov. 2012	9:48	1.6
28 Nov. 2012	9:49	7.7
28 Nov. 2012	9:50	1
28 Nov. 2012	9:51	-9.3
28 Nov. 2012	9:52	-19.3
28 Nov. 2012	9:53	-19.6

The twister hit the port area between 9:45 pm and 9:55 pm GMT on 28 November 2012, triggering a sudden jump in the sea level, which rose 30 cm in the space of 5 minutes, returning to its normal level after approximately 3 minutes.



Sea levels recorded by the Taranto tidal gauge during the passage of the twister of 28 November 2012.

Figure 5.7: Sea-level readings taken by the Taranto tide gauge (28 November 2012)[15]

Marine dynamics and processes in shallow waters are influenced not only by tidal currents, but also by the motion of the waves, the majority of which are generated by the action of the wind.

The statistical study of the directions typically taken by waves is referred to as the “wave climate”.

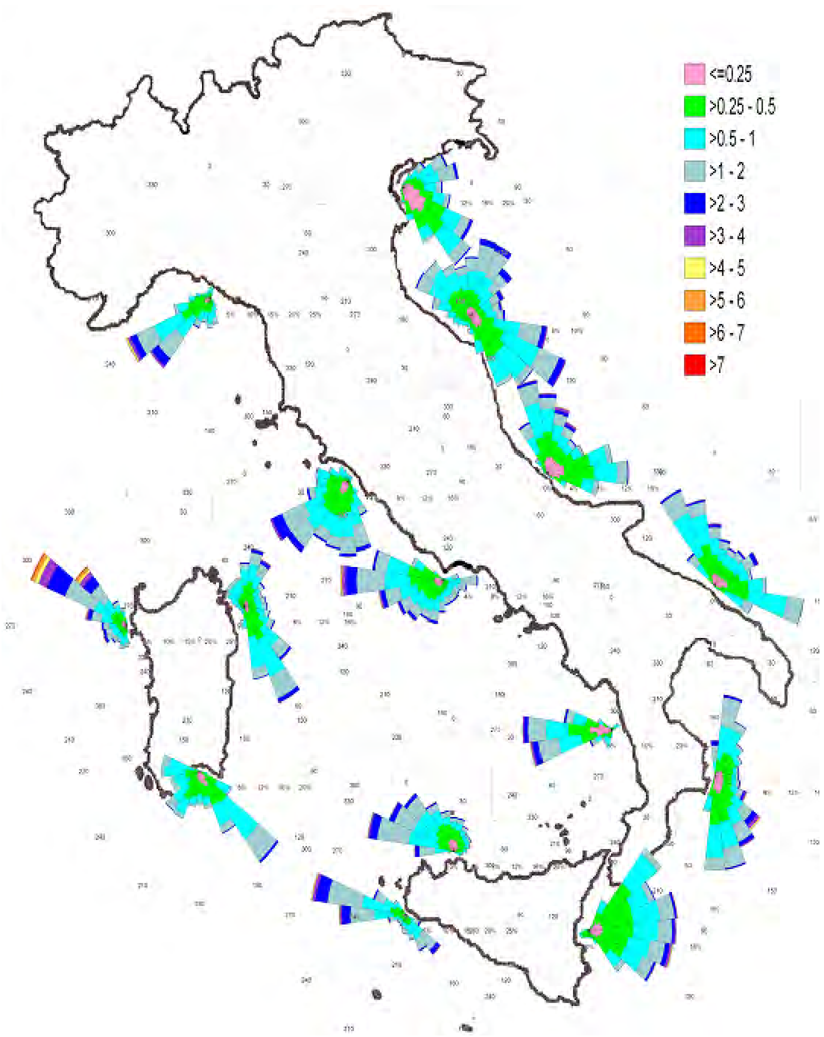
The most useful analyses for studying the wave climate at a given site are statistical distributions of significant wave height, presented graphically, with respect to the period and direction of the waves, in the form of “wind rosters”.

As shown by Figure 5.8, each point of measurement present a roster of winds that provides two different types of information: the angular distribution of the significant wave height and the frequency of wave events, divided by categories of wave height.

Marine dynamics and processes in shallow waters are influenced by tidal currents and by the motion of the waves.

[14] Source: ISPRA

[15] Source: Ibidem



Wave events in the Tyrrhenian Sea tend to be unidirectional, whereas the wave climates in the Ionian and Adriatic Seas are always bimodal at the very least. The Tyrrhenian also presents the highest peak wave heights in all the Adriatic.

Figure 5.8: The wave climate along the Italian coastline - The radial distance indicates the probability of an event in the corresponding directional sector, while the colour indicates the significant wave height[16]

The Italian wave climate follows two main patterns: unidirectional (as in the case of La Spezia) or distributed over two or more directional sectors (Ancona and Civitavecchia).

The Italian wave climate follows two main patterns: unidirectional (as in the case of La Spezia) or distributed over two or more directional sectors (Ancona and Civitavecchia).
Events in the Tyrrhenian Sea tend to be unidirectional, whereas the wave climates in the Ionian and Adriatic Seas are almost always bimodal, at the very least. The Tyrrhenian also presents the highest wave peaks in all of the Adriatic, due not only to the intensity of its winds, but also to the greater surface area along which the wind is able to transfer energy to the waves. The highest waves are registered at the Alghero buoy, which also presents the most episodes of waves higher than at least 3 m (Figure 5.8). The *Maestrale* is the wind that generates almost all the storm surges in western Sardinia, and its effects are also felt in the central and southern Tyrrhenian Sea. For example, the all-time maximum level of 9.8 m registered by the Alghero buoy involves the same event registered by the buoys of Cetraro (8.9 m) and Ponza (7.9 m) as well: the storm surge of 28 December 1999, known as the “storm surge of the century” or “the Christmas storm surge".

[16] Source: ISPRA processing of data registered by the National Wave Measurement Network

Storm surges in the Adriatic often arrive from the north, or from the east east-northeast, in which case they tend to be less intense (maximum recorded height of 6.2 m), though instances of waves measuring around 3 m are not rare.

The wave climates of the seas, supported by the wave parameters recorded by observation networks, provide an overview of the number and intensity of the storm surges to which the various coastal sectors are exposed, though the destructive effects of certain storm events, together with the risk posed to many coastal areas, makes analyses of extreme events increasingly necessary for calculation of the long-term probability of the recurrence of a given storm event.

The destructive effects of certain storm events, together with the risk posed to many coastal areas, makes analyses of extreme events increasing necessary.

Extreme events are studied by identifying a series of events of maximum intensity, regardless of the wave heights recorded, and then applying the Peak Over Threshold (POT) method. The results of the analysis make it possible to determine the average amount of time likely to pass between two intense events (return time).

This method also makes it possible to establish the probability that a wave higher than 6 m will occur within a given period of time (25 years, for example), in addition to providing a way to determine, conversely, what will be the highest wave to occur within a period of 25 years (return height), once that probability has been set at 95%.

Note
The return period corresponds to the maximum result observed in 20 years (T_m); the return level corresponds to periods of 35, 40, or 50 years (H_{s35}, H_{s40}, H_{s50}), depending on the length of the time series available.

Figure 5.9: Distribution of extreme events along the Italian coastline[17]

Studies of extreme events involve identifying a series of events of maximum intensity, regardless of the wave heights registered, and then applying the Peak Over Threshold (POT) method. The results of the analysis make it possible to determine the average amount of time likely to pass between two intense events (return time), as well as the probability that, within a given period of time, there will be a wave higher than 6 m or, conversely, what the highest wave will be within a period of 25 years (return height), if the probability is set at 95%.

[17] Source: ISPRA processing of data registered by the National Wave Measurement Network

As a rule, storm surges are more intense and more frequent in the seas of Italy's west coast (Tyrrhenian, Ligurian, Straits of Sicily, central Mediterranean), than along the country's east coast (Adriatic and Ionian Seas).

Storm surges are most frequent in the seas on Italy's west coast.

Based on the average number of storm surges per year and the maximum heights registered, three different zones can be distinguished:

- The Adriatic Sea, with 12-15 episodes a year and return heights of 5-6 m;
- The Ionian Sea, with 8-15 events a year and return heights of approximately 6 m;
- The Sea of Sardinia, the Sea of Sicily, the Tyrrhenian and the Sea of Liguria, with 12-20 episodes a year and return heights of more than 6.8 m.

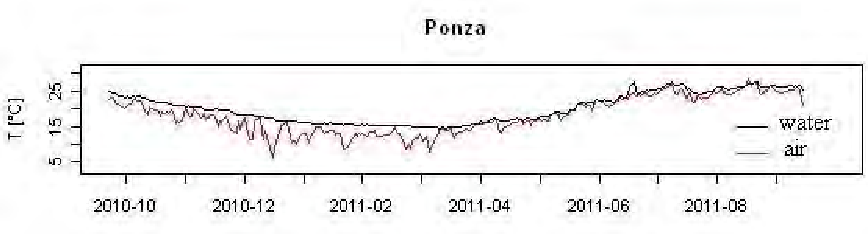
In addition to the wave and tide patterns, another fundamental parameter for analysing the physical characteristics of the sea is the temperature of marine waters: a key factor in understanding the movements of ocean masses, on a par with the temperature and humidity of the air with regard to atmospheric movements, and of fundamental importance in assessing instances of climate change.

The temperature of marine waters is a key factor in understanding the movements of ocean masses and evaluating climate change.

The surface of the sea absorbs a large part of the energy radiated by the Sun. As is common knowledge, this energy then spreads from the upper layers of the water towards to the lower, colder layers, by means of conduction, or it propagates as a result of the convective effect created by the turbulence of the fluid mass. The process of thermal transmission by conduction alone is practically negligible within timeframes of days or even years, becoming significance only with respect to extremely long-range outcomes (such as those that arise in the course of geological periods), whereas convection proves dramatically more rapid and effective, causing noteworthy increases in water temperature down to depths of several hundred metres.

The set of readings for air and water temperatures present characteristics with significant similarities, such as a marked auto-correlation in terms of time, plus the presence of seasonal and daily components, due to variations in solar radiation. A direct comparison of these readings, which were taken in the open sea by the buoys of the National Wave Measurement Network, provides a significant amount of information on the thermal characteristics of the surface of the sea, as well as on heat exchange with the upper layers of the air, even in the absence of readings on the underlying driving factor, meaning solar radiation.

An example is provided by the comparison of the temperatures of the sea and the air registered during the annual cycle of the Ponza buoy (Figure 5.10). As can be seen, the surface level of the sea presents limited thermal fluctuations during the annual phase of rising temperatures, and this despite the enormous amounts of thermal energy absorbed. For the most part, the absorbed heat is lost in exchanges with the air, through evaporation and as a result of the convective transmission to the underlying layers of water; still, the balance of the heat absorbed and lost from solar radiation is positive, as the average surface temperature of the water proves to be higher than that of the air above. Based on the data of the National Wave Measurement Network, the average thermal difference between the water and the air in Italy's seas is approximately 1.7°C.



Note
Temperatures from the sensors of the Ponza buoy docked in the open sea, latitude 40°52’00’N, longitude of 12°57’00’E, depth of the sea floor 115 m.

Figure 5.10: Temperatures of the water and the air registered by the Ponza buoy[18]

The surface layer of the sea presents limited thermal fluctuations during the annual phase of rising temperatures, despite the large amount of thermal energy absorbed. The average thermal difference between the water and air of Italy’s seas is approximately 1.7°C.

To evaluate air-water interactions on the open surface of the sea, all seasonal components must be identified and eliminated.

To evaluate the air-water interactions on the open surface of the sea, meaning the factor that determines heat exchange, it is best to identify and eliminate all the seasonable variables. The cross-correlation chart for the historical plotting of the average daily air and water temperatures registered by the Ponza buoy (Figure 5.11a) points to a marked interdependence between the air and water temperatures, despite the presence of an annual seasonal component. This characteristic is not eliminated when only the residual values obtained from the difference between the air and water temperatures are considered (Figure 5.11b), with the interdependence appearing even between results from different time periods.

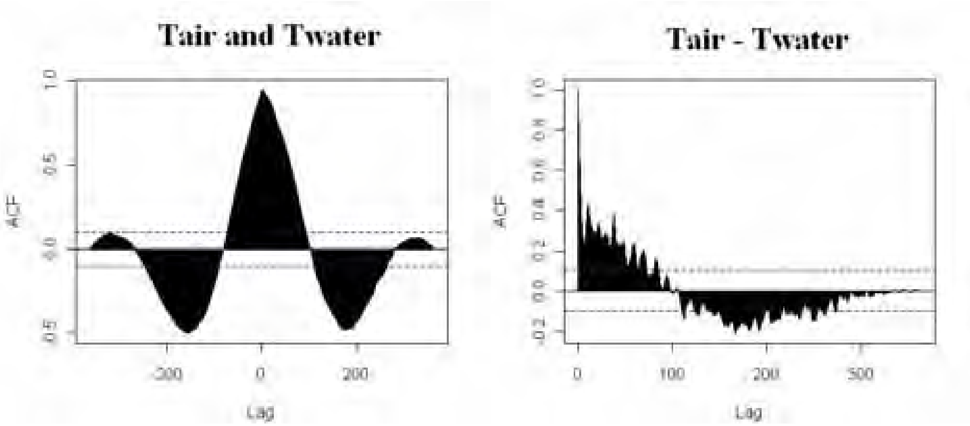


Figure 5.11: Cross-correlation chart of temperature variables (a) and residual results (b) (Ponza buoy)[19]

On the other hand, once the average monthly figures are removed from the historical series, a weak correlation can be observed among the residual values (Figure 5.12a). These residual values represent the difference between the water temperature and the air temperature, after accounting for the seasonal effect, and they are determined by the series of marine-weather factors referred to earlier, and especially evaporation, as shown by Figure 5.12b, which cross-analyses the figures for the relative humidity with the “de-seasonalised” temperatures.

[18] Source: ISPRA
[19] Source: ISPRA processing of data gathered by the National Wave Measuring Network

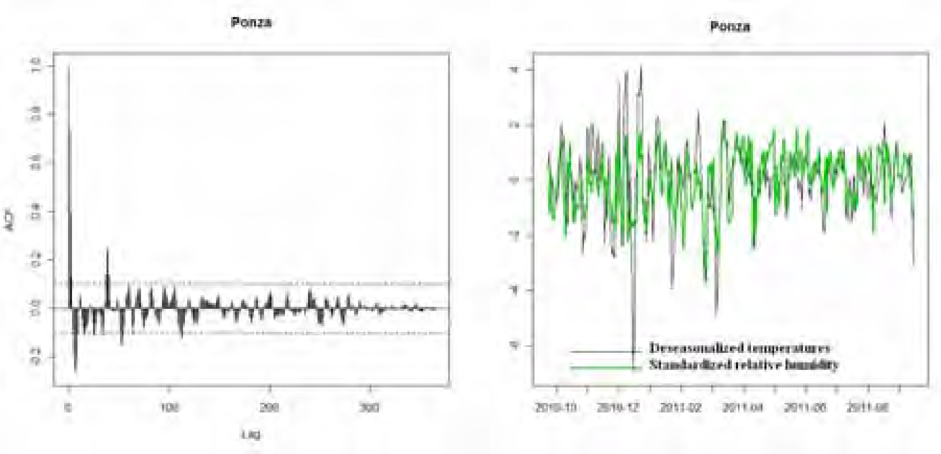


Figure 5.12: Correlation chart of the residual figures of the de-seasonalised temperatures (a) and comparison of the residual figures with the relative humidity (b) (Ponza buoy)[20]

The masses of surface water heat and cool slowly.

On a scale of days, the masses of surface water heat up and cool off slowly, unlike the ground, which can heat and cool intensively in a single day. The range of the daily thermal excursion varies, depending on factors such as the geographic features of the site and the stability of the stratification of the water, plus local factors, including cloudiness, rate of humidity and wind.

An analysis of the daily thermal excursion of the temperatures of the surface of the water and the air above it for the period 2010-2011 shows that the maximum variation in the Tyrrhenian Sea was on the order of 0.3°C for the water and approximately 1.8°C for the air. As a rule, the temperature of sea water, during the day, varies by only tenths of a degree, with the thermal peaks occurring around 3:00 pm. It can also be observed that the average daytime excursion in the open sea never exceeds a few tenths of a degree, whereas near the coast the shifts can be higher, and even twice as large. The peak water temperatures are invariably recorded when the sky is clear, the air is calm, and the Sun is at its maximum height, while the conditions for the minimum temperatures are cloudy skies, rough waters and a minimum height of the Sun, with the daily thermal fluctuation of the air proving significantly higher than that of the surface water.

In the course of the year, the temperatures follow variations in the position of the Sun, rising when it is high and falling when it is low on the horizon. The thermal peaks of the water arrive more slowly than those of the air: the readings of the National Wave Measurement Network place the peak temperatures of marine waters between July and October, with the maximum frequencies occurring in September.

Annual thermal fluctuations can reach 16°C in the Tyrrhenian Sea and 22°C in the Adriatic.

In the seas that surround the Italian peninsula, which is subject to continental influences as well, the annual thermal fluctuations reach approximately 16°C in the Tyrrhenian and 22°C in the Adriatic, compared to respective average temperatures of 19.5°C and 18.2°C. Compared to marine thermal fluctuations for continental areas at the same latitudes, they prove much lower.

[20] Source: ISPRA processing of data recorded by the National Wave Measurement Network

The quality of marine - coastal for bathing waters meets the requirements set in the decree issued by the Italian Ministry of Health on March 30th, a measure that concluded the transposition into Italian law of Directive 2006/07/EC, a process initiated with Legislative Decree no. 116 of 30 May 2008. In fact, since the 2010 bathing season, the waters used for this purpose have been monitored and evaluated according to the new criteria described below.

The new monitoring of bathing waters calls for sampling of indicators of faecal contamination (Enterococci and Escherichia coli*).*

The new system calls for sampling of only two indicators of faecal contamination (Enterococci and *Escherichia coli*) on a monthly basis. What is more, the qualitative evaluation no longer leads to a judgment of compliance, but rather places each bathing site in a quality class (excellent, good, sufficient, poor) determined on the basis of the results of the of the monitoring performed in accordance with the new directive over the last four years.

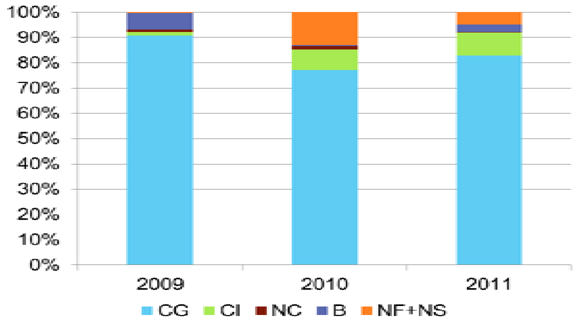
In Italy, the first classification carried out under the new provisions shall be completed by the end of the 2013 bathing season, more than a year in advance of the deadline set in Directive 2006/7/EC (by the end of the 2015 bathing season).

System of transitory classification called for by the EC.

The European Commission consider the period leading up to the first classification to be a transition phase. During this time, the concentrations of intestinal Enterococci and *Escherichia coli* for a single year of sampling are evaluated in relation to the threshold values contemplated under Directive 76/160/EC for, respectively, faecal Streptococci and faecal Coliforms. The end result is not full-fledged classes of quality but classes of compliance with the guideline values and the imperative values of the aforementioned directive.

Furthermore, in view of the operating difficulties involved in changing over to the new monitoring system, the European Commission agreed to greater tolerance in terms of the interval between successive samplings for the 2011 bathing season as well (41 days instead of 30); should this interval be exceeded, even for a single sample, then the quality rating will not be expressed and the site will be classified as “insufficiently sampled”.

Italy counted 4,901 marine bathing waters for the 2011 season. A total of 91.9% of the waters were approved, with 83% meeting the guideline standards and 8.9% the imperative ones (Figure 5.13). This result represents an improvement over 2010, when overall compliance was 85.3%, though it is lower than 2009 (92.2%). Compared to 2009, compliance with the more restrictive guideline standards fell by 13.6% in 2010 and by 7.8% in 2011 (Table 5.5). An improvement can also be observed in the percentage of waters classified as not complying with the minimum standards (the imperative reference value); in fact, though there was a slight increase (0,2%) between 2009 and 2010, in 2011 the figure fell to 0.4% of the total. As for waters closed to bathers for the entire season, though the number fell significantly between 2009 and 2010 (from 310 to 33), in 2011 it once again showed an increase (133). Waters classified as insufficiently sampled, or not sampled at all, decreased by 8% in 2011, compared to the previous year (4.9% of all waters monitored).



Legend
CI: compliant with imperative values; CG: compliant with guideline values;
NC: not compliant with imperative values; NF: insufficient sampling;
NS: not sampled; B: banned

Figure 5.13: Percentage of compliance of bathing waters[21]

In 2011, 91.9% of bathing waters met the established standards, with 83% satisfying the guideline values and 8.9% the imperative levels.

Table 5.5: Compliance of bathing waters by region – 2011 sampling 2011[22]

Region	TOTAL	CG	CI	NC	B	NF/ NS
	number	%				
Abruzzo	118	54.2	28.8	1.7	15.3	
Basilicata	60	96.7	3.3			
Calabria	651	72.2	23.3	0.3	3.8	0.3
Campania	348	72.7	7.8	2.0	17.5	
Emilia-Romagna	96	97.9	2.1			
Friuli-Venezia Giulia	57	91.2	8.8			
Lazio	274	85.4	10.9		2.2	1.5
Liguria	406	81.3	11.1	1.2	0.5	5.9
Marche	240	88.3	3.3	0.4	7.9	
Molise	33	100				
Apulia	674	93.5	4.7	0.1		1.6
Sardinia	660	94.7	5.0		0.3	
Sicily	823	83.1	6.4			10.4
Tuscany	367	64.6	3.5	0.8		31.1
Veneto	94	98.9	1.1			
TOTAL	**4,901**	**83.0**	**8.9**	**0.4**	**2.7**	**4.9**

Legend
CI: compliant with imperative values; CG: compliant with guideline values;
NC: not compliant with imperative values; NF: insufficient sampling;
NS: not sampled; B: banned

In 7 coastal regions (Molise, Veneto, Emilia-Romagna, Basilicata, Sardinia, Apulia and Friuli-Venezia Giulia), the percentage of compliance with the guideline values falls between 90% and 100%, while in 4 regions it exceeds 80%, and in the remainder it stands at between 50% and 70%).

The results of the monitoring carried out during the 2011 bathing season (Table 5.5) show that in five regions (Basilicata, Molise, Emilia-Romagna, Veneto and Friuli-Venezia Giulia) all the bathing waters met the standards, and at high levels of compliance (between 91% and 100%) with the more restrictive guideline values. As a rule, this last result is common to almost all the regions, as the vast majority of the compliant bathing waters satisfy the stricter guideline values, demonstrating the excellent quality of Italy's coastal bathing waters. In seven different regions there are waters that fail to meet even the imperative values, though at decidedly low percentages, while in an equal number of cases, and at percentages that vary to a greater extent, critical problems remain in terms of waters where bathing is prohibited for the entire season. In terms of waters that were not adequately

All the bathing waters in the regions of Basilicata, Molise, Emilia-Romagna, Veneto and Friuli-Venezia Giulia met the standards, and at high percentages.

[21] Source: ISPRA processing of EEA data
[22] Source: Ibidem

sampled (NF, NS), meaning that no quality rating can be given, the figure for the Tuscany region is of note (31%), with the figure consisting almost entirely of waters that were not sampled (30.5%).
During the 2011 season, there were also 87 sites where bathing was temporarily prohibited due to events involving "short-term pollution"[23], most of them attributable to poor operation of waste-water treatment plants or to adverse marine weather conditions that may have caused sewage systems to malfunction. In such cases, some regions, in taking adequate countermeasures, not only prohibited bathing in the area but also established constant monitoring of the watercourses that flow onto the stretch of shoreline involved.

Ostreopsis ovata Fukuyo (Figure 5.14) is a potentially toxic dinoflagellate that was observed in Italian waters for the first time in 1994, in the Lazio region (Tognetto *et al.*, 1995). Since then, this microalga has been detected in Italy with increasing frequency, in a growing number of regions and in elevated quantities, especially in the benthos.

Ostreopsis ovata.

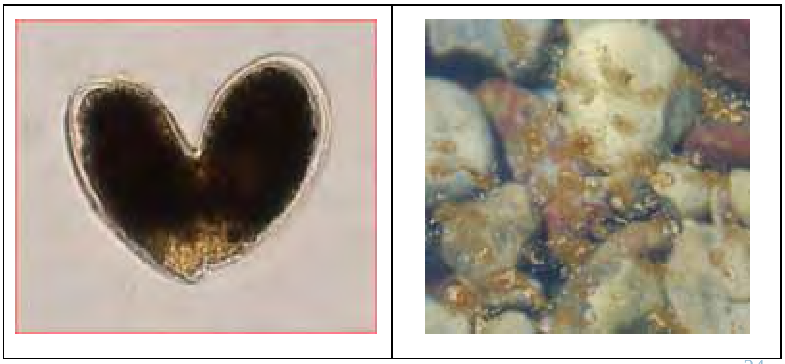


Figure 5.14: *Ostreopsis ovata* under an optical microscope[24], plus floating floccules[25]

Blooms of *Ostreopsis* in recent years have led, in some cases, to human intoxication or suffering/ mortality of benthic marine organisms[26]. *O. ovata* has also been reported in numerous other areas of the Mediterranean. The first observation took place in Villefranche-sur Mer in the late 70's (Taylor, 1979). Other reports in the Mediterranean are from the coasts of Lebanon, Algeria, France, Spain and the Balearic Islands, were cases of human intoxication have been observed (Illoul 2012, Sechet 2012, ISPRA Report no. 148/2011). The microalga has also been noted in the northern Aegean Sea, where contamination of shellfish by *Ostreopsis* sp.'s toxins was reported (Aligizaky and Nikolaidis, 2006).

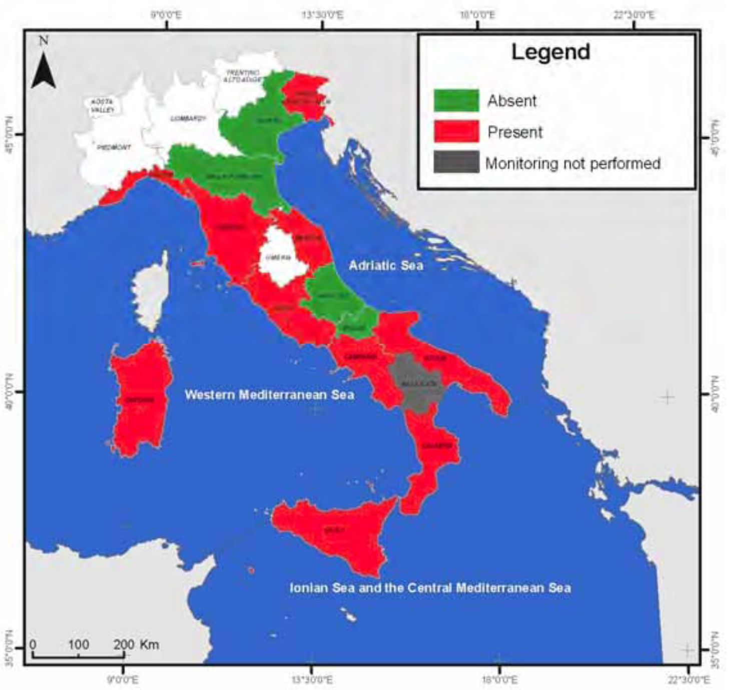
The benthonic microalga Ostreopsis ovata, *found for a number of years now in the Mediterranean, can give rise to episodes of toxicity affecting both humans and the marine environment.*

[23] "Short-term" pollution, a concept introduced under Directive 2006/7/EC, refers to microbiological contamination whose causes are clearly identifiable and is not normally expected to affect bathing water quality for more than approximately 72 hours, from its initial occurrence. Such events must be forecast, and preventive measures must be taken to safeguard bathers
[24] Source: ARPA Liguria
[25] Source: ARPA Friuli-Venezia Giulia
[26] ISPRA reports nos. 127/2010, 148/2011 and 173/2012

The benthic blooms are visible to the naked eye, in the form of mucilaginous layers or biofilms that are reddish-brown in colour and cover widespread areas of sea bottom or hard substrate. Also to be seen are beige-brown-reddish coloured foams that develop most frequently on the surface, with extensive opalescence that reduces the transparency of the water and the presence of flakes suspended in the water column. In Italy, recurring summer blooms of *Ostreopsis ovata*, often in combination with other potentially toxic dinoflagellates, such as *Amphidinium* cfr. *carterae*, *Coolia monotis* and *Prorocentrum lima*, have occurred in systems with both high and low levels of hydrodynamism, as well as on various types of substrates, in numerous locations in the Tyrrhenian, Ionian and Adriatic seas, with toxic effects on humans and benthic organisms (shellfish and echinoderms), associated with toxins belonging to the palytoxin group (palytoxin and ovatoxin-a)[27].

The location and timing of the blooming of these microalgae can vary significantly, causing serious damage to the benthonic communities.

Based on the studies carried out to date, it has been determined that there exists an Italian and Mediterranean genotype of *O. ovata*, and that the species *Ostreopsis* cf. *siamensis* can be found in our waters (Penna *et al*., 2008, Accoroni *et al*., 2011). In the Mediterranean, *O. ovata* is more widespread than *O. siamesis.* The distinction between the two is extremely important, since the toxins they produce have different effects on marine organisms and on human health (Accoroni *et al.*, 2011).



In 2011, the toxic microalga was reported as being present in all the coastal regions, with the exception of Emilia-Romagna, Molise, Abruzzo and Veneto.

Figure 5.15: *Ostreopsis ovata* along Italy's coasts (2011)[28]

In 2011, *Ostreopsis.* cf. *ovata* was detected in 10 coastal regions, while it was not found in any of the samples taken along the coasts of Abruzzo, Emilia-Romagna, Molise or Veneto (Basilicata did not carry out the monitoring) (Figure 5.15).

[27] ISPRA Reports n. 127/2010, 148/2011 and 173/2012

[28] Source: ISPRA processing of data from the coastal ARPA, 2011

O. cf. *ovata* is often found together with other potentially toxic species, and in particular the benthic dinoflagellates *Coolia monotis* and *Prorocentrum lima* or *Amphidinium* spp. and *A. carterae*. Episodes of blooming have occurred in many areas, including those already identified in earlier years as "hot spots" in Puglia and Marche. Furthermore, cases of human intoxication have been reported in Sicily and Puglia during periods of blooming. In 2011, the blooming once again varies widely in terms of location and timing, a situation that, though it makes possible comparisons with the data from earlier years, continues to prevent an evaluation of the phenomenon on a national scale.

In 2011, the blooming dynamics were found to involve a wide variety of locations and time periods.

The causes

In both the Mediterranean as a whole and in Italy, marine coastal zones remain among the most vulnerable and seriously threatened natural ecosystems, despite the fact that, to a large extent, they are subject to specific safeguards, both national and European-wide. Confirming as much is the fact that the EEA[29] has once again acknowledged that the coastal zones of Europe are subject to widespread and progressive deterioration in terms of loss of habitats, eutrophication, contamination, invasion by alien species and erosion.

The marine coastal zones of the Mediterranean and Italy represent some of the most vulnerable and threatened natural ecosystems.

Along steep coasts, the action of the sea and the percussive force of tide surges (strong breakers) set off a slow process of erosion that can undermine the foundations of cliffs, causing portions to collapse under certain conditions, while along the more vulnerable, low-lying coasts, the ongoing shifting of silt and sediment gives rise to a continuous and more readily apparent restructuring of the territory. The considerable inland extension of the Italian shoreline can be traced to the intensive commercial and agricultural activities of centuries past. These endeavours accelerated erosive processes in the countryside and in hilly regions, favouring the river-borne transport of enormous quantities of silt down to the sea. Many river mouths, benefiting from these massive supplies of silt, developed extensive, elaborately structured deltas that made possible the formation of coastal plains and the encroachment of beaches into the sea. The subsequent reining in of waterways and the urban development of the coastline, accompanied by the dismantlement or artificial reinforcement of dune systems, plus more attentive use of the land, geared towards educing the loss of top soil and stabilising hillsides, eliminated the massive flow of silt, causing beaches to retreat and processes of erosion to arise along the entire peninsula. The compaction of coastal sediment resulting from the siphoning-off of water for use in irrigation or during the reclamation projects that rendered many pestiferous coastal zones inhabitable created vast low-lying areas currently found below sea level and subject to flooding, as in the vicinity of the city of Ferrara.

The primary influence on the evolution of Italy's shoreline has been the flow of river silt.

In short, the erosion of Italy's shoreline is constantly on the rise due to:

- the reduced flow of river silt caused by the dredging of riverbeds the entrapment of the silt by stabilising structures along the banks, plus the regularisation of waterways and the formation of dams (for the most part manmade);
- tidal surges accompanied by flooding, leading to peaks of erosion

Tidal surges, a relative increase in the sea level, subsidence and unbridled urban development have contribute to the

[29] EEA, 2010, *The European Environment – State and outlook 2010*, Report 1/2010

at river mouths;

- increase in the relative sea level, plus a lowering of the land due to both natural and manmade subsidence;
- unbridled coastal urban development, with clusters of vacation homes, seaside infrastructures, squares encroaching on beaches, poorly positioned port facilities and breakwaters or groynes potentially built to protect earlier defensive structures.

erosion of the coastline.

Two overriding factors are driving changes in Italy's port system: the demand for berths for pleasure craft and the growth of cargo and container shipping traffic, which requires large port hubs. Container ships (some over 300 m in length) dock in hubs that must offer deep sea bottoms (15-18 m), extensive space for manoeuvring and port dept areas that extend at least 400 m inland. To obtain the necessary space, the standard approach is to build brand-new structures at a distance from more heavily urbanised areas, as was done in the Italian ports of Gioia Tauro, Cagliari and Savona-Vado or, looking at the rest of Europe, in Marseilles, La Rochelle and Algeciras.

The port system continues to grow in terms of the pleasure-craft sector and infrastructures for cargo and container traffic.

Of the new port projects completed between 2000 and 2007, only in Olbia was the terminal container built outside of the urban area, as elsewhere the difficulty of finding large unoccupied areas, together with the convenience of drawing on port infrastructures already in place, led to decisions to restructure or convert existing facilities rather than build new ones.

In the cases of Leghorn, Chioggia, Civitavecchia and Ancona, the necessary space was procured directly from the sea, through major land-fill projects, and the maritime structures were built or enlarged around these spaces.

The rigid structures (groynes, barriers etc.) built to counter shoreline erosion have not resolved the problem, even contributing, in many cases, to heightening the artificial transformation and deterioration of marine coastal habitats.

The rigid structures built to protect eroding seashores have not resolved the problem.

The practice of restoring eroded beaches through artificial replenishment can often prove to be eco-compatible and less invasive of marine coastal areas, though the dredging of relict sand can have repercussions on sea bottoms and on the surrounding marine environment.

The practice of dredging relict sand answers the need to dispose of large quantities of material for the replenishment of beaches. Indeed, for a number of years now there has been widespread use of offshore sand deposits in both Europe and the rest of the world.

The dredging of relict sand for replenishment can have repercussions of no small significance on the marine environment.

There are a number of advantages to using relict sand rather than relying on land quarries, including: the availability of large quantities of sediment (millions of cubic metres), a composition potentially very close to that of our beaches, a limited effect on the environment and, in the case of replenishment efforts involving large quantities of material, limited costs.

But the movement of even high-quality marine sediment can have repercussions of no small significance on the marine environment. The main effects involve variations in the nature and features of the sea bottom, with the possibility of localised repercussions on fishing operations (such as torn nets), plus the introduction of fine sediment into the water column, primarily when the overflow of water taken up

with the sediment is let off during the loading of the dredge.
The dispersion of the murky cloud that results can damage sensitive habitats in the vicinity of the dredging area, such as prairies of *Posidonia oceanica*, coral growth etc.

Study of the hydrodynamic processes of the sea (tide patterns, wave climate, tidal surges etc.) not only contributes to determining the weather and marine characteristics of basins, but also serves as preparation for planning efforts in coastal areas and for the design of strategic works (ports, railways, roads, offshore structures), plus those meant to protect habitats and activities in the most vulnerable areas.

Study of the hydrodynamic processes of the sea not only contributes to determining the marine and weather characteristics of basins, but also serves as preparation for planning efforts in coastal areas and for the design of strategic works, plus those meant to protect habitats.

The risk posed by storms in coastal areas is expressed in terms of the probability of possible events and the vulnerability of the areas being considered.
From the post-war period onward, the more accessible coastal lands have been subject to elevated manmade development, with the construction of urban, economic and production facilities, a trend that shows no signs of slowing, with the unfortunate effect of rendering coastal areas all the more vulnerable.
Though the study of extreme events makes possible reliable estimates of the probability of potential events in various areas, it should be remembered that climate change may have effects of no small importance on the distribution of weather and marine events over the medium term.
As noted earlier, population density, together with exploitation of the soil and the coastal landscape, leave no doubt as to the intensive interaction between man and the marine-coastal environment, as well as the impact of the attendant repercussions on the coastal environment, of which urban and industrial discharges constitute the primary cause of the pollution and eutrophication of marine waters.
There are many sources of pollution that can render water unfit for swimming, but the most noteworthy involve microbiological pollution.

Land-based sources of pollution of bathing waters include sewage and effluents that are treated inadequately or not at all, as well as runoff from land used in agriculture. It follows that purification plants for liquid waste from urban areas, industrial and agricultural activities (fertilisers, pesticides etc.) and livestock operations, plus slid-waste plants, are all potential sources of pollution. The risk posed to bathers by a given source of contamination can vary, depending on the hydrological characteristics of the drainage basin. As a rule, the presence of a large-scale river mouth in the vicinity of an area utilised for bathing can constitute a potential risk for the bathers, based on the quantity of pollutants that enter the waterway in question through waste outlets or as drainage water. Meteorological conditions taken on particular importance, given the finding that strong rains can lessen the quality of waters used for bathing by adding pollutants washed away from the soil and carried to the bathing area by rivers, resulting in situations of short-term pollution.

Insufficiently treated sewage and effluents, together with the runoff from agricultural land, are the main sources of pollution of waters used for bathing.

With regard to toxic blooms, and specifically *O. ovata*, the studies performed show that blooms of *Ostreopsis* cf. *ovata* occur almost exclusively during the summer and autumn seasons (early October). Along the Tyrrhenian and Ionian shores, the peak in abundance

Blooms of Ostreopsis ovata *almost always occur exclusively during the* occurs in mid-summer (July-August), while the southern Adriatic coast shows the greatest abundance in the months of August and September and the northern Adriatic in September and October, pointing to the likelihood of a varied eco-physiological response on the part of the populations involved (Totti *et al.* 2010, Accoroni *et al.* 2011). Conditions that would appear to favour the onset and maintenance of such blooms include: shallow waters, the presence of a rocky and/or macroalgal substrate, low hydrodinamism, due to the natural morphology of the coast or to the presence of groynes or artificial barriers to defend against coastal erosion, weather and marine conditions presenting elevated stability, water temperatures of more than 25°C in the Tyrrhenian Sea and of between 20°C and 23°C in the Adriatic Sea, along with the absence of thermocline[30].

summer and autumn seasons (early October). Along the Tyrrhenian coast, the maximum levels are recorded in mid-summer, while the mid Adriatic shows the greatest abundance in the months of September and October.

Specific regional characteristics

ARPA Tuscany

On 17 December 2011, two semi-trailers carrying canisters of spent catalyser used for the desulphurisation of petroleum were lost off the deck of the cargo ship Eurocargo Venezia of the Grimaldi company while it found itself off the Island of Gorgona.

The Harbourmaster’s office, assisted by the department of the ISPRA responsible for “environmental emergencies at sea” and based on Leghorn, handled both the immediate search for the materials and the evaluation of the environmental effects and the risks tied to the loss of the cargo.

The ARPAT – together with other authorities in the field (the local board of health and the Experimental Zooprophylactic Institute) – was alerted by the regional government to respond to the emergency of the canisters of toxic material. Forms of indirect environmental monitoring able to detect significant anomalies in the levels of the heavy metals dispersed ere put in place. The operations in which the ARPAT was involved included:

- intensification of the routine environmental monitoring of marine and coastal waters.
- collaboration with the Harbourmaster’s office and the port chemical service, in order to obtain an improved chemical characterisation of the substances transported and determine how they would behave in a marine environment.

ARPAT carried out trawl fishing on a sea-bottom area measuring approximately 450 metres in the location where the toxic containers were thought to have been lost, taking samples of the fish caught and subsequently sending it to Experimental Zooprophylactic Institute (IZS) of Pisa for the relevant analyses.

[30] ISPRA Reports nos. 127/2010, 148/2011 and 173/2012.

The responses

Regulatory measures

There is a common denominator to all the regulatory measures on the marine and coastal environment, in that they promote and call for the formulation and development of a "mechanism" of coordination among the various sectors of the economy, government and the cultural sphere, with the ultimate goal of safeguarding the marine environment and arriving at a sustainable development of coastal areas. This entails integrating all the pertinent policies followed by the different sectors involved and by the various levels of government, in addition to bringing together the land and sea components of the territory being dealt with, starting from an initial evaluation of the state and the utilisation of the marine and coastal environment. Another key component is the monitoring of environmental and ecological parameters through initiatives that ensure an ongoing assessment of national strategies, as well as of the effectiveness of plans and programs of development, both proposed and implemented.

A European-Community approach to the management of the marine and coastal environment.

In previous editions of the Almanac, extensive attention was focussed on the numerous legislative measures and tools, on both the European and regional levels, whose application contributes to protecting the seaside environment. This edition will illustrate the most recent developments in the Integrated Coastal Zone Management (ICZM) provided for under Directive 2007/60/EC on the assessment and management of flood risks, as well in the Water Framework Directive 2000/60/EC and the Marine Strategy Framework Directive 2008/56/EC of 17 June 2008.

The marine environment as a whole is increasingly the focus of political initiatives on various levels, give the growing realisation that its correct management and planning can yield enormous advantages in terms of both development and environmental defence.

Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning (MSP).

This explains the efforts currently underway to harmonise the instructions of the European Commission on Maritime Spatial Planning (MSP, concerning the need to plan activities with respect to space and time)[31] with the model for the formulation of policies suggested under the ICZM, which stresses close coordination of the various economic, cultural and territorial policies, so as to arrive at an eco-systemic approach. In contrast, noteworthy developments have not been observed with respect to the implementation of the directive on integrated management, either on the national or regional levels. For now it is far more likely that efforts will be focussed on coastal planning geared towards the management of flood risk, given the deadlines established under Directive 2007/60/EC for satisfaction of the obligations placed on the responsible parties.

The Directive on River and Coastal Flooding.

Directive 2007/60/EC, together with the related act of implementation, Legislative Decree 49/2010, establish the criteria for the evaluation and management of flood risks. Both contain references to coastal flooding as well, contemplating, along the same

[31] COM (2008) – 791: "Roadmap for Maritime Spatial Planning: defining the share principles of the EU" COM (2010) – 771: "Maritime Spatial Planning in the EU – results and foreseeable developments"

lines as those followed for flooding originating from rivers, a preliminary risk evaluation meant to identify the areas for which maps of danger and risk should be drawn up, following by the drafting of management plans.

Coastal planning: spread of an integrated approach to the formulation of measures for the management of coastal areas.

The establishment of an integrated approach to measures falling under the responsibility of regional governments and basin authorities continues to spread. The number of basin authorities that have drawn up specific plans for coastal erosion recently grew: the need to do so is felt with particular intensity in the areas of the Italian peninsula characterised by steep coastlines, meaning zones where episodes or erosion can result in landslides and cave-ins. The problems involved in defending coastal lands have always been included among the tasks of the basin authority responsible for the portion of the basin looking out onto the sea. Basin authorities also make increasingly frequent use of the ICZM approach to the planning of coastline areas, meaning, for example, that steps have been taken to involve the different stakeholders in the planning process or, to cite a more technical consideration, the evaluations carried out for the purpose of establishing perimeters have been expanded to include not only resources closely connected with the defence of human life, but also those involving the landscape and the environment. In the meantime, those regions that have not yet drawn up a plan for their coasts are putting in place legislative and organisational measures to do so (as in the cases of Basilicata and Sicily), while other regional governments are currently completing, through the drafting of new measures, their path towards integrated coastline management, as in the case of Liguria and its Plan for Marine and Coastal Environmental Defence.

A survey of compliance with the requirements of the Directive on Flooding shows that, to date, only a few regions have performed a flood risk evaluation.

A survey by ISPRA on compliance with the requirements of Directive 2007/60/EC shows that, to date, only a few regions have drawn up an evaluation of the flooding risk. Till now, priority was placed on problems of erosion, with the measures and/or planning documents drafted to manage such events, which are more frequent along our coasts, and with noteworthy economic repercussions. In fact, erosion robs space from bathing areas and poses a threat to structures found on the shore. Furthermore, the results of the survey made it clear that the evaluations and subsequent actions taken to mitigate the risk of erosion can also have an indirect effect on the risk of flooding. The presence of beaches, the extent to which they run inland, ad the manner in which they dissipate the energy released by the movement of the waves, can reduce the danger. In order to involve the backend of the beach, the magnitude of the event must be all the greater for the length of the beach between the backend and the water. For that matter, the presence of a sandy beach would automatically reduce the level of risk, seeing that any tidal surge is destined to exercise its primary effect on a system which, by definition, offers excellent resiliency in the face of submersion, namely a beach. In light of these considerations, and based on the initiatives already undertaken by a number of basin authorities and regional governments, it should be stressed that the identification of areas posing potential problems in terms of erosion can indeed amount to a sort of “preliminary evaluation” designed to identify those areas most exposed to the risk of flooding.

The Framework Directive on a Strategy for the Marine Environment (Directive 2008/EC/56) is an extremely important and innovative measure, being the first binding regulatory act to treat the marine environment, under a systemic approach, as a valuable heritage to be protected, safeguarded and, whenever possible, restored, in pursuit of the end goal of maintaining biodiversity and preserving the health and vitality of the seas and oceans. To this end, the Directive aims, among other things, to promote the integration of environmental demands and needs in all the pertinent policy sectors, thus serving as the environmental cornerstone of the future maritime policy of the European Union. Given the "holistic" nature of the Directive, particular attention is placed on considerations regarding the consistency of all the policies and topics pertaining to the sector and likely to have repercussions on the marine environment through "pressures" and "impacts" that could ultimately affect the "state" of marine waters. A further objective of the directive is to arrive at a flexible mode of management, or a "dynamic balance", between a "good environmental state" of marine waters and a "sustainable" process of development, doing so through an appropriate use of both marine resources and the marine environment itself (considerations tied to the use of space and to the various types of pollution possible).

Framework Directive on a Strategy for the Marine Environment (MSFD).

Another key element is the cross-border aspect of the measure, with the member states being called on to ensure that their individual strategies are formulated in a coordinated fashion with respect to each marine region and sub-region. Seeing that the marine regions and sub-regions are shared not only with other member states, but with non-EU countries as well, every effort must be made to achieve coordination in the formulation and implementation of the marine strategy. Among the possible instruments of implementation, the Directive gives preference to instruments of planning, coordination and concerted action, as well as consistency with policies in other pertinent sectors, such as transportation, fishing, tourism, infrastructures, research etc., all in the interests of establishing an "integrated maritime policy".

Requirements of the MSFD.

The Directive requires that, by 2020, the member states, through an eco-systemic approach to marine management, arrive at the GES, or Good Environmental Status, for their marine waters. In achieving that goal, each member state must enact, for each marine region or sub-region, a marine strategy that consists of a preparatory phase and a program of measures.

To date, Italy has carried out the first phase of his process, having specifically completed:

- the initial evaluation (art.8, Directive 2008/EC/56)[32], formulated on the basis of the existing data and information;
- determination of good environmental status (GES) (art.9, Directive 2008/EC/56), based on 11 quality descriptors of the marine environment referenced to multiple aspects of marine ecosystems, such as biodiversity, pollution, impact on production activities (Annex I, Directive 2008/EC/56). The decision taken by the

[32] Directive 2008/56/EC of the European Parliament and Council, issued on 17 June 2008 to establish a framework for European Community action in the field of marine environmental policy (Legislative Record L 164 (2008), pg. 19)

European Commission on 1 September 2010 (2010/477/EU)[33] lays out the approach to be taken in determining the GES through the use of 26 criteria and 56 indicators associated with 11 descriptors. These criteria and indicators include a mix of elements regarding status, impacts and pressures;
- the setting of environmental goals able to help gauge the progress made in the process of achieving the good environmental status.

The EC was notified of the results of the activities described with reports drawn up according to a standard format that will allow the Commission to evaluate whether the results reached by all the different countries can satisfy the requirements of the Directive.

Italy: state of compliance with the requirements of the MSFD.

The subsequent phase involves the following activities:
- the preparation and implementation, by 15 July 2014, of a monitoring program;
- the formulation of a program of measures in the year 2015;
- the start-up of the program of measures in the year 2016.

ISPRA activities for the MSFD. First phase: initial evaluation, determination of good environmental status and of environmental targets.

Given the complex, multifaceted nature of the requirements of the aforementioned Directive, and of its transposition into Italian law as Legislative Decree 190/210[34], and in consideration of the provisions of art. 1, paragraph 2, of the ISPRA Regulations found in Inter-Ministerial Decree no. 123 of 21 May 2010, according to which ISPRA is to serve as the technical–scientific institute of reference, on the date of 1 January 2011 the Ministry and the Institute entered into an operating agreement that stipulated all the further and additional activities, above and beyond the ordinary ones, necessary for implementation of articles 8, 9, 10, 11 and 16 of the Legislative Decree. The activities carried out by ISPRA in order to achieve the objectives of implementation involved both national coordination, through the establishment of national workgroups consisting of researchers from ISPRA and other scientific bodies/institutes of reference, and coordination with the member states involved in the same sub-regions (Western Mediterranean, Central and Ionian, Adriatic). Furthermore, environmental and socio-economic data were controlled and processed in order to perform the initial evaluation and establish the good environmental status and the environmental targets. For the reporting activities, ISPRA developed a marine data system that met the standards called for by the Commission.

Public consultation and participation in the process of determining the national strategy.

Finally, public consultation was initiated through the creation of a website (www.strategiamarina.isprambiente.it), so as to promote the participation of citizens and stakeholders in the process of determining the strategy itself.

Observations, problems and prospects for the implementation of the MSFD on a national level.

The first phase of the implementation of the Marine Strategy demonstrated that, although Italy can draw on a notable quantity of data/information regarding the marine environment, it is not enough to full satisfy the demands of the Directive. The fact is that the scope of application of the Directive is not limited to the waters nearest the

[33] Commission Decision 2010/477/EU of 1 September 2010 on the criteria and methodological standards for reaching the good environmental status of marine waters

[34] Legislative Decree no. 190 of 13 October 2010. Enactment of Directive 2008/56/EC establishing a framework for European-Community action in the field of marine environmental policy (Legislative Record no. 270 of 18 November 2010*)*

coast (1 nautical mile), but extends to the areas within which the state exercises its jurisdictional rights, as per the international law of the sea, meaning territorial waters (12 nautical miles; the exclusive economic zone - 200 nautical miles) ad the zones of ecological protection.

In the case of a number of elements, such as physical disturbances (underwater noise or marine waste), the lack of data made it impossible to carry out a satisfactory initial evaluation. Generally speaking, as regards the definition of the GES, the shortcomings detected in the course of the initial evaluation, traceable primarily the scarce availability of data,and therefore the lack of specific knowledge on how the eco-systems operate, as well as on any impacts caused by the different pressures at play, made it impossible to determine the threshold values, and thus prevented definition of the GES in quantitative terms.

As for the environmental targets, in order to avoid an excessive depletion of the financial resources, operating targets were drawn up, meaning objectives tied directly to management actions. Under this approach, a series of measures already enacted within the framework of current legislation, and thus already provided with financial coverage, can be utilised. The next steps are the preparation of monitoring programs designed to fill the gaps in knowledge and render the methodological approaches as uniform as possible, plus the implementation of supplementary measures, together with the reinforcement of the controls and compliance with the regulations currently in force.

Specific regional characteristics

ARPA Friuli-Venezia Giulia

The quality of marine-coastal waters and transitional waters in the Friuli-Venezia Giulia region was determined using the indicators contemplated under Legislative Decree 152/06 and under the Ministry of the Environment’s Decrees 131/08, 56/09 and 260/10, which transpose into Italian legislation the objectives introduced under the European directive (WFD 2000/60/EC).

Identified was made of 38 bodies of water (19 marine coastal waters and 19 transition waters) all considered to be “at risk” of not reaching the good quality status in 2015.

As a rule, the condition of the coastal waters was observed to be good and that of the marine waters further offshore excellent. The results obtained for the transitional waters point to an ecological status worse than that of the marine waters by the shore.

To limit emissions of nitrates, in the wake of the definition of the Nitrate Vulnerable Zones (NVZ) attributable to agricultural activity, the Friuli-Venezia Giulia region issued (on 24 May 2010, Decree no. 0108/2010/Pres of the Regional President) an Action Program for the safeguarding and clean-up of waters polluted by nitrates of agricultural origin for companies located in vulnerable zones.

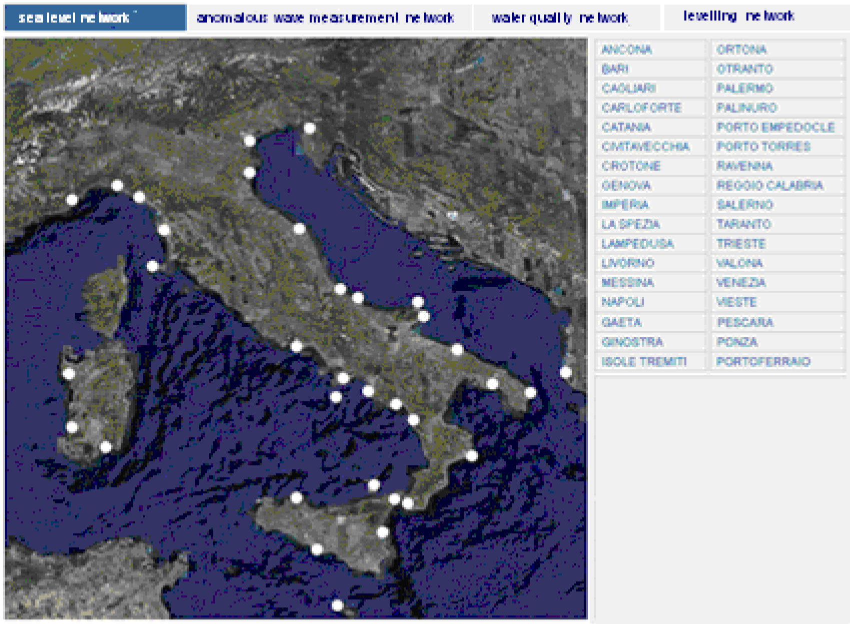
Monitoring and forecasting systems

Networks for observation of the physical, chemical and biological sea conditions, systems for forecasting tide surges and marine weather events in general, plus systems supporting evaluations of environmental status and planning activities are the instruments designed to improve knowledge of natural events and reduce both the vulnerability of marine and coastal environments and the risk faced by manmade activities and structures. This knowledge can be obtained through continuous monitoring of marine events, together with an in-depth analysis of exactly what occurs, plus an examination of variations, in terms of geographical location and time, in the events themselves. Mitigation of potential damage through mitigation is important, especially in light of climate changes, which could cause new vulnerabilities and new risks to arise.

Monitoring of marine events and analysis of what occurs make it possible to adjust and to mitigate the effects.

For a number of years now, two national networks have been in operation in Italy for observation of the status of the sea: the National Sea Level Network (RMN) and the National Wavemeter Network (RON), both run by ISPRA. The parameters recorded by RMN and RON, used to obtain knowledge of the status of the sea and the marine-coastal environment, are shared and inserted in international projects and networks for the observation of the sea (the Sea Level Observing System of the Intergovernmental Oceanographic Commission (IOC); the Global Telecommunication System (GTS) of the World Meteorological Organization (WMO)), sources that have long been used for planning efforts, as well as in the design and construction of marine works and coastal protective structures, plus navigation activities in ports and the open sea.

ISPRA operates the National Sea Level Network (RMN) and the National Wavemeter Network (RON).



The National Sea Level Network (RMN) has 33 measuring stations uniformly distributed throughout Italy.

Figure 5.16: The National Sea Level Network: measuring sites[35]

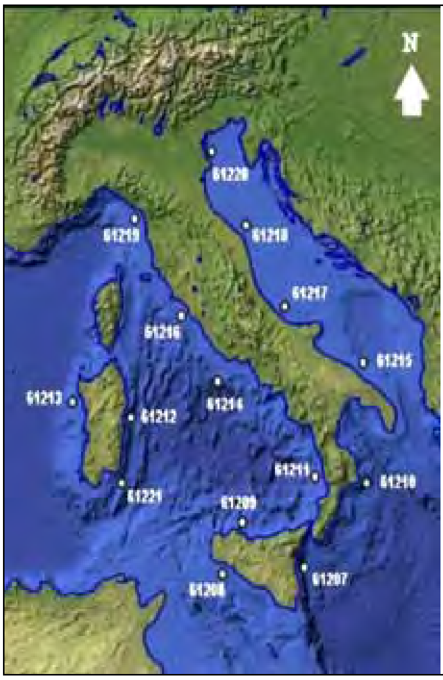
The National Sea Level Network (RMN) (Figure 5.16), with 33 stations uniformly distributed throughout Italian territory, is today one of the most important networks for measuring the level of the sea in the Mediterranean.

The National Sea Level Network (RMN) and the marine weather parameters registered.

[35] Source: ISPRA

All the measuring stations of the RMN are equipped not only with sensors to record the level of the sea, but also with sensors for the temperature and humidity of the air, water temperature, the speed and direction of the wind and the air temperature. And in order to gauge the quality of the water in environmentally sensitive areas, 10 stations are also outfitted with a multi-parametric sensor able to register the following parameters: water temperature, pH, Redox, conductivity.
The parameters recorded by the stations are published on the ISPRA site (www.mareografico.it), along with figures for the tide levels for the main and secondary ports, listed in the section on tide tables.
Sets of weather and oceanographic data collected over lengthy periods of time in the open sea have always been of vital importance to meteorologists and oceanographers looking to fully understand the mechanisms of exchanges between the sea and the atmosphere and their influence on the behaviour of the two elements. Readings taken on-site, using meteorological-oceanographic buoys, represent the sole system capable of providing direct evidence that can lead to an understanding of the processes of the weather and the waters at work in the open sea. Such measurements constitute a key reference for studies of climate and for forecasts tied to both the atmospheric environment and that of the sea.

The National Wavemeter Network (RON) consists of 15 fixed metering sites distributed uniformly along Italy's coasts, at a distance of no more than 15 nautical miles from the coastline and in waters roughly 100 metres deep.



61207	CATANIA
61208	MAZARA
61209	PALERMO
61210	CROTONE
61211	CETRARO
61212	SINISCOLA
61213	ALGHERO
61214	PONZA
61215	MONOPOLI
61216	CIVITAVECCHIA
61217	ORTONA
61218	ANCONA
61219	LA SPEZIA
61220	VENEZIA
61221	CAGLIARI

Figure 5.17: Location of the RON buoys and WMO codes[36]

ISPRA's National Wavemeter Network (RON), which has been in operation since 1989, currently consists (Figure 5.17) of fifteen fixed metering sites distributed along Italy's coasts, at a distance of no more than 15 nautical miles from the shoreline and in waters of a depth of approximately 100 metres. The measurement stations are directional wave metres with solid state accelerometer sensors, outfitted with a full meteorological station and capable of transmitting the data recorded to the corresponding reception land centres, at 30-minute intervals, at which point the data are brought together in real time at the control

The National Wavemeter Network, with 15 fixed metering sites located off Italy's coasts, transmits the data in real time.

[36] Source: ISPRA

centre found in the ISPRA headquarters. The data are also distributed in real time, primarily via internet, at the address www.telemisura.it, and on RAI Televideo (page 719); since 2009, the sae data have also been sent over the Global Telecommunication System (GTS) to national and international bodies to be included in large-scale forecasting models.

Marine weather forecasting systems.

While the networks for monitoring the state of the sea register current conditions, a important tool for mitigating the risk associated with the onset of adverse marine weather conditions and storms at sea is forecasting of the state of the sea using models of digital simulation. As is widely known, the physical processes behind changes in the state of the sea (wave movement, currents, height of the sea) a closely tied to atmospheric dynamics, which, in turn, maintain a crucial interaction with the surface of the sea (by exchanging quantities of motion, heat and humidity). This explains why the global models used for climate simulations employ coupled air-ocean approaches. The models for forecasting the state of the sea (wave metering models, models for forecasting the level of the sea surface, oceanographic models) are operated "in sequence" with a meteorological model that provides them with the figures for driving forces behind atmospheric conditions (normally wind and surface pressure) for the entire duration of the forecast.

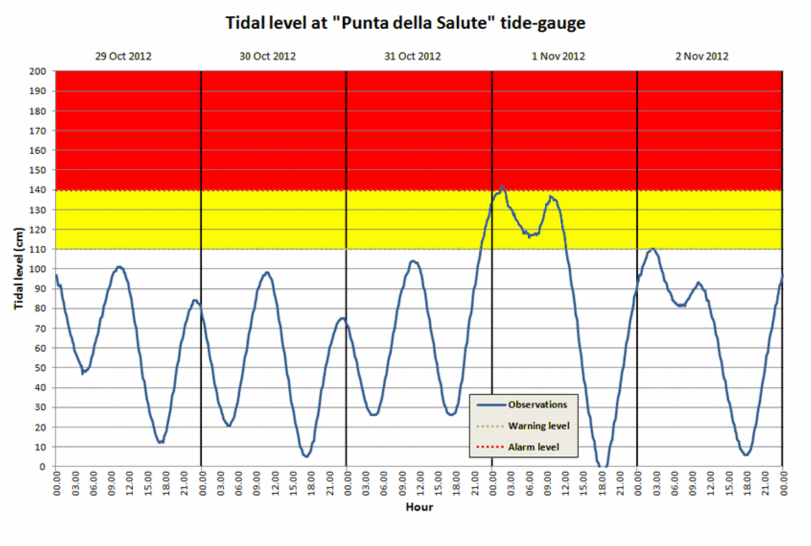
The Hydro-Meteo-Marine System (SIMM).

In the Mediterranean area, the forecasting of conditions of the atmosphere and the sea surface must take into account specific difficulties. Mediterranean weather is characterised by a bidirectional interaction between large-scale factors (such as extra-tropical cyclones arriving from the Atlantic) and the effects of "complex" local factors (the lay of the land, the distribution of areas of land and sea etc.) that give rise to conditions on both a small and medium scale (between 10 km and 1,000 km). As for the quality of wave-metering forecasts, they depend to a critical extent on forecasts of sea winds (the same can be said for forecasts of the height of the sea and their dependence on the atmospheric pressure at the surface). In conclusion, a good forecasting system must simultaneously handle all the different scales pertinent to atmospheric conditions, meaning that it must be able to apply a resolution on the order of hundreds of metres to an extensive domain of integration. The previous edition illustrated the structure of the models and the methodology of the ISPRA Hydro-Meteo-Marine Forecasting System (SIMM)[37] used to draw up forecasts of weather and sea conditions for other applications, including weather routing (optimisation of shipping routes based on marine weather conditions) and the tracking of the transport of pollutants at sea (such as oil spills).

In 2012, more advanced configurations of the SIMM's BOLAM (Bologna Limited Area Model) were experimented and tested. The results of a statistical assessment of precipitation led to the selection of a new configuration whose modified features included an increase in the horizontal resolution of the model from the current 10 km to 7.8 km. It was found that this version did indeed offer improved forecasting performance, and in terms of its coupling with sea models, the increased resolution of surface-wind forecasts could constitute an added advantage for wave-metering forecasts.

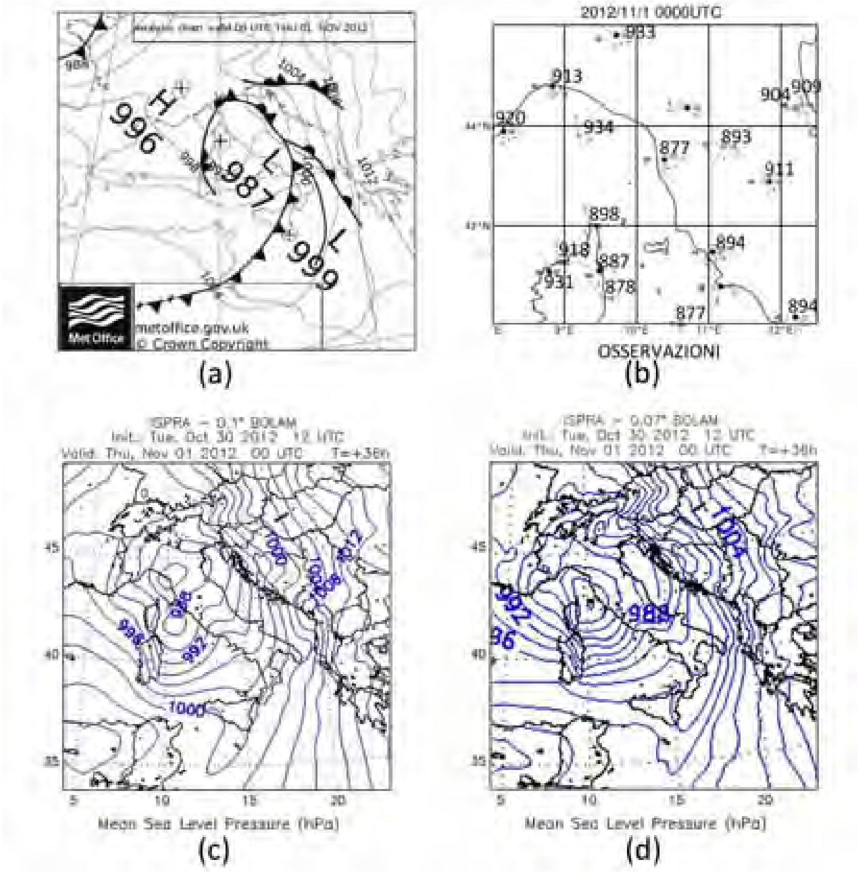
[37] www.isprambiente.gov.it/pre_meteo/; www.isprambiente.gov.it/pre_mare/

While waiting for the SIMM's BOLAM D-4 at 7.8 km to go into operation, the configuration has been implemented on an experimental, pre-operational basis as part of the international program HyMeX (Hydrological cycle in Mediterranean EXperiment), an initiative geared towards upgrading knowledge of the hydrological cycle in the Mediterranean while monitoring and forecasting highly impactful marine weather events. The forecasts have been produced daily since September of 2012; the image archives is available on the site http://sop.hymex.org. The HyMeX initiative includes measurement campaigns for special periods (SOP), during brief periods of intensive monitoring (IOP) corresponding to noteworthy events are identified. Some of these events, which occurred in SOP 1 (September-November 2012), shall be treated as case studies for further assessment of the "sequential order" of the SIMM models, in both the operating and experimental configurations, in particular by coupling the BOLAM with the SHYFEM model for the forecasting of high-water events in Venice.
The results show, for example, that the event of 1 November 2012, for which a peak tide of 143 cm was registered at Punta (Figure 5.18), is the 13th highest reading since 1872. Apart from the astronomic tide, the chief factors behind high-water events are the effects of wind and atmospheric pressure (the "meteorological contribution"). Both the presence on the Adriatic of strong winds out of the southeast (the "*Libeccio*") and drops in the surface pressure on the upper Adriatic can contribute to such events, and when these circumstances occur in phase with the astronomic tide, then the result can be exceptional events. This is why the accuracy of high-water forecasts are closely tied with that of the weather forecast. The event in question arose from what is a fairly frequent occurrence on the Mediterranean: the rapid formation of a cyclone that, being centred in the Gulf of Genoa, produced the double effect mentioned above (a drop in the pressure on the northern Adriatic and a strong wind from the southeast on the Adriatic), as illustrated by the weather chart in Figure 5.19a. These charts ("analyses") tend to "smooth out" the maximum and minimum values; when the figures for the actual observations are used (surface stations of the observation network, figure 5.19b), they generate an estimate of the minimum pressure, centred around the Island of Elba, of less than 877 hPa, as opposed to the 987 hPa of the analysis.
Cross-analysing the observations with the forecasts produced by the two BOLAM configurations, the experimental one (fig. 5.19d) turns out to provide a more realistic forecast than one currently in operation (fig. 5.19c), pointing to a cyclone that is more developed and deep (with a minimum of 980 hPa compared to the 988 hPa of the version in operation), and that would presumably result in a higher quality tide forecast by any sea-level measurement model associated sequentially.



High-water event in Venice on 1 November 2012, when a peak tide of 143 cm was recorded at Punta della Salute.

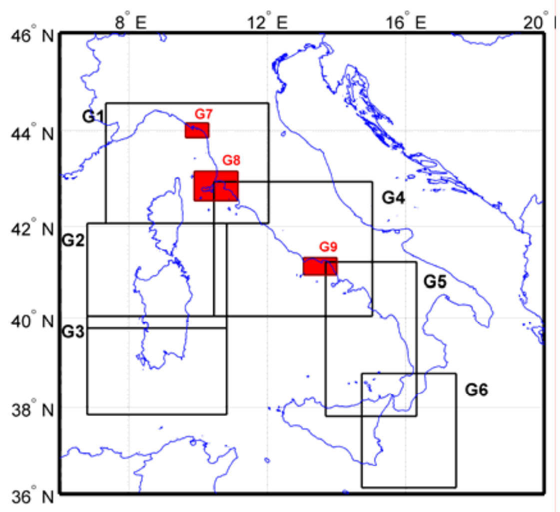
Figure 5.18: High-water event of 1 November 2012: tide levels recorded at Punta della Salute[38]



Weather conditions observed (weather chart and land-station readings) and forecast (BOLAM in operation and BOLAM-D4) for the event of 1 November 2012.

Figure 5.19: Event of 1 November 2012. Comparison between the pressure recorded at sea level (midnight Greenwich mean time) and the forecasts for the two BOLAM configurations discussed in the text. (a) Meteorological chart[39]**; (b) results (in hPa) registered by the surface observation stations; (c) forecast of the operating BOLAM; (d) BOLAM-D4 forecast**[40]

[38] Source: ISPRA
[39] Source: UK Met Office
[40] Source: ISPRA



The Coastal Forecasting System (SPC) for long-term planning and the design of works and projects of reclamation.

Figure 5.20: Structure of the regional areas (in black) and the coastal areas (in red) of the Coastal Forecasting System[41]

Coastal Forecasting System (SPC).

In light of the numerous activities found along the coastline, it is important that there also be a specific coastal forecasting system for long-term planning and the design of works and project of reclamation.

ISPRA's Coastal Forecasting System, in operation since 2011, makes it possible to consider six regional areas inside of which high-resolution coastal areas are identified and digital simulations can be performed (Figure 5.20).

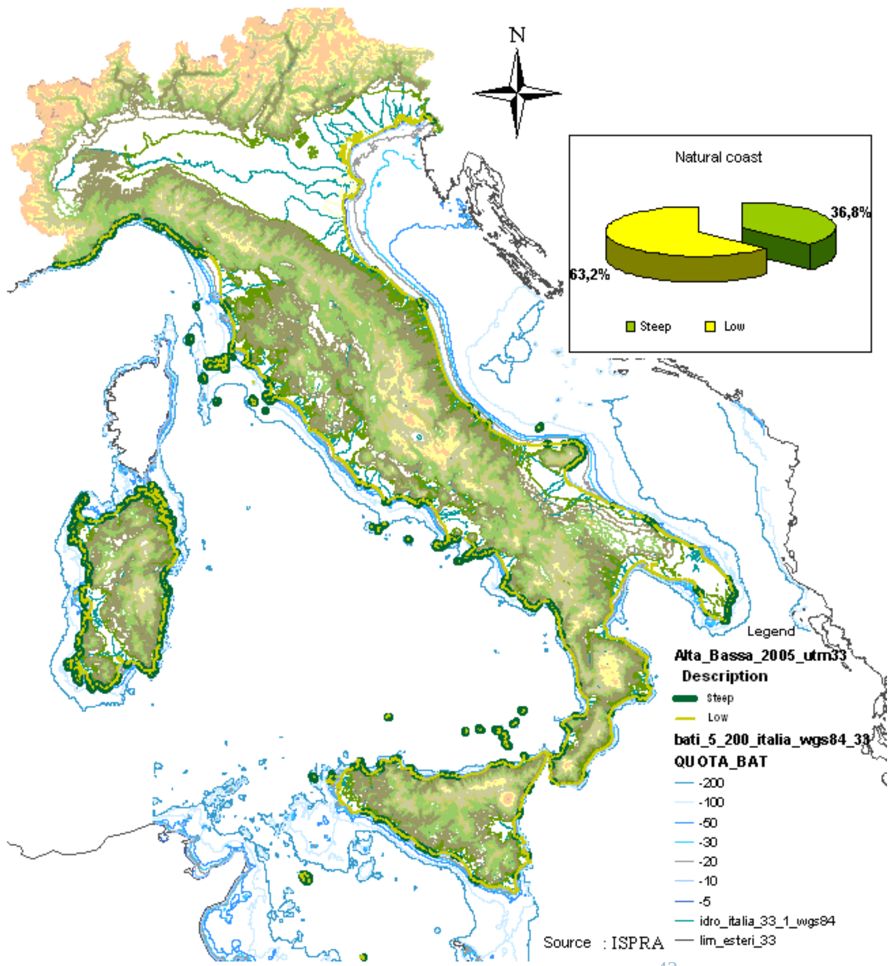
The goal for the future is to make the Coastal Forecasting System part of the SIMM.

Coastal Geographical Information System (SIGC).

In order to study the morphology and dynamics of beaches and the vulnerability of coastal areas, the systems providing knowledge of the sea must be supplemented with programs permitting periodic observation of geomorphological variations in the coastal zone, so as to obtain measurements and indications on the extent of variations while identifying, in accordance with the urban and environmental context, the most vulnerable areas.

The Coastal Geographical Information System (SIGC) developed by ISPRA depicts the coastal territories in a uniform manner for all of Italy (Figure 5.21), providing information on the geomorphological factors that characterise coastal territories, plus data from analyses of the dynamics of change along the shore, data on port infrastructures, on works to safeguard the shore from erosion, on land occupation and on safeguard measures connected with the management of coastal areas. The system combines territorial coverage obtained through traditional techniques of environmental observation and diagnosis (historical cartography and orthorectified vertical aerial photography) with experimental approaches employing high-resolution satellite images and aerial photographs for forecasting.

[41] Source: ISPRA



The Coastal Geographical Information System (SIGC) depicts coastal areas in a uniform manner for all of Italy.

Figure 5.21: Map of Italy's coasts: steep and low[42]

A map of the morphological elements of Italy's seas is currently being drawn up (scale 1:750,000).

At present, studies are being carried out on the physiography and morphology of Italy's seas. By interpreting data on the seafloor and drawing on existing studies, a map is to be drawn up (scale 1:750,000) on the morphological elements of the Adriatic Basin, the Tyrrhenian Sea, the Ionian Sea, the Straits of Sicily and the Sardinian Sea, with the goal of supplementing the information on the above-water areas with information on the chief geomorphological characteristics of the sea bottom. The end product will be of use in various areas of application, seeing that it regards the study of the sea, providing an overview of Italy's basins on a national scale; furthermore, the methodology followed in its formulation will make possible subsequent updates and refinements, based on newly acquired data, of both the quantity and quality of the information on the sea floor.

European initiatives on the dredging of relict sand.

On the European level, the topic of dredging relict and/or offshore sand for beach replenishment has been addressed from a number of different perspectives (engineering and design, environmental and economic) by the projects: BEACHMED Operational Program INTERREG IIIB - MEDOOC "Environmental Reclamation and Maintenance of Eroded Shoreline through the Use of Sea Sand Deposits" and BEACHMED-e Regional Framework Operation, INTERREG IIIC "The Strategic Management of Shoreline Defence for the Sustainable Development of Mediterranean Coastal Zones".

[42] Source: ISPRA, Processing of territorial coverage available with the ortophotos of flight IT2006; sea bottom data of the IIMM (2005)

The regulatory framework currently in force in Italy, specifically as regards the dredging of relict sand or beach replenishment, is still, in part, in the development stage.

The current regulatory reference framework in Italy is still, in part, under development. A protocol for environmental monitoring has been drawn up by ISPRA.

Replenishment with relict sand is still governed by the Ministerial Decree of 24 January 1996 (preliminary activities for the issue of the authorisation) and by Law no. 179 of 31 July 2002, which transferred responsibility for the authorisations from the central government to the regional administrations. In the case of dredging activities, it is important that there be detailed and up-to-date information on the environment in which the deposits are found, so as to be able to forecast and evaluate the effects of moving the material and decide on appropriate measures for mitigating the resulting impact. Since 1999, ISPRA, initially in collaboration with the Lazio and Emilia-Romagna regions (ARPA Emilia-Romagna), has carried out a series of environmental studies that, over the years, have led to the formulation of a specific protocol of environmental monitoring for such activities, a tool that can be used in other geographical settings as well. ISPRA subsequently expanded experimentation on this protocol to include other regions of Italy (Marche), in addition to presenting a protocol with the same level for refinement for Europe as a whole (www.beachmed.eu).

Measures for the management of bathing waters.

Legislative Decree no. 116 of 30 May 2008, together with its decree of implementation, issued by the Ministry of Health on 30 March 2010, stipulate new technical procedures regarding the quality of bathing waters. The decree of implementation specifically sets the criteria for bathing prohibition, as well as the specific procedures and techniques for preventing health risks bathers. In fact, the primary objective of Directive 2006/7/EC is to protect human health from risks tied to poor water quality by means of a strategy of prevention and environmental improvement.

The procedure for classifying the quality of bathing waters is based on a set of data from three or four years rather than a single year, making it more realistic than in the past. A further level of control was established under the Ministerial Decree of 30 March 2010, as compared Directive 2006/07/EC, through the setting of threshold standards for the individual samples, beyond which bathing should be banned until conditions of health safety had been restored. These values are 200 ufc/100 ml for intestinal Enterococci and 500 ufc/100 ml for the *Escherichia coli*.

The new approach to managing waters used for swimming calls not only for the sampling of microbiological parameters, but also for a series of environmental evaluations, with a particular focus on potential sources of

The new approach to managing bathing waters calls not only for sampling of microbiological parameters, but also for a series of environmental evaluations, with a particular focus on potential sources of pollution. Consideration must be given to a number of different factors, such as the morphology and the hydro-geological characteristics of the territory, along with the specific marine weather conditions of the area. For this reason , each of the bathing waters has a *profile* that contains not only the data identifying the water itself, but also a description of the territory in which it is located, plus, even more importantly, information on any impacts that could influence the water quality. Any forecasts of short-term pollution must also be indicated, along with the adequate management measures undertaken. An initial version of the profiles was prepared prior to the start of the

2011 bathing season. Drawing up a profile entails an attentive analysis of the territory to which the water belongs, making it a useful tool for the competent authorities. Seeing that the Directive places particular importance on information to the public, a more synthetic, less technical version of the profile is also to be prepared, containing not only specific indications on the quality of the water, but also practical information, such as the physical characteristics of the beach, the access routes and any services located in the area.

pollution.

Actions and monitoring regarding Ostreopsis ovata.

Cases of proliferation of algae are a topic unto itself. For a number of years now, certain coastal areas have been affected by blooms of potentially toxic species, such as *Ostreopsis ovata*. In dealing with the most serious episodes, local authorities have issued temporary precautionary measures closing down the sections of the shoreline involved. Given that such events are exceptional in nature, and not easily foreseen, the measures taken do not count towards the formulation of the qualitative judgment.

The ISPRA's coordinating role in the line of activities regarding "Algal blooms of O. ovata *along Italy's coasts".*

ISPRA, acting in concert with the Regional Environmental Protection Agencies (ARPA), coordinates the line of activity "Algal Bloom of *O. ovata* along Italy's Coasts". The priority goal of this activity, which began in 2006 with the Directive for the Toxic Algae Program of the Ministry of the Environment (GAB/2006/6741/B01), was to determine the elements of a shared national strategy for sampling, analysis, monitoring, surveillance, information, communication and handling of "toxic algae". To this end, ISPRA, in collaboration with the ARPAs, carried out a series of initiatives (training courses, the drafting of "operational protocols", study and discussion seminars, annual and triennial reports, a website), in addition to coordinating the research program "*Ostreopsis ovata* and *Ostreopsis* spp.: new risks of microalgal toxicity in Italian waters" (2008-2010), in the course of which considerations tied to biology, ecology, physiology and genetics were examined in greater depth, as were the methodologies followed in the sampling and analysis of the microalgae and the toxins produced.

At present, updates on the presence and abundance of *O*. cf. *ovata* in coastal areas are provided through annual seminars organised by ISPRA, with the participation of the ARPAs and of the national scientific community. Further dissemination of the information is ensured by ISPRA's publication of the proceedings of seminars and of annual reports on the monitoring activities of the ARPAs.

National monitoring of Ostreopsis cf. ovata *part of the* Marine Strategy *(2008/56/EC).*

The information on the annual monitoring of blooms of *Ostreopsis* cf. *ovata* is also used for the reports called for under Directive 2008/56/EC. Since 2012, ISPRA has been part of the working group responsible for revising the guidelines of the Ministry of Health, already found in the Ministerial Decree of 30 March 2010 on the management of algal blooms of *O. ovata* and other potentially toxic benthic microalgae.

The monitoring activities carried out in 2011 by the ARPAs with respect to the presence and abundance of *Ostreopsis* cf. *ovata* were performed along the shorelines of 14 regions (with the exception of Basilicata).

The surveys were enacted both to control bathing waters quality, in compliance with the pertinent statutes and regulations (Legislative

Decree 116/08 and the Ministerial Decree of 30 March 2010), and as part of ARPA/regional government projects, or as under initiatives involving the monitoring of potentially toxic species in waters meant for the raising of shellfish (the Gulf of Trieste).
Generally, the monitoring was carried out in the period between June and September or, in a few cases, up through October or December, at intervals of fifteen days or a month. A total of 246 sampling stations presenting hydromorphological features suitable to the development of microalgae, or that registered the presence and bloom of microalgae, have been identified and monitored. Samples of water, macroalgae or hard substrate have been taken under jointly approved methods[43] and studied at the same time as the chemical-physical parameters of the waters, plus any signs of microalgal bloom or unhealthy states manifested by marine organisms (sea urchins, mussels, starfish, other fish, macroalgae) registered in the areas subject to the greatest impact and during the peak period of bloom. For the 2011 season, the ARPA of Liguria is supplementing the traditional monitoring with an experimental forecasting model based on 5 categories of risk and potentially capable of estimating the probability of the occurrence and permanence of an algal bloom, based on the weather report (temperature - pressure – wind direction). This forecasting approach could prove to be a useful tool for regulatory bodies and local government administrators, making it possible to optimise monitoring campaigns while developing objective and effective systems of information and prevention on both the local and regional scales.

GLOSSARY

Good environmental status:
The environmental status of marine waters that ensures preservation of their ecological diversity, together with heir vitality as clean, healthy and productive seas in their intrinsic condition, with use of the marine environment being made in sustainable fashion, so as to safeguard its potential or satisfying the uses and activities of both present and future generations (Legislative Decree 190/2010).

Wave climate:
The long-term distribution of the measurements that have the greatest effect on wave patterns, meaning: significant wave height, peak period and average direction of origin.

Cross-correlation chart:
A graphic representation of the linear relations between the variables of two processes at a given distance in time (or space).

Coastal dynamic:
This terms refers to the sum total of the factors that govern the evolution of the immediate coastal area over time. The fact is that the conformation of the seashore is the result of a complex interaction of numerous factors, both marine and continental, some of which are

[43] APAT/ARPA Protocols 2007, ISPRA Protocols 2012; Abbate *et al*. 2010

heavily influenced by extreme meteorological events: river silt, wave motion and currents, wind transport, tectonic events that raise/lower the coastal sector, eustatic variations in sea level, manmade modifications of waterways or seashores, natural or induced subsidence (Atlas of the Works of Coastal Regularisation, APAT, 2007).

Eutrophication:
A degenerative process of the aquatic ecosystem due to an excessive enrichment of nutrients (mainly phosphorous and nitrogen compounds), to the point of altering the balance.

Anomalous event:
An event considered to be rare in terms of its distribution and probability of occurrence, and which exceeds a critical threshold set for a given location. Defined on the basis of its marked intensity and infrequent occurrence.

Physiography:
The sector of geography that studies the nature and distribution of dry land and the seas.

Ovatoxin:
A toxic compound similar to Palytoxin, produced by the benthic microalga *Ostreopsis ovata*, from which it takes its name.

Palytoxin:
A toxic compound isolated for the first time from the marine coelenterate (invertebrate) *Palythoa toxica*, from which it takes its name.

Relict sand:
These are sedimentary deposits whose composition has not been transformed, located along the continental platform in conditions of imbalance with the current sedimentary dynamic.

CHAPTER 6

EXPOSURE TO PHYSICAL AGENTS

Introduction

The term "physical agents" refers to those factors governed by physical laws that trigger a transformation in the environmental conditions in the setting where they take place.

The term "physical agents" refers to those factors that lead to introducing energy into the environment, which may be potentially harmful for human health and for ecosystems.

This category includes noise, electromagnetic fields, vibrations, light pollution , ultraviolet (UV) radiation, and ionizing radiation.

The data collected and processed in the European Community, aimed at estimating the numbers of persons exposed to specific noise levels, identify noise pollution as one of the leading environmental problems, with high and widespread impact on the population and the environment. The effects, in terms of disturbance and deterioration of quality of life, are well documented and have been induced the European Commission to pursue, as a priority objective, the progressive reduction of the number of persons exposed to noise by implementing a policy based on sharing analysis of the phenomenon and the measures to be adopted.

The data collected and processed in the European Community, aimed at estimating the numbers of persons exposed to specific noise levels, identify noise pollution as one of the leading environmental problems, with high and widespread impact on the population and the environment.

Despite the contributions made to resolving the phenomenon by the EC and the national legislative structure in force, by more in-depth studies, and by implementing actions aimed at prevention and remedy, the issue still requires attention and shared, effective responses.

As regards electromagnetic pollution, in society we are still seeing a decline in the population's intense perception of the risk connected with exposure to electromagnetic fields at radio frequencies. This is also the result of the extensive monitoring and information activity carried out during these years by the environmental Agencies system, a major driving force in this area. The radio and telecommunications industry is currently experiencing a phase of deep technological development, which has already shown its first effects in recent adjustments of national and regional industry regulations.

We are still seeing a decline in the population's intense perception of the effects on human health caused by exposure to electromagnetic fields at radio frequencies.

NOISE

The problem

The latest studies[1] by the World Health Organization (WHO) document the effects of noise on human health, recognizing its seriousness and other investigations show that in Europe, environmental noise exposure is recording a growth trend in comparison with other stress factors[2].

[1] WHO-JRC, 2011; Report on "Burden of disease from environmental noise"

[2] Project "Environmental Burden of Disease in Europe" 2011 " http://en.opasnet.org/w/Ebode

The data collected and processed in the first implementation phase of Directive 2002/49/EC relating to the assessment and management of environmental noise, aimed at defining a common approach with a view to avoiding, preventing, or reducing – depending on the respective priorities - the harmful effects of exposure to environmental noise, highlight the presence of a significant number of persons exposed to noise levels affecting the quality of life.

In the European Community, significant numbers of persons in agglomerations are exposed to noise levels. In particular, about 56 million persons are exposed to L_{den} values greater than 55 dB and about 40 million are exposed to L_{night} values greater than 50 dB, considering major road transport infrastructures.

In Europe, about 56 million persons in agglomerations are exposed to L_{den} values greater than 55 dB, while about 40 million persons are exposed to L_{night} values greater than 50 dB, considering major road transport infrastructures, inside the agglomerations[3].

In Italy, according to the data published by the European Commission in the NOISE (*Noise Observation and Information Service for Europe*) database, the number of persons exposed to L_{den} values greater than 55 dB, within agglomerations, equals approximately two million, seven hundred thousand, for 27% of the total population residing in the considered agglomerations whose strategic noise mapping was delivered to the Commission[4].

The implementation of Directive 2002/49/EC and the availability of broader and more accurate information highlights a critical situation, inducing the European Commission to strengthen the action of directive by making the commitments and deadlines that are introduced more stringent.

Directive 2002/49/EC, adopted into Italian law through Legislative Decree no. 194/2005, proposes determining exposure to environmental noise by requiring the Member States' competent authorities to draw up noise maps for agglomerations and major road, railway, and airport transport infrastructures, using the indicators L_{den} and L_{night} introduced to establish the number of persons exposed respectively to noise-induced annoyance or sleep disturbance. Member States are also required to produce measures regarding the adoption of Action Plans with the following purposes: preventing and reducing environmental noise where effects harmful to health may occur; protecting good acoustic quality in areas where it is already present; informing the public and ensuring its involvement with regard to environmental noise and its effects.

The implementation status in Italy of the requirements put in place by Legislative Decree no. 194/2005 is marked by delays and failure to respect the established deadlines.

The implementation status in Italy of the requirements put in place by Legislative Decree no. 194/2005, in turn implementing the initial phase of Directive 2002/49/EC on agglomerations with more than 250 thousand inhabitants, road infrastructure with more than 6 million vehicle passages/year, railway infrastructure with more than 60 thousand train passages/year, and major airports with more than 50 thousand movements/year, is marked by numerous failures to respect the established deadlines.

The second round of the directive implementation process regards agglomerations with a population in excess of 100,000 persons,

[3] Directorate-General for Internal Policies - Policy Department A: Economic and Scientific Policy, *Towards a comprehensive Noise Strategy* - November 2012, data processing: 30 June 2011

[4] NOISE, *Noise Observation and Information Service for Europe*

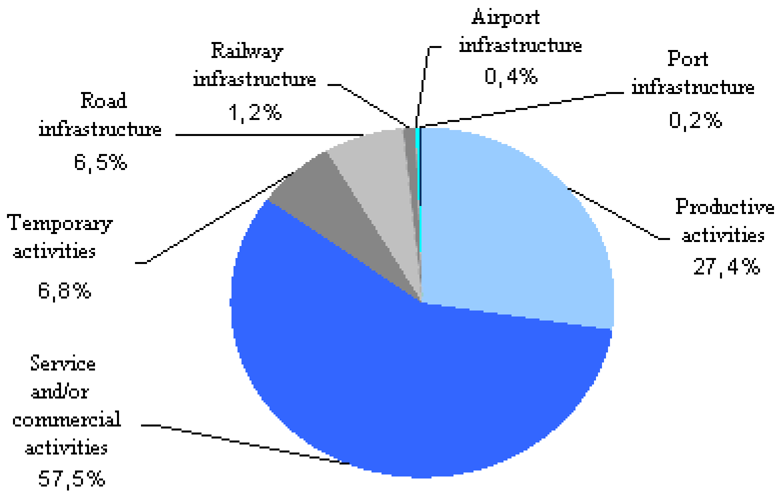
major roads with more than 3 million vehicle passages/year, and railways with more than 30,000 train passages/year. The deadline for drawing up and transmitting the noise maps, the strategic noise maps, and the information as per Annex VI to Directive 2002/49/EC was set for 30 June 2012 for the competent authority (Ministry of the Environment) and 30 December 2012 for Communication to the Commission. The next deadline regards drawing up and delivering the Action Plans and the summaries as per Annex VI, and is set for 18 July 2013.

Prior to Directive 2002/49/EC, the European Parliament and the Council issued Directive 2000/14/EC on the noise emission in the environment by equipment for use outdoors, transposed into Italian law by Legislative Decree no. 262 of 2002. This directive, and consequently the decree adopting it, requires those responsible for placing on the market 57 types of machines to subject these products to a conformity assessment procedure. In the event of a positive outcome, the equipment is then sold accompanied by the EC declaration of conformity, bearing the EC marking and a label indicating the Guaranteed Sound Power expressed in dB(A). Analysis of the activities performed by the Environmental Regional Agencies System in 2011 shows 2.958 noise sources that were controlled with measurements by ARPA/APPA, with distinct percentages in the various sectors.

The sources that were most measured, for 2011 as well, were service and/or commercial activities (57.5%), followed by productive activities (27.4%); road infrastructure remains the most-controlled transport source (6.8%) (Figure 6.1). Compared with 2010, service and/or commercial activities have increased as a percentage of the total of controlled sources (52.5% in 2010), and productive activities controlled by ARPA/APPA (31.5% in 2010) have shown a decrease.

The control activity is carried out mainly after reports/complaints by citizens: in 2011, overall, about 85.5% of controlled sources were controlled following complaints. In particular, the greatest number of sources controlled upon complaint is found for service and/or commercial activities (96% of the total of controlled service activities). Out of the total of the complaints lodged by citizens, following which controls were performed by ARPA/APPA, 95% is represented by all activities (productive, commercial, and/or services and temporary activities). The high number of complaints and of cases of exceeding the regulatory limits recorded in 2011 (42.2% of the controlled sources exceed the limits) shows a constant attention to noise pollution and a demand for greater protection by citizens in dealing with a truly critical situation.

There is clearly great attention by citizens and demand for personal and environmental protection: 85 controls out of 100 are triggered by citizens' complaints, and 42.2% of the sources reported by citizens shows that the limits have been exceeded.



The controlled sources deemed highly annoying by citizens are commercial and service activities (57.5%), productive activities (27.4%), and temporary activities (6.8%).

Note
Data for the Regions of Veneto, Campania, Calabria, Sicily, and Sardinia are unavailable

Figure 6.1: Distribution of controlled sources (2,958) in the various types of activities/infrastructure (2011)[5]

Major noise sources

While railway and air traffic is showing a growth trend, road traffic is holding steady.

The main noise sources, which may be identified as road, railway, and air traffic, are showing different trends. Specifically, while air traffic and railway traffic (passengers) are growing, road traffic has been holding steady in recent years. In particular, airport traffic, after the 17.7% increase recorded between 2003 and 2007, has shown, over the past five years (2007-2011), a 5.4%, reduction, a trend that resumed growth after 2009, with an approximately 5% rise over the three-year period from 2009 through 2011. Vehicle traffic, on the other hand, after a 61% increase between 1990 and 2007, since 2008 has held steady at 83 million vehicles/km, with a slight decrease (-1%) between 2010 and 2011.
As regards railway traffic, in 2011 about 321 million trains/km for passenger transport circulated on the State Railway (+7.4% against 2004) and 42 million trains-km for cargo transport (-34.2% against 2004).
The obligation for transport infrastructure operating bodies to draw up Plans for noise containment and abatement interventions, as provided for by the ministerial decree of 29 November 2000, has yet to be fulfilled, although in recent years many operators have delivered their studies. The aforementioned elements of pressure, although diminishing, along with the faulty implementation of the regulations and the lack of synergies and forms of dialogue between the major players, are obstacles to an organic, shared definition of actions. Car traffic is the main source of noise pollution in an urban setting, but we must not neglect such other sources as, for example: industrial and handicraft activities, commercial activities with their installations (air conditioning, refrigerators, etc.) and discotheques, which generate significant impacts in urban settings. The noisy machinery operating in road

[5] Source: ARPA/APPA data processed by ISPRA

and construction work sites, and gardening apparatus, which are the main object of Directive 2000/14/EC, also influence the acoustic climate of the surrounding environment, and for this reason are no minor cause for disturbance.

Actions to contain noise pollution

Forms and modes of harmonization of European Community and national legislative instruments must be identified and shared in the various areas of the issue.

The progressive implementation of Directive 2002/49/EC, albeit with the differences that may be found in the amoung Member States, shows a greater awareness of the state of the environment in the matter of noise pollution at Community and Member State level, and a greater sharing of problems encountered and of actions performed. The need to carry out the directive's implementation process and the pursuit to harmonize Community legislation with the complex national legislative system, whose basic reference is Framework Law on noise pollution no. 447/95, are privileged areas of activity, capable of creating an occasion for reflection and developments in the legislative structure.

Analysis of the state of implementation of and the experiences in implementing Directive 2002/49/EC by the Member States[6] has made it possible to identify the possible opportunities and critical areas produced by the directive, thus allowing different scenarios and alternative proposals for solving the problems occurring in implementation to be foreseen[7]. Moreover, in order to permit accuracy and comparison of data originating from the Member States (in implementation of art. 6 of Directive 2002/49/EC) for estimating the exposed population, the CNOSSOS (*Common Noise Assessment Methods*) project is in its final phase, with the aim of defining a common model for determining the noise generated by the road, railway, airport, and industrial noise sources.

At national level, attention is aimed at guaranteeing full integration between the provisions of Directive 2002/49/EC and the complex structure of noise legislation, through the definition of harmonization criteria; however, there is an absence of implementation decrees dedicated to enforcing the directive, which were provided by Legislative Decree no. 194 of 2005.

Numerous projects cofinanced by the European Commission address various aspects of the directive[8]. In particular, as part of the HUSH project, methodological and technical contributions and proposals for legislative review were made with regard to harmonizing European, National, and Regional requirements[9]. The main critical areas remain: lack of organic treatment of the sector's legislative regulations at the various levels of enforcement; the failure to complete the implementation decrees provided by the Framework

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[6] COM/2011/0321 *Final Report from the Commission to the European Parliament and the Council - Relazione della Commissione al Parlamento Europeo e al Consiglio sull'applicazione della direttiva sul rumore ambientale ai sensi dell'articolo 11 della direttiva 2002/49/CE.*

[7] *MILIEU, Final Report on Task 1, Review of the Implementation of Directive 2002/49/EC on Environmental Noise, May 2010*

[8] Project NADIA http://www.nadia-noise.eu/en; Progetto QUADMAP: http://www.quadmap.eu/; progetto HARMONICA: http://harmonica-project.com/

[9] Project HUSH *Harmonization of Urban noise reduction Strategies for Homogeneous action plans http://www.hush-project.eu/it*

Law, and in particular the one on defining the criteria for designing, carrying out, and renovating building constructions and transport infrastructure; the disregarded application of the decree dedicated to buildings' passive noise requirements; the failure to strengthen those legislative instruments in force that are dedicated to managing environmental noise but are constantly neglected. Moreover, actions aimed at preventing and mitigating the effects produced by noise pollution are still clearly fragmented. In particular, even if signs of change are recorded, especially in construction, there are still discontinuities between sectors. An appropriate number of actions (transport infrastructures) is devoted to some, and less attention is paid to others, as found in the integration between territorial and acoustic planning.
As regards the actions aimed at environmental communication and information and getting citizens involved, greater attention is seen, due also to the principles and instruments introduced in a European Community setting.
In this setting, ISPRA has carried out the Catasto Nazionale delle Sorgenti di Rumore (national noise sources registry) project, which consists of an archive of data for characterizing noise sources, designed to contain the information of use for the acoustic characterization of the chief sources on the national level (industries, roads, railways, airports, and ports) and any noise measurements connected with them. There are still clear differences regarding implementation status in the various sectors and local settings. The institutional activities conducted by the Environmental Agency System are intensified and attentive to citizens' needs, in both monitoring and information.
Analysis of the data regarding the requirements established by the regulations in the various sectors shows a situation holding steady with respect to years past, as well as a fulfilment of certain obligations in the area of transport infrastructure. In particular, the absence of a regional law, in certain Regions, with provisions regarding noise pollution, as established by the Framework Law, underscores the insufficient response that characterizes the national picture.
Five Regions are still without their own regional law (Molise, Campania, Basilicata, Sicily, and Sardinia); the last region to have issued a regional law implementing art.4 of Law no. 447/95 is Calabria (Regional Law no. 34 of 19 October 2009 "Regulations in the matter of noise pollution for the protection of the environment in the Region of Calabria"), while Tuscany recently, with Regional Law no. 39/2011, issued the measure modifying the prior regional law in the matter of noise pollution dating back to 1998, further supplemented by the provisions present in regional laws no. 29 and no. 69 of 2012.
It bears mentioning that often, through Regional Council Deliberations, measures are issued regarding individual procedural acts, as guidelines for drawing up the acoustic classification or procedures for recognizing the figure of acoustics technician, to work around the lack of an organic handling of the matter on the regional level.

The approval of the acoustic classification of the municipal territory, a priority instrument of acoustic planning, which defines the territory’s use and permits subsequent actions for protection and the remedying of critical areas, was implemented, as of 31 December 2011, for 49.1% of Italy’s municipalities, as against 46% the year before. There are still considerable distinctions among the various Regions. Those with the highest percentage of zoning municipalities are Marche and Tuscany (97%), Aosta Valley (93%), Liguria (84%), the Province of Trent (76%), Piedmont and Lombardy (73%), Emilia-Romagna and Veneto (64%), while those with percentages under 10% are Abruzzo (7%), Sardinia (3%), and Sicily (1%).

There is insufficient application of the acoustic classification and an uneven spread in national territory, with the presence of policies that were effective in some Regions, and features of inertia in other areas.

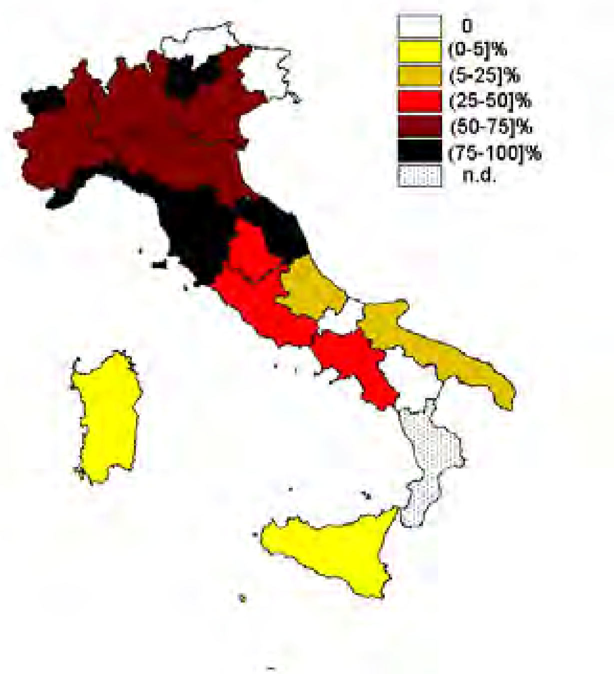
The acoustic classification Plan is not a municipal planning currently used in the Province of Bolzano, in Friuli-Venezia Giulia, in Basilicata, or in Molise. Information regarding the region of Calabria, on the other hand, is lacking.

Similarly, considerable increases have been seen in the percentage of population residing in municipalities with approved acoustic classification - equalling 55.8%, as against 52% for the previous year; the same trend holds for the percentage of zoned area out of the entire national area (from 39.9% in 2010 to 42.1% in 2011). (Figures 6.2, 6.3, 6.4).

The increased number of municipalities that have approved acoustic classification is due to the slight increases found in those Regions with high percentages of municipalities that have adopted the plan, further underscoring the gap that exists between local settings with almost all the territory zoned, and others where there is no municipality with approved zoning.

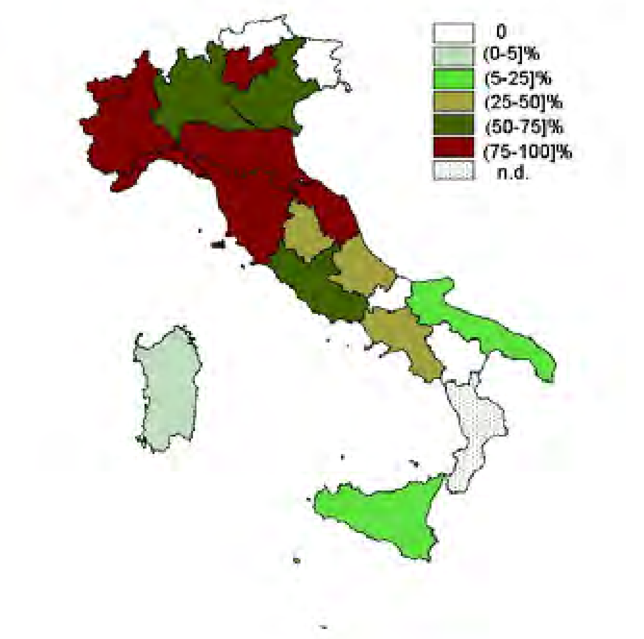
The percentage of Italian municipalities with classification (49.1%), and the excessive local differences, highlight a still insufficient application of the instrument, and an uneven spread in national territory, with effective policies in some Regions and a stalled situation in other areas.

Critical points regard the citizens’ scant knowledge of the Plan and of its incidence on the territory and on the quality of the environment; this results from insufficient information and the excessively sectoral nature of the instrument, which has yet to be fully integrated with the chief territorial planning devices and with the other plans connected with environmental issues.



The percentage of Italian municipalities that have approved the acoustic classification, as of 31 December 2011, equals 49.1%. Marche and Tuscany (97%), Aosta Valley (93%), Liguria (84%), the Province of Trent (76%), Piedmont and Lombardy (73%).

Figure 6.2: Percentage of municipalities that approved the acoustic classification out of the total number of municipalities in each Region/Autonomous Province (data updated as of 31 December 2011)[10]



The percentage of the population residing in municipalities that approved the zoning is equal to 55.8%.

Figure 6.3: Percentage of population resident in municipalities that approved the acoustic classification out of the total population of each Region/Autonomous Province (data updated as of 31 December 2011)[11]

[10] Source: ARPA/APPA data and ISTAT data processed by ISPRA
[11] Source: Ibidem

The percentage of territorial area of municipalities that have approved the classification equals 42.1%, against 40% in 2010.

Figure 6.4: Percentage of territorial area of municipalities that have approved the acoustic classification, out of the total of municipalities in each region/autonomous province (data updated as of 31 December 2011)[12]

49.1% of municipalities approved the territory's acoustic classification plan; only 1.5% of the municipalities with an acoustic classification plan has also adopted a remedy plan. Only 15% of the municipalities so required drew up a biennial report on acoustic status.

The drawing up of the biennial report on acoustic status of municipality, introduced by law no. 447/95 as an instrument of analysis and management of the "noise pollution" problem in a municipal setting, has been largely disregarded. In fact, no variations with respect to previous years are recorded: out of the total of 149 municipalities with a population exceeding 50,000 with the obligation to write the report, as of 2011 only 21 had complied; the greatest number is recorded in Tuscany, with 11 compliant municipalities out of 13, and in Lombardy with 5 municipalities out of 15.

The adoption of the municipal acoustic remedy plan, provided for by Law no. 447/95, is also little used: according to the available data, only 61 municipalities, equalling 1,5% of the municipalities that approved the acoustic classification, also approved the noise abatement Plan. This planning instrument is used chiefly in Tuscany, which has 43 approved noise abatement Plans.

At present, 19 airports out of 40 have approved the acoustic classification of the airport surroundings.

The acoustic characterization of the airport surrounding, required by the decrees implementing Law no. 447/95 in the matter of airport noise, was approved, as of 2011, in 19 out of 40 domestic airports for which data are available, and is being assessed in 8 more.

The remedial actions provided for by the Framework Law for operators/owners of transport infrastructures show distinctions: for railways and almost all motorways, studies of the criticalities present in their infrastructure network have been completed, and an

[12] Source: ARPA/APPA data and ISTAT data processed by ISPRA

initial series of mitigation interventions has been designed and planned; for roads and airports, studies are clearly delayed.
As regards the state of implementation of the noise containment and abatement interventions plans (*Piani degli interventi di contenimento e abbattimento del rumore* – PCAR) pursuant to the Ministerial Decree of 29 November 2000, as pertains to the operators of motorway infrastructures under concession, 18 have delivered these plans to the Ministry of the Environment and Protection of Land and Sea and to the affected Regions/municipalities; 3 operators have not delivered the PCAR, having declared that their sections under concession, by respecting the limit values in force, do not require new interventions; lastly, a single operator has yet to deliver its PCAR (Table 6.1).
ISPRA has seen to the technical examination of the plans that were delivered, sixteen of which were approved by the Ministry of the Environment downstream of the agreement reached at the unified Conference.
ISPRA, in compliance with art. 4 of Legislative Decree no. 262/2002, is responsible for overseeing the market established under Directive 2000/14/EC.
Thus, in order to guarantee compliance with requirements, it has thus far carried out more than four hundred document checks, resulting in the regularization of more than three thousand models of noisy machines and equipment, and the first activities provided for by the Ministerial Decree of 04 October 2011 have been carried out at the companies.

Table 6.1: Delivery of noise containment and abatement interventions plans, pursuant to the Ministerial Decree of 29 November 2000, by operators of motorway infrastructures under concession (December 2011)[13]

For 94.2% of the kilometres of motorway infrastructure under concession, PCARs were delivered; for 3.9%, the PCAR has yet to be delivered; and 1.9% requires no interventions by the operator.

PCAR	km	%
Delivered	5,230.30	94.2
To be delivered	218.00	3.9
Declared unnecessary by operator	106.60	1.9
TOTAL	**5,554.90**	**100**

In the current phase, it is necessary to concentrate activities on harmonizing the methods and instruments for preventing and mitigating noise pollution, through the opportunities introduced by the legislative acts in the matter of reorganizing the regulations, emphasizing the critical aspects that have persisted for too long and reinforcing awareness of the dynamics inside the country and in the European Community. The prevention, planning, and remedy instruments present in the national legislation must be made harmonized and effective, along with those introduced by Directive 2002/49/EC, accompanied by clear, proper, and comprehensive information to the public on the main aspects of the issue, and above all on the effects on people and the environment.

[13] Source: ISPRA

Specific regional characteristics

ARPA Friuli Venezia Giulia

The state of progress of the acoustic classification in the regional territory of Friuli Venezia Giulia has, as of late May 2013, reached 88 zoned municipalities (or municipalities that are in an advanced state of defining the PCCA), out of a regional total of 218.
With these partial data, an interesting initial assessment may be made on the urban planning choices in the *noise* component made by the Local Administrators of Friuli Venezia Giulia: the clearest set of data refers to the choice of assigning most of the municipal territory to the classes that most greatly limit noise emissions: in fact, the first three acoustic classes (I, II, III) account for 97.3% of the zoned territory; in greater detail, it is noted that II is far more representative of the regional territory (67.1%), followed by class I (27.0%). The latter figure even further confirms the choice of a greater protection of the territory to the benefit of the environment and the resident population.
As regards the population distribution, although the sample taken as a reference is still quite limited (20.0%) and does not include the four provincial capitals, it may be stressed that class III is the most representative (66.3%), with an even distribution over the remaining classes II and IV reserved for residence by sectoral legislation.

ELECTROMAGNETIC POLLUTION

The problem

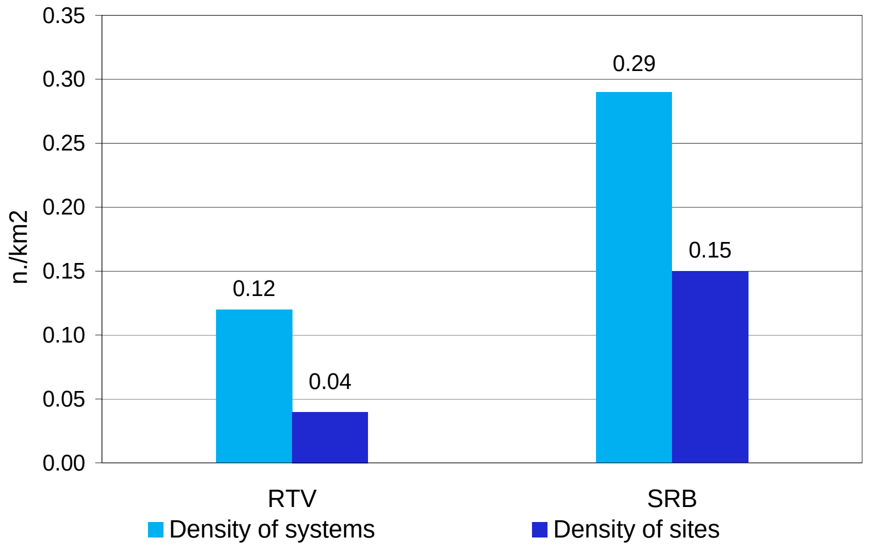
In recent years, as regards electromagnetic fields, numerous actions have been undertaken both nationally and regionally, in terms of monitoring and developing information instruments. These actions have made it possible to somehow contain the scaremongering among the citizens and to improve their trust in institutions. Currently, in Italy, a phase of great technological development involving radio and telecommunications systems is being seen, starting with the passage from analogue to digital signal, and then following the wake of the future technologies that will being appearing over the next two-three years on national territory (UMTS 900, LTE, Single Ran apparatus). This has already brought about a nationwide regulatory adjustment, creating quite a few difficulties in application on the regional level. These changes in the types of apparatus and in regulatory acts must, however, continue to be supported by the same instruments as those that in years past have made it possible to give positive impetus to the social management of this problem. The great steps forward in the legislative and technical/scientific field to protect the population's health continue to be the basis for further actions to be undertaken in order to obtain a better knowledge of the repercussions on the environment of certain electromagnetic sources present in national territory.

It is necessary to keep supporting the strong technological development in radio and telecommunications systems with actions aimed at obtaining a better knowledge of these systems' environmental repercussions on national territory.

The main sources of electromagnetic fields

The following information regards the sources of electrical, magnetic, and electromagnetic fields, represented by power lines and radio and telecommunications systems (radio/television broadcasting antennas (RTV) and base transceiver station (BTS)), which are the object of the "EMF Monitoring Unit"" a database annually populated by regional and provincial environmental agencies (ARPA/APPA) contacts. For 2011 (Figure 6.5), it is noted that the BTS show a density of facilities over the entire national area that is 2.4 times greater than that for RTV systems (respectively, 0.29 and 0.12 systems per km^2), while the density of BTS sites (0.15 sites per km^2) is about circa 4 times greater than that of RTV sites (0.04 sites per km^2). The environmental impact in terms of pressure exerted by the facilities of said systems on national territory, underwent, from 2010 to 2011, a variation connected chiefly with BTS systems, which grew by 6%, while RTV and their total power fell by 8% and 13% respectively. This information was gleaned from the Regions, which provided the complete data for the two years in consideration for both types of systems (Piedmont, Aosta Valley, Lombardy, Veneto, Emilia-Romagna, Umbria, Marche, Molise, and the autonomous province of Bolzano).

Between 2010 and, 2011 there was 6% growth of BTS systems, while RTV systems and their total power fell by 8% and 13% respectively.

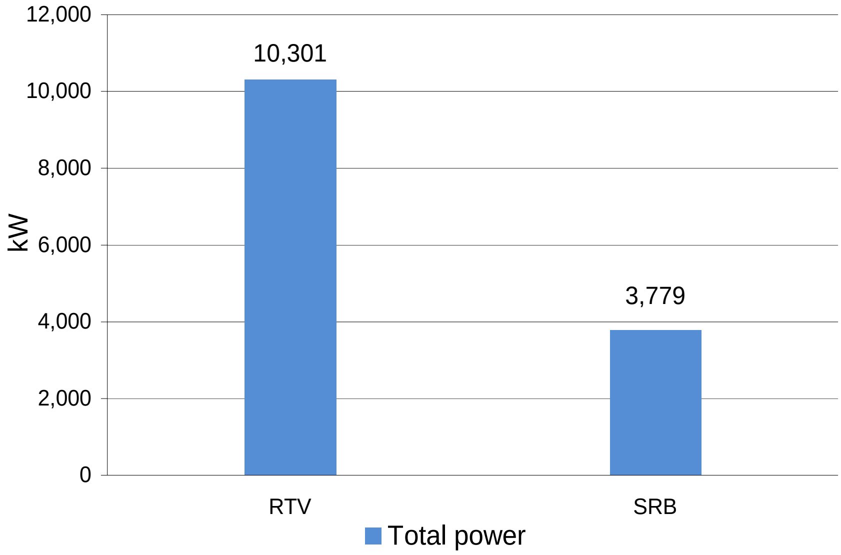


The BTS show a density of systems over the entire national area 2.4 times greater than the RTV systems. A similar situation exists for the density of the sites, where BTS have a density about 4 times greater than that of the RTV.

Figure 6.5: Density of systems and sites; comparison between RTV and BTS, for Regions where the complete set of data is available (2011)[14]

The total power of the BTS systems (3,779.35 kW) is about 3 times lower than that of the RTV systems (10,300.82 kW). The lower total power associated with the BTS systems results in greater pressure on the territory than the RTV systems, as shown earlier, in order to guarantee at any rate coverage of the territory based on the service requirements of mobile telephony.

[14] Source: ARPA/APPA data (EMF Monitoring Unit) processed by ISPRA



The most substantial environmental pressure in terms of power is exercised by the RTV systems. These systems, in fact, are marked by a total power level about 3 times greater than that of the BTS systems.

Figure 6.6: Total power, compared between RTV and BTS, for the Regions where the complete set of data is available (2011)[15]

In this setting, another important pressure is exerted by the high and very high voltage power lines. With regard to the updated data, a slight increase (1.9%) in lines with voltages under 40 kV from 2010 to 2011 may be noted. As regards the information on the size of the national electrical grid, broken down by voltage, only the data for the power lines with voltages under 40 kV and part of the electrical substations (those for which ENEL Distribuzione is responsible) have been updated to 31 October 2011. The remaining data (power lines with voltages of 40-150 kV, 220 kV, 380 kV and Terna substations, data on the Aosta Valley and Trentino-Alto Adige) are updated to 31 December 2010.

Actions to contain electromagnetic pollution

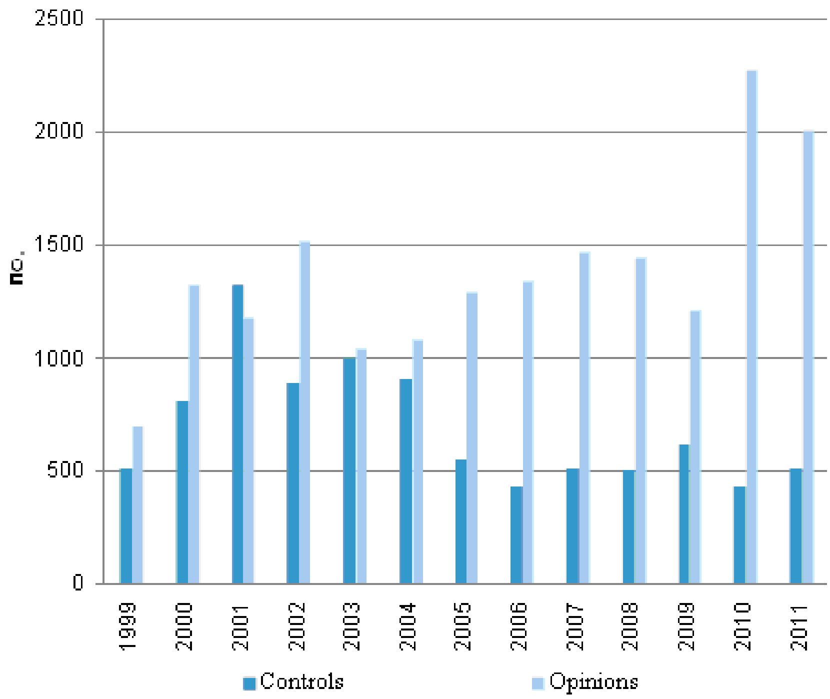
The control and oversight activities regarding ELF (Extremely Low Frequency), RTV, and BTS systems, entrusted by law (art. 14 of Framework Law n. 36/2001) to ARPA/APPA, provide an important support to municipal and provincial administrations in the authorization phase (preventive opinions) and in the operation phase (post-activation controls with forecasting and instrumental models) of the radio telecommunications systems. The environmental Agencies exploit the results of these activities not only for the primary purpose of verifying compliance with the limits established by the regulations in force (DPCM of 08 July 2003), but also to collect, over the years, information for a better understanding of the repercussions on the environment of the emissions of certain electromagnetic sources and to promote more complete and transparent information to the population. From 2010 to 2011, considering the Regions that provided the complete and updated set of data for both types of source (Piedmont, Aosta Valley, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Tuscany, Umbria, Marche, and Molise), there has been an increased number of preventive opinions, equal to 23% for BTS and 33% for RTV. The total number of controls performed on

Between 2010 and 2011, there has been an increased number of preventive opinions, equal to 23% for BTS and 33% for RTV. As regards post-*activation controls, there has*

[15] Source: ARPA/APPA data (EMF Monitoring Unit) processed by ISPRA

BTS has increased by 18%, while the controls made at the citizens' request declined by 4%. In the case of RTV systems, there has been an increase, albeit slight, in the total number of controls, equal to 1%; the controls carried out upon request have, on the other hand, seen a considerable decline, equal to about 7.5%. As regards the opinions and checks regarding power lines (ELF), between 2010 and 2011 a substantial increase was recorded, both in the number of preventive opinions (10.5%) and in the number of controls carried out (32%). This information was obtained from the Regions that supplied the complete set of data for the two years in consideration for both types of system (Piedmont, Aosta Valley, Lombardy, Trentino-Alto Adige, Veneto, Tuscany, Umbria, Marche, and Molise). It is specified that the trend shown in Figure 6.7 refers to the Regions for which a complete set of 1999-2011 data is available: Aosta Valle, Lombardy, the autonomous Province of Bolzano, Veneto, Emilia-Romagna, Tuscany, Umbria, Marche, Abruzzo, Molise, and Basilicata).

been a slight increase for RTV systems, equal to 1%, while BTS systems have shown an 18% increase. The controls at the citizens' request with regard to RTV and BTS systems fell in both cases, by 7.5% and 4% respectively.



From 1999 to 2011, the number of controls on electromagnetic field sources has shown a rather variable trend which, since 2005, has recorded a general decline from previous years (2000-2004).

Notes

The data are those regarding only the Regions/Autonomous Provinces for which there is a complete set

Figure 6.7: Trend in the number of opinions and controls for sources of ELF fields in Italy[16]

Based on the data contained in "EMF Monitorin Unit" the cases of overcoming the legal limits for RTV systems (equal to 603) are about 7 times greater than those regarding the BTS systems (equal to 85). For the Regions for which the set of information has already been updated (Piedmont, Aosta Valley, Lombardy, Bolzano, Veneto, Friuli-Venezia Giulia, Liguria, Emilia-Romagna, Umbria, Marche, Molise, Abruzzo, Basilicata, and Calabria), the percentage of remedial actions concluded with regard to RTV systems is 63% of the total, against 85% for the BTS systems (Figure 6.8). It bears mentioning that the information regarding the status of the remedial actions corresponds to the environmental

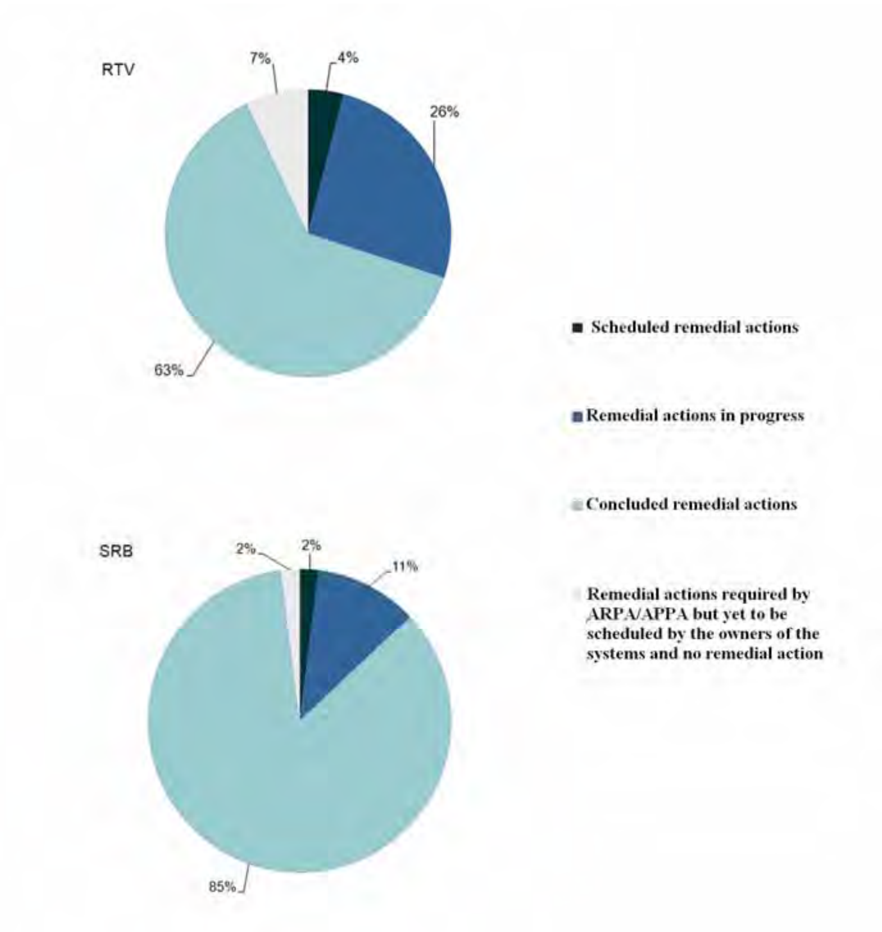
The cases of exceeding the legal limits regarding the RTV systems (equal to 603) are about 7 times greater than those regarding the BTS systems (equal to 85).

[16] Source: ARPA/APPA data (EMF Monitoring Unit) processed by ISPRA

Agencies System's state of current knowledge. As for the BTS systems, a high percentage of concluded remedial actions has been recorded in comparison with RTV systems, for which the complexity of the remedial action (involvement of a number of systems, difficulty in maintaining the same service quality as per the concession documents) results in a greater presence of remedial actions to be concluded. The regional regulatory scenario presents no new elements with regard to protecting the population from exposure to electromagnetic fields. For the Regions for which the information was updated (Piedmont, Aosta Valley, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Tuscany, Umbria, Marche, Molise, Apulia, Basilicata, and Calabria), no variations from 2011 are recorded. There are still but a few Regions with a registry for both high and low frequency; in fact, only 11 Regions (Aosta Valley, Liguria, Emilia-Romagna, Tuscany, Umbria, Marche, Abruzzo, Campania, Apulia, Calabria, and Sardinia) have an RF/ELF registry either developed or being developed.

There are still few Regions with a registry for both high and low frequency; in fact, only 11 Regions have an RF/ELF registry in progress or being developed, or already developed.

For RTV systems, the remedial action is technically more complex. In fact, the relative percentage of concluded remedial actions (63%) is lower than BTS systems (85%).



Notes

The data are those regarding only the Regions/Autonomous Provinces for which there is a set updated to 31 December 2012 for both types of RF source.

Figure 6.8: Status of remedial actions at sites where excess due to RTV and BTS systems was surveyed (1998-2012)[17]

[17] Source: ARPA/APPA data (EMF Monitoring Unit) processed by ISPRA

Specific regional characteristics

ARPA Friuli Venezia Giulia

In the last months of 2012, in Friuli Venezia Giulia, the process still underway began for the formation of the Regional Plan for the Recovery of Radio Electric Systems pursuant to Law no. 36/01 and the corresponding Strategic Environmental Assessment Procedure. This Plan should enable the gradual adjustment, in accordance with certain procedures, of the systems currently involved in situations of exceeding the limits. The remedial procedures provided for by the Plan will in substance be reduction to compliance on site and removal to sites with characteristics responding to the urban planning, radio electric, healthcare, and environmental compliance requirements in force.

ARPA Tuscany

The "La Spezia-Acciaiolo" (line 314) power line has an 89 km route that takes it to the provinces of Massa Carrara, Lucca, and Pisa, traversing the territory of 15 municipalities. Taking as a reference the average currents recorded on line 314 in the years 2005-2010, it may be pointed out that in 14 of the households monitored by ARPA Tuscany (ARPAT) the average level of exposure of 1 µT has been exceeded.
This situation has suggested starting a project for activating an ongoing control system making it possible to update exposure levels virtually in real time.
The objective of the project led by the Province of Lucca is to be able to provide to public administrations and citizens an estimate of the exposure levels to the magnetic fields produced by the line, employing mathematical models that use the results of measurements made continuously at a fixed station.
Through appropriate calibrations, it is in fact possible to know the current circulating on the line at a given instant. The physical laws that relate the current to the magnetic field are at the basis of the PLEIA-EMF model ver. 1.6, developed for ARPAT by FAC-CNR, Florence, and validated by the Agency.
The information on the exposure levels generated by the power line at receivers along the power line's entire route, was made available to citizens and local bodies by means of a monthly bulletin (http://www.arpat.toscana.it/datiemappe/bollettino-elettrodotto-la-spezia-acciaiolo).

ARPA Aosta Valley

Since 2004, ARPA in the Aosta Valley has undertaken a solar radiation monitoring programme. Starting up a set of accurate measurements trackable to international references is in fact an essential condition for identifying medium- and long-term trends (linked, for example, to the phenomena of the variations in the ozone layer and to global dimming/brightening), in order to deepen knowledge of the dynamics of air quality, of the natural contribution to fine dusts, and of the radiative balance in the atmosphere (photo-chemical pollution, concentrations of gases identifiable by solar absorption spectroscopy, optical, microphysical, and properties of aerosols), and to study the positive and negative effects of exposure to the sun by residents and tourists, especially at high elevations, as well as the effects on flora, fauna, flora, and materials. Underway at the Aosta Valley ARPA are investigations in broad and spectral, ultraviolet and visible band, ozone layer estimates, sulfur and nitrogen dioxide by means of Brewer spectrophotometer, and measurements of the optical properties of aerosols with narrowband solar photometry. The Agency belongs to the leading international networks on solar data (WOUDC, EuroSkyRad, etc). Advances are planned for estimating natural infrared radiation and the vertical profile of aerosol.

TERMS AND DEFINITIONS

Physical agents:

Those factors that trigger emissions of energy into the environment that are potentially harmful to human health and to ecosystems. This category includes noise, electromagnetic fields, vibrations, light pollution, ultraviolet (UV) rays, and ionizing radiation.

L_{den}:

Day-evening-night noise indicator, for overall annoyance, introduced by Directive 2002/49/EC.

L_{night}:

Night-time noise indicator, for sleep disturbance, introduced by Directive 2002/49/EC.

NOISE:

Noise Observation and Information Service for Europe, maintained by the European Environment Agency (EEA) and the European Topic Centre on Spatial Information and Analysis (ETC-SIA, previously ETC-LUSI) on behalf of the European Commission. It contains data related to strategic noise maps delivered in accordance with European Directive 2002/49/EC relating to the assessment and management of environmental noise.

Decibel (dB):

The decibel (symbol dB) is one tenth of a bel (symbol B): 10 dB = 1 B. Although the bel has now fallen into disuse, it remains the fundamental unit of measurement from which the decibel derives; moreover, corresponding measurements are pure numbers and are precisely obtained as a logarithm of the ratio between two values of a physical quantity (which is to say, they can be expressed in the same unit of measurement, and thus such that their ratio is a pure dimensionless number).

Catasto Nazionale sorgenti di rumore (**national noise sources registry**):

Developed by ISPRA, at the mandate of the Ministry of the Environment, it is an archive of data for characterizing noise sources of national importance, such as transport infrastructure or systems subject to integrated environmental authorization (Autorizzazione Integrata Ambientale - AIA). The register lends itself to being a tool of great usefulness in the area of environmental impact studies, but above all as a public-targeted component of environmental information processes.

Osservatorio CEM (**electromagnetic field monitoring unit**):
The "Osservatorio CEM" database was born from the need to develop an adequate knowledge base regarding the number of systems present on the territory (RTV systems and cell sites for high frequency, and power lines for extremely low frequencies -), the control activity performed by regional and provincial environmental protection agencies (ARPA/APPA), and the existence of critical situations on the territory, connected with exceeding the limits provided for by the legislation in force.

System (**RF**):
The number of antennas operating at a given frequency equals an impact (this definition is in line with the technical specifications of the osservatorio CEM).

Site (**RF**):
Geographic location where telecommunications systems are installed. The site may be simple - t a pole or pylon, for example - complex, with many poles and/or pylons, generally fenced in (this definition is in line with osservatorio CEM's technical specifications).

Radio television systems (**RTV**):
Systems for radio and television broadcasting transmit electromagnetic waves at radio frequency, with frequencies between a few hundred kHz and a few hundred MHz.

Cell sites (**CS**):
Cell sites (CS) are mobile phone systems that receive and retransmit cellphone signals. These systems operate in various frequency bands, between 900 and 2,100 MHz, depending on the technological system used.

CHAPTER 7

NUCLEAR ACTIVITIES AND ENVIRONMENTAL RADIOACTIVITY

Introduction

As known, the nuclear power plants (NPPs) and the fuel fabrication facilities in Italy have been out of operation for several years now, though there are in place activities aimed at the safe disposal of the radioactive waste generated by earlier activities and from the decommissioning of the said NPPs. In addition, a number of small research reactors continue to operate at universities and research centres, and there is still widespread use of sources of ionising radiation in medical and industrial applications, as well as in scientific research, with the necessary transport activities for both radiation sources and deriving waste. Consideration must also be given to natural sources of ionising radiation, such as radon gas, which constitutes the primary source of exposure of the population, along with radioactive materials of natural origin present in, or deriving from, specific industrial processes. Pressures placed on the environment by ionising radiation, therefore, remain significant in importance and quantity, so that protection against radiation must necessarily continue to be a key point in the protection of the environment, the population and workers. In Italy, the protection of the workers and of the population from ionising radiation is governed by Law no. 1860 of 31 December 1962, together with Legislative Decree no. 230 of 17 March 1995, plus subsequent modifications, and Legislative Decree no. 52 of 8 February 2007. The national legislation currently in force places precise obligations on the operators, the state administration (governmental agencies and ministries) and the local governmental institutions (prefectures, regional governments, autonomous provinces).

The oversight of nuclear activities and the monitoring of environmental radioactivity are top-priority functions to ensure a high level of protection for the population and the environment with respect to the risks tied to exposure to ionising radiation.

NUCLEAR ACTIVITIES

The main activities

The nuclear activities involving risk from exposure to ionizing radiation of the population and the environment in Italy currently are:

- nuclear facilities of the past nuclear program currently under decommissioning, and research reactors;
- nuclear waste storage facilities mainly inside the nuclear installations;
- activities employing sources of ionising radiation;
- transport of radioactive materials.

The main installations of the past nuclear program, which are currently in different stages of decommissioning, are the four NPPs, Garigliano, Latina, Trino and Caorso, the EUREX and ITREC experimental reprocessing facilities, the Plutonium and OPEC 1 plants of the ENEA Centre in Casaccia, the Fuel Element Manufacturing Plant, the Avogadro Storage Facility and the installations of the Joint Research Centre in Ispra (Province of Varese).

The installations of the past nuclear program are currently being decommissioned.

The decommissioning of the installations consists of a series of planned operations aimed at the installations' final dismantling or unconditional release of the site, all in accordance with the requirements of safety and radiation protection of workers, population and the environment.

The decommissioning of the installations consists of a series of planned operations aimed at the installations' final dismantling or unconditional release of the site.

The primary operations carried out in preparation of the decommissioning of the installations involve the removal from the same of any spent nuclear fuel, which is then transported to an authorised site outside Italy for reprocessing, and operations of treatment and conditioning of the radioactive waste generated by the earlier operation of the plant.

In order to enable the safe disposal of the radioactive waste and allow - as ultimate goal - the unconditional release of the sites, a suitable national structure for the disposal of low-activity waste and for the long-term storage of high-activity waste is needed. Until a similar national storage facility becomes available, suitable storage conditions have been ensured at the sites in question through the establishment of temporary deposits that meet the requirements of the current international standards.

A national repository for the disposal of low-activity waste and for the long-term storage of high-activity waste is needed.

The decommissioning activities generate also different types of solid waste materials which can, within the prescribed limits of radioactive concentration, be unconditionally released from the plants. In the course of the activities liquid and gaseous effluents can also be released into the environment, if their radioactivity values are within the specifically authorised limits. The criteria established by the Italian legislation, used to determine the feasibility of removal of solid materials and release of effluents into the environment, corresponds to the internationally recognised value of "radiological irrelevance", equal to 10 microSv/year.

Decommissioning involves the production of solid materials which can be unconditionally released.

The use of sources of ionising radiation continues to be widespread in applications in medicine, industry and scientific research, requiring the necessary transport activities for the distribution of sources and transfer of the used ones to the deposits. In the field of medicine in many hospitals and other medical facilities (centres of nuclear medicine, metabolic therapy, laboratories of immunological analysis etc.) radioactive sources are used, for example, for diagnostic and therapeutic purposes.

Sources of ionising radiation are utilised in medical, industrial and scientific research applications.

The sources used in medical diagnostics are generally unsealed, meaning that they are not built-in in a solid material or inlaid in a sealed casing designed to prevent dispersion.
In industry, on the other hand, the use of mostly sealed radioactive sources is very widespread in a number of sectors (level and thickness measuring, radiation and sterilisation systems, geological introspection etc.); one of the most common applications is industrial radiography (also known as industrial gamma-radiography when the radiation source employed is an isotope), used to carry out non-destructive controls, as in the case of welding of pipes or mechanical components, through a technique very similar to that used in hospitals with X-ray machines.

Sources of ionising radiation are utilised in medical, industrial and scientific research applications.

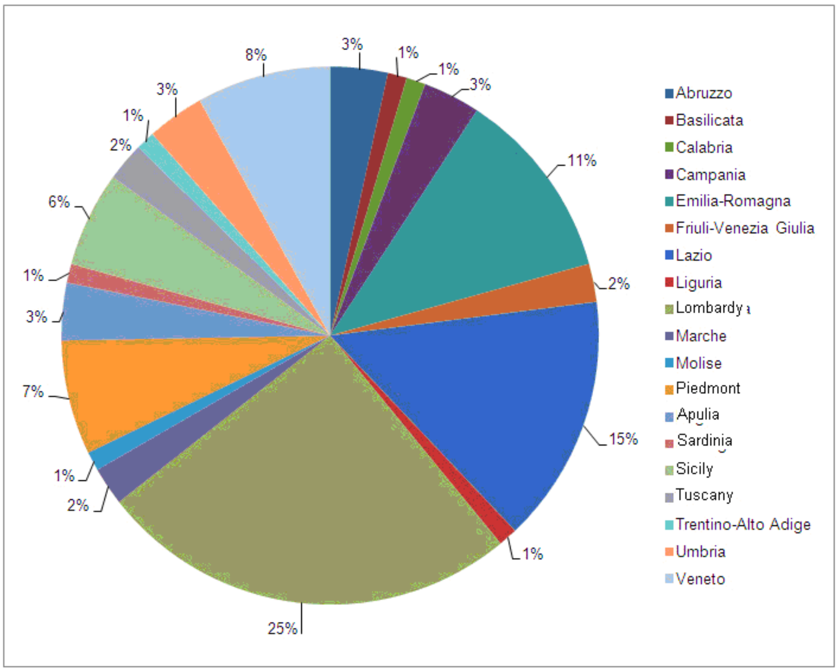


Figure 7.1: Distribution in Italy of installations authorised by central authorities to use ionising radiation sources [1]

As already noted, the use of radioactive sources implies their transportation to be performed by specifically authorised companies, taking care also of the retrieval of the radioactive waste produced in the course of the above referred activities and of the decommissioned radioactive sources (meaning those to be taken out of operation); this waste then has to be delivered to authorised storage facilities managed by specialised operators.

[1] Source: ISPRA, Ministry for the Economic Development

Key issues

With regard to the decommissioning of the main nuclear installations, the bulk of the spent fuel is to be transferred to France under an intergovernmental agreement signed in 2006. In the frame of this project 190 tons of spent fuel have already been transferred from the Caorso NPP, and the transfer of the remaining 45 tons from the Avogadro Deposit and the Trino NPP is foreseen to be completed within 2014.

The decommissioning of nuclear installations foresees the shipment of spent fuel to France.

There are to be mentioned the 2 tons of fuel at the ITREC plant in Trisaia (Province of Matera), which, in the absence of an agreement for its return to the United States, is to be kept in an appropriate dry storage facility to be built on-site.

The major part of the radioactive waste in Italy derives from the past nuclear program and is kept at the installations managed by Sogin S.p.A. – the former NPPs of Trino, Garigliano, Latina and Caorso, the former ENEA EUREX plant in Saluggia, the Trisaia ITREC plant in the Province of Matera, Plutonium and OPEC plants at the Casaccia Centre (Province of Rome), Avogadro Deposit in Saluggia (Province of Vercelli), the Nucleco facilities of the ENEA Casaccia Centre (Province of Rome) – and at the installations of the Joint Research Centre of the European Commission in Ispra (Province of Varese).

The above said waste, classified on the basis of its characteristics and radionuclide-concentration, accordingly to the criteria laid down in the Technical Guide no. 26 of ENEA-DISP (today ISPRA), amounts to approximately 26,500 m^3 for Category I and II waste and 1,700 m^3 for category III.

Additional waste of approximately 30,000 m^3, mostly of category II, is expected to be produced in the course of the installations' decommissioning.

Radioactive waste totals approximately 26,500 m^3 for categories I and II and 1,700 m^3 for category III, plus other 30,000 m^3 of future category-II waste from the decommissioning of installations.

There is finally the radioactive waste - the spent fuel used earlier for the NPPs' operation - returning in Italy after having been reprocessed abroad (United Kingdom and France); the volume of this conditioned, high-activity waste amounts to some tens of m^3.

Major part of the waste, stored at the above said sites (nuclear power plants, experimental facilities, research centres) has still to be treated and conditioned, in order to be transformed into durable material able to ensure adequate isolation of the radioactivity from the environment and suitable for transport, storage and disposal. These operations, which represent the preparatory steps to the plant's decommissioning, have to be accelerated, especially in the case of liquid waste, mainly at the EUREX plant in Saluggia (Vercelli) and the Trisaia ITREC plant (Province of Matera), and in the case of waste collected in underground structures in the 1960's and 70's, like at Garigliano NPP and the Trisaia ITREC plant.

Stored waste has to be treated and conditioned, in order to ensure isolation of radioactivity and become suitable for transport, storage and disposal.

In addition to the so-called "energy" radioactive waste, deriving from the NPPs' past operation, waste continues to be generated by the medical, industrial and research applications, piling up at the facilities of the different operators, where it is stored without adequate conditioning, in structures which, due to their location, are not suitable for a long-term management. This kind of waste, currently totalling approximately 4,000 m^3, is produced at a rate of a few hundred cubic metres a year. It is stored in a number of authorised installations in Italy, some of which can only receive, classify and store the containers of waste, while others are authorised also to carry out some simple manipulations.

Waste generated by medical, industrial and research applications (approximately 4,000 m^3) is stored in the authorised installations of Italian operators

At national level the whole management cycle related to no longer utilised radioactive sources and radioactive waste deriving from medical, industrial and research applications, in all its management phases (collection, treatment, conditioning and temporary storage), is carried out by the "Integrated Service for decommissioned sources and radioactive waste management", operated by ENEA.
The Integrated Service can be joined by any authorised facility carrying out activities involving collection and potential provisional storage of decommissioned radioactive sources.

The ENEA's "Integrated Service for decommissioned sources and radioactive waste management" handles all the phases of the management cycle.

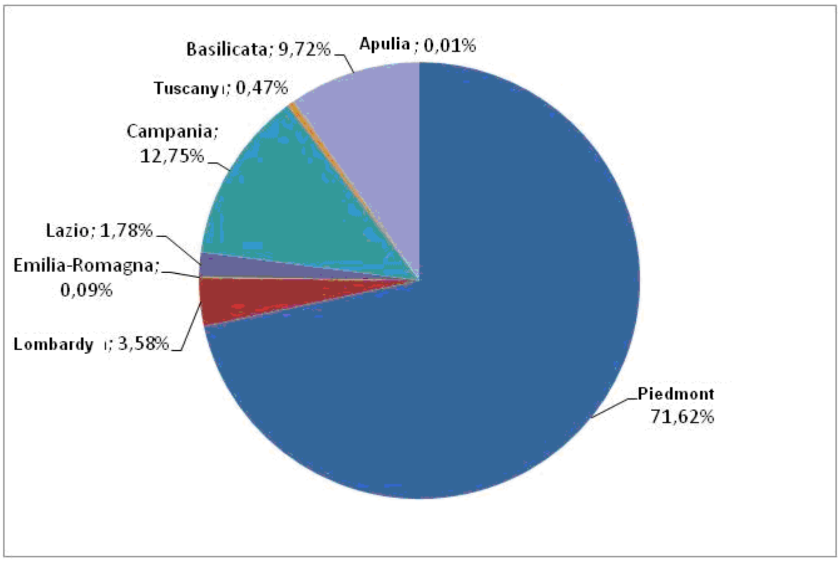


Figure 7.2: Regional distribution of radioactive waste in terms of activity (2011)[2]

The bulk of radioactive waste in Italy, in terms of activities, is found in Piedmont (71.6%), followed by Campania, at 12.75%, and Basilicata at 9.7%.

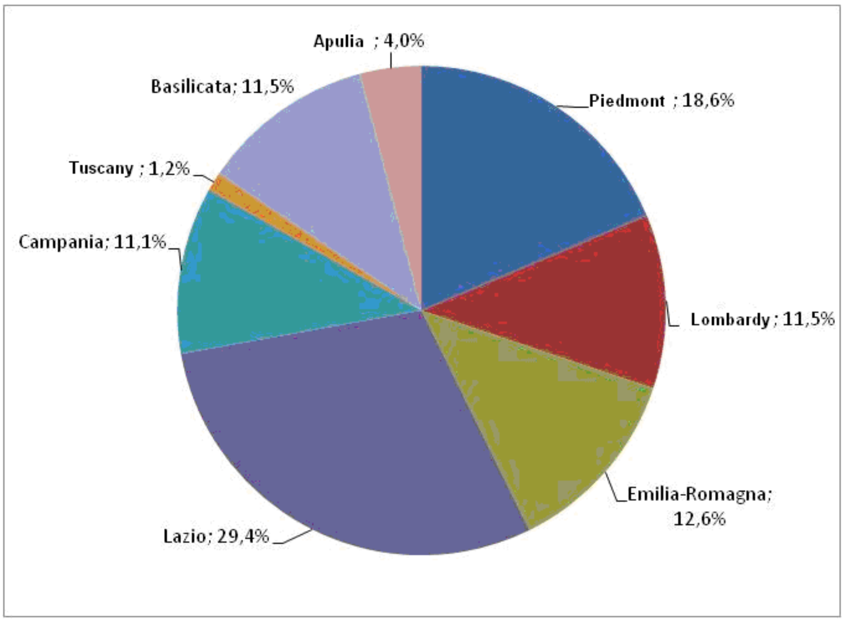


Figure 7.3: Regional distribution of radioactive waste in terms of volume (2011)[3]

In terms of volume, the regional distribution of radioactive waste shows the highest concentration in Lazio, at 29.4%, followed by Piedmont (18.6%) and Emilia-Romagna (12.6%).

[2] Source: data supplied by the operators of nuclear installations processed by ISPRA
[3] Source: Ibidem

Another issue worth of mentioning is the problem of “orphan” sources, found with a certain frequency in metal scrap coming from abroad. Regarding the emissions of liquid and gaseous effluents from nuclear installations, it can be considered stable. The Latina and Garigliano NPPs registered a slight drop in both liquid and airborne discharges, while the Fuel Element Manufacturing Plant, the ENEA Casaccia and the ITREC facilities recorded a limited increase of discharges, in both terms of quality and quantity. The observed increases are to be attributed to the activities carried out in preparation of the planned decommissioning or, in the case of the ENEA Casaccia Centre, to the liquid-discharge operations performed, after many years of interruption, with a new methodology. The figures for the remaining plants, i.e. Caorso and Trino NPPs, the Triga reactor in Pavia, the CCR Researtch Centre of Ispra, the EUREX plant in Saluggia and the Avogadro deposit, remain practically unchanged and in line with the percentage of the analogous discharge of year 2010.

Emissions of liquid and gaseous effluents from nuclear installations are stable with respect to the criterion of radiological irrelevance.

The transport of radioactive materials can be divided into two distinct but interrelated spheres, taking into account either their radioactive characteristics alone or both their radioactive and fissile characteristics:

- transport carried out within the nuclear fuel cycle;
- transport carried out in relation of medical, industrial and research applications, involving materials such as sources in special forms for radiating products or for gamma radiographs in the field, sources for geological prospecting, sources for the control of industrial processes, sources for diagnostic and therapeutic use in non-special forms and waste produced by the related facilities.

Given the situation in Italy, where nuclear activities involve decommissioning of NPPs and management of radioactive waste, the transport activities related to the fuel cycle are very limited, essentially consisting of the transfer abroad of spent nuclear fuel for reprocessing or for removal of the fissile material, operations moreover foreseen to be completed in the next few years. There are also a limited number of operations involving the transfer of low or medium-activity radioactive waste to the treatment facilities. The situation could change once the national deposit for radioactive waste becomes available.

Transport related to the fuel cycle is extremely limited.

Therefore, transport of radioactive material in Italy involves sources used in industry, research and, most of all, in medicine (Figure 7.4).

The transport of radioactive materials involves sources used in medicine, industry and research.

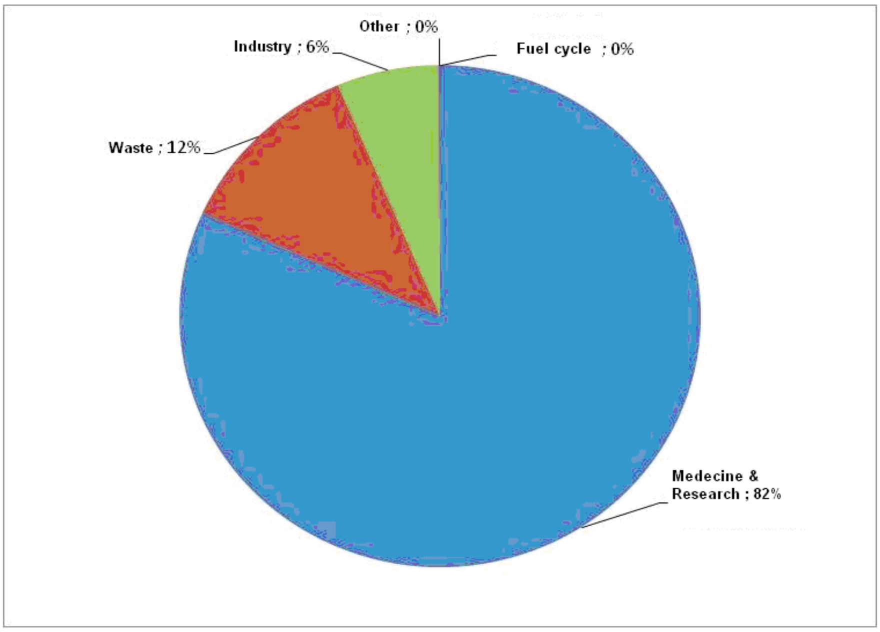


Figure 7.4: Distribution of containers transported in Italy, based on the application of the radioactive materials [4]

The transport of radioactive materials primarily regards sources used in medicine and research (82%), industry (6%) and, to a very limited extent, in the fuel cycle.

The available data shows that, as already said, the transport of radioactive materials involves sources used mainly in medicine. The major part of the radioisotopes used for diagnostic and therapeutic purposes comes from abroad, as far as in Italy no manufacture of such isotopes (I-131, Mo-99, Tl-201 etc.) exists, with the only exception of F-18, which is produced also in Italy. These radioactive materials are imported primarily by roadway and air transport and taken to a number of centres for the collection and distribution of the containers. Roadway shipments leave from these centres for direct delivery to the final recipients or to other Italian airports, from where they are transported to their final destinations.

Roadway transport is the primary mode of shipment of containers of radioactive materials.

Roadway is the most frequently used way to transport radioactive materials, followed by air transport, which is especially common for radioisotopes with short half-lives.

Radioisotopes are rarely transported by sea. Such operations are only used for taking the sources to the offshore drilling platforms or Italy's two main islands, Sicily and Sardinia.

Railway transport of radioactive containers in practice is very rare.

In the period 2002 – 2013, for example, the only case of rail transport was the shipment of spent fuel from Sogin to the reprocessing facilities in Sellafield (UK) and La Hague (France).

Possible exposure to ionising radiation during transport of radioactive materials can occur even under normal conditions, meaning in absence of accident.

Following the introduction in 2009 of an online system for collecting data on shipments of radioactive materials performed by authorised carriers, the trend observed, regarding the number and type of containers and the types of radioisotopes transported each year, has been fairly stable, though in recent years there has been a slight decrease in the number of containers transported, especially for materials used in nuclear medicine.

[4] Source: ISPRA

The intervals in the indicator illustrating the transport of radioactive materials (Figure 7.5) leaves no doubt as to which provinces hold the major and most hospitals and diagnostic centres (Rome, Milan, Turin, Naples etc.), as well as distribution hubs associated, in part, with air transport.

The transport index indicates the level of radiation found in the vicinity of the containers of the radioactive material. It is used to determine what measures of radiation protection the shipper should take to minimise the levels of radiation during the transport.

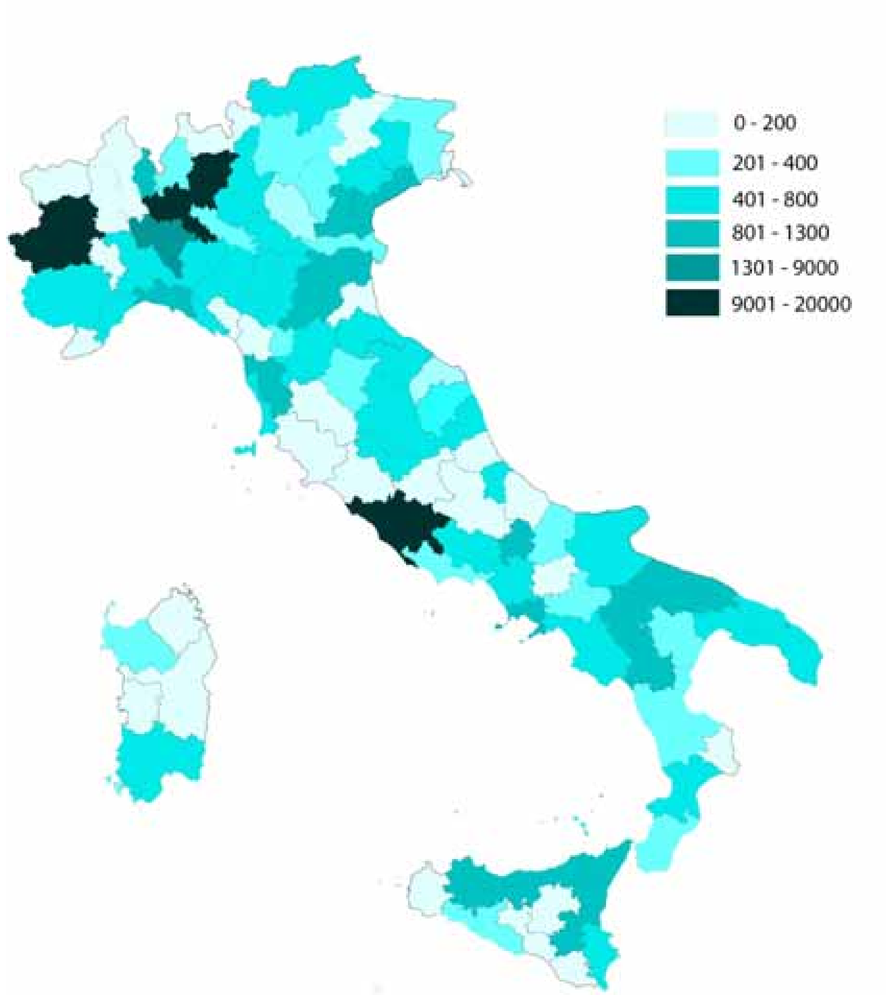


Figure 7.5: Map showing the overall transport indexes by province (2011)[5]

Actions of control and monitoring

Legislation governing the control of nuclear activities.

The control of nuclear activities that can involve exposure of the population to ionising radiation is regulated in Italy by Law no. 1860 of 31 December 1962, by Legislative Decree no. 230 of 17 March 1995, and subsequent modifications, and by Legislative Decree no. 52 of 8 February 2007. These controls are implemented, on a preventive basis, through the provision of binding technical advices by the Nuclear Safety Authority, and by other government bodies when applicable, to the authorities responsible for issuing authorisations (the Ministry of Economic Development, the prefectures etc.). For the NPPs, with respect to their current status, the advices relate to authorisations for plant modifications or special operations, including even those tied to decommissioning before issuance of the decommissioning license, or advices concerning the authorisation itself. The advices in question are issued by ISPRA.

Controls are implemented through evaluations and assessments for the issue of authorisations, as well as inspections during the operating phase.

[5] Source: ISPRA

The authorisations regard in particular the feasibility of modifications or operations, in terms of compliance with the general criteria for nuclear safety and radiation protection, and normally the start-up of a detailed project or operating plan is subject to approval by ISPRA.
The advices and approvals are formulated by ISPRA in accordance with the results of the review and independent evaluation carried out on the documentation presented by the operator, resulting normally in the prescription of interventions, if necessary.

Advices and approvals are drawn up by ISPRA on the basis of the results of review and independent evaluation carried out on the documentation presented by the operator.

In the case of licensing procedure for decommissioning, the measures currently in force call for the responsible authorities to draw up observations on the documentation presented by the operator in support of the license request and to send them to ISPRA, which, based on its own background investigation, as well as the observations received, formulates its advice, stipulating also eventual prescriptions, if necessary. In 2012 decommissioning licenses were issued for Trino and Garigliano NPPs.
During the operative phase and performance of operations, controls, meant to assess compliance with the legislation currently in force and with the requirements established in the authorisation, are carried out by ISPRA inspectors, who are empowered to act as judiciary officials.

ENVIRONMENTAL RADIOACTIVITY

The problem

In public opinion, the term "radioactivity" is often associated with people's fear of the effects radioactivity can have on health. The initial images conjured up by the word regards direct effects, similar to burns and attributable to acute exposure, such as what occurred at the nuclear explosions of Hiroshima and Nagasaki. Such effects are technically referred to as "deterministic", and they occur as a result of very intense exposure. Other fears are tied to less intense exposure leading to effects that are not immediately visible, but that manifest themselves over time, or in future generations, often being associated with the risk of cancer. An example would be the consequences of the exposure of the population following the accident at the Chernobyl power plant in the Soviet union. These effects are referred to as "stochastic", meaning they are tied to a probability of occurrence that depends on the intensity and duration of the exposure.

Ionising radiation is almost always associated solely with the production of nuclear energy, and yet there are instances of exposure to ionising radiation for medical purposes, both diagnostic and therapeutic. In such cases, the associated risks are more than justified by the benefits to the individuals who undergo such treatments.

Not to be overlooked is society's concern over events that, although they have no health-related consequences on the national level (such as the accident at the Fukushima power plant), give rise to significant interest and a need for information. It is of fundamental importance, therefore, that an adequate system of environmental monitoring is in place, and that the results obtained are communicated in a proper and transparent manner.
It should also be noted that the collective imagination essentially equates radioactivity with the production of nuclear energy, including the treatment and storage of nuclear waste, and that such fears often give rise to preconceptions regarding other activities or situations that constitute sources of ionising radiation.

At the same time, certain types of exposure to radioactivity are generally accepted, such as exposure for medical purposes, either diagnostic or therapeutic. In such cases, the resulting risks are rightly considered to be amply justified by the benefits to the individuals who undergo the treatments.

"Justification" is one of the guiding principles in the radiological protection of the general population and workers.

Any activity that entails exposure of the population or workers must be justified by cost-benefit considerations, in light of the possible alternatives as well; exposure should also be "optimised", or reduced to the lowest levels that can reasonably be obtained.

A further consideration regards the extent of the natural exposure to which the population is generally subject, as compared to the types of exposure described above. It should be pointed out that, with the exception of atomic explosions and nuclear accidents, exposure traceable to energy production activities is far lower than that attributable to natural sources. The radionuclides responsible for the vast majority of exposure to radioactivity are to be found in the cosmos and in the earth, in the air and in our own organism.

These considerations point to the need to examine in great depth, and to spread knowledge of, the impact of exposure to sources of ionising radiation, so as to arrive at a less difficult, and more fully aware, method for evaluating the risks and benefits associated with all sources of radiation.

The main exposure occurs between the walls of our homes, at workplaces and in the other closed environments, so called "indoors", where we spend the bulk of our time. The air in these sites holds radon, a natural gas that, on the whole, represents the main source of exposure for the general population. In certain cases, this gas can reach concentrations where, based on the cost-benefit considerations referred to earlier, the risk associated with exposure is deemed unacceptable, and remedial actions are recommended or even required. Exposure to radon gas in residential environments and at workplaces is associated with the onset of lung cancer. Also of note is the combined effect of radon and smoking: at equal levels of radon exposure, the risk of coming down with a cancer is twenty to twenty-five higher for smokers than for non-smokers.

Because it is not known whether there exists a threshold below which radon exposure is free of risks, it is assumed that lower concentrations of radon correspond to lower risk. This type of exposure can be controlled, to a certain extent, by following strategies and taking measures designed to reduce the exposure of the population as a whole, and particularly in cases with high concentrations.

The choice of strategies for the prevention and reduction of the corresponding risk depend on many factors, such as the distribution on the territory or the effectiveness of corrective actions; moreover all these considerations need to be considered in terms of the socioeconomic factors.

Communication regarding the risks related to radon exposure takes on a fundamental role, constituting a challenge for the stakeholders involved by this issue, since that the general population is often unaware of the existence of this gas and of the associated risks for human health. These considerations point to the need to examine in greater depth and to spread knowledge of the impact of exposure to sources of ionising radiation, so as to arrive at a more easily understandable and fully aware evaluation of the risks and benefits associated with all sources of radiation.

Exposure to radon

An illustration of exposure to radon within Italian territory is provided by the results of a survey performed in the 1980's and 90's but valid in terms of the overall characteristics of exposure throughout the country (Figure 7.6).

The regions of Lazio and Lombardy show a high concentration of radon (Rn-222). The difference compared to other regions is traceable to the different levels of uranium in rock and soil and to differences in the permeability of these substances.

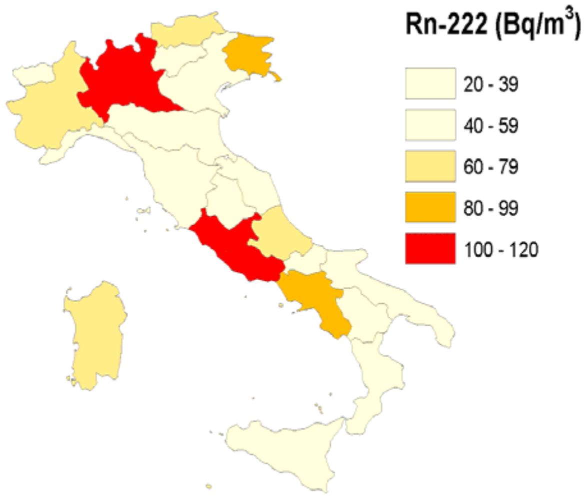


Figure 7.6: Map of concentrations of Rn-222 activity in homes by region and autonomous province (the intervals used were selected merely as examples) (1989-1997)[6]

In terms of responses, protection against radon exposure at the workplace was made into law with Legislative Decree no. 241 of 2000, which modified and supplemented Legislative Decree no. 230 of 1995. The decree stipulated obligations for the operators of workplaces and for the regional governments. In particular, the latter were assigned the task of identifying the areas presenting the highest probability of elevated concentrations of radon. Until such time as criteria can be arrived at for defining zones and formulating instructions for the methodologies to be followed in their identification, a number of regional governments and ARPAs/APPAs have initiated studies and surveys in order to establish a classification of areas with varying probabilities of elevated concentrations of radon. Figure 7.7 indicates the regions for which data and evaluations of radon dating from 2002 are available. At present, some of the regions that have performed radon surveys, shown in green on the map, are working to increase the number of measurements, so as to arrive at a more complete mapping of the regional territory. Information on the implementation of remedial action in building presenting high concentrations of radon is still scarce, in terms of both residential environments and workplaces. The European Commission is addressing the problem of radon exposure as part of a new directive currently under discussion by the Member States for final approval, a measure that indicates responses meant to deal with and reduce the impact of such exposure.

Until such time as criteria can be arrived at for defining zones and formulating instructions for the methodologies to be followed in their

[6] Source: Bochicchio, F. et al., *Results of the National Survey on Radon Indoors in all 21 Italian Regions*, Proceedings of a workshop on *Radon in the Living Environment*, Athens, April 1999

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Figure 7.7: Regions (in green) where studies/initiatives have been undertaken since 2002 to identify areas subject to radon risks (December 2012)[7] *Until such time as criteria are set to define zones at risk of radon, along with instructions on the methodologies to be followed in identifying such zones, a number of regional governments and ARPAs/APPAs have initiated studies and surveys to arrive at a classification of areas with different probabilities of elevated radon concentrations.*

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Surveillance of environmental radioactivity

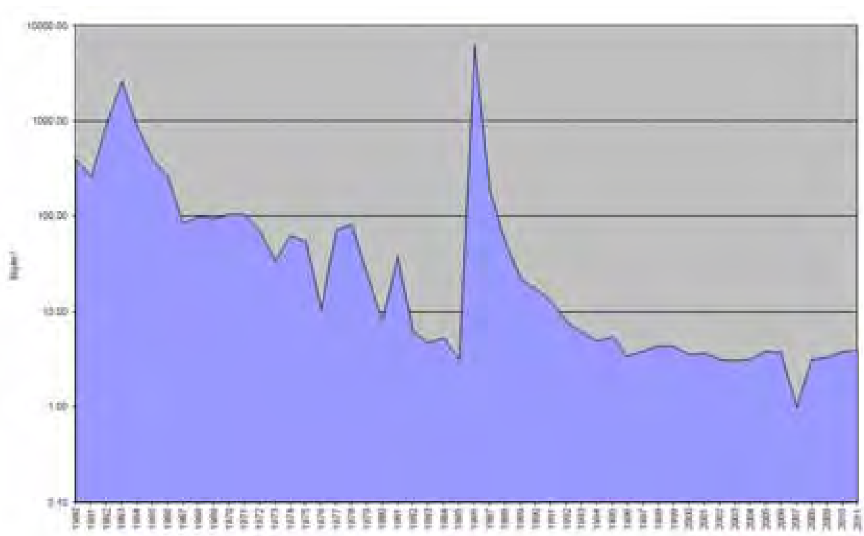
Surveillance of environmental radioactivity in Italy is organised, as per Legislative Decree 230/95, as subsequently amended, plus the pertinent measures of the European Community, into a series of networks structured on three levels: local, regional and national. The local networks carry out controls in the vicinity of nuclear plants; the regional networks monitor environmental radioactivity in the regional territory, while the national networks collect data to illustrate the situation on a national level, even in the presence of anomalous events. *Surveillance of environmental radioactivity in Italy is structured on three levels: local, regional and national.*

Surveillance of environmental radioactivity in Italy is structured on three levels: local, regional and national.

[7] Source: ISPRA, ARPAs/APPAs

Shown below are the concentrations over the years of cesium-137 in airborne particulate, in humid and dry depositions and in cow milk, which indicate the historic indicators of the presence of radionuclides in the environment over time (Figures 7.8, 7.9, 7.10).

Figure 7.8: The trend of Cs-137 concentration in airborne particulate in Italy[8] *Peak levels of contamination can be observed in correspondence with the arrival of the "Chernobyl cloud" in Italy (April 1986) and an accident at a Spanish foundry near Algeciras (June 1998), an event that left more notable signs in northern Italy. The figures registered in recent years have been stationary, and well below the "reporting level" set by the EC (30 mBq/m^3).*
Peak levels of contamination can be observed in correspondence with the arrival of the "Chernobyl cloud" in Italy (April 1986) and an accident at a Spanish foundry near Algeciras (June 1998), an event that left more notable signs in northern Italy. The figures registered in recent years have been stationary, and well below the "reporting level" set by the EC (30 mBq/m^3).



[8] Source: ISPRA/ARPA/APPA data collected by the ISPRA Environmental Radiation Laboratory Department processed by ISPRA; OECD-ENEA, 1987, *The Radiological Impact of the Chernobyl Accident in OECD Countries*, Paris; ISPRA

Figure 7.9: Trend for wet and dry depositions of Cs-137 in Italy[9] *Fallout events tied to testing carried out in the 1950's and 60's are evident, along with the peak corresponding to the Chernobyl accident of 1986, after which the contamination levels follow a downward trend. There is no reporting level for this matrix.*

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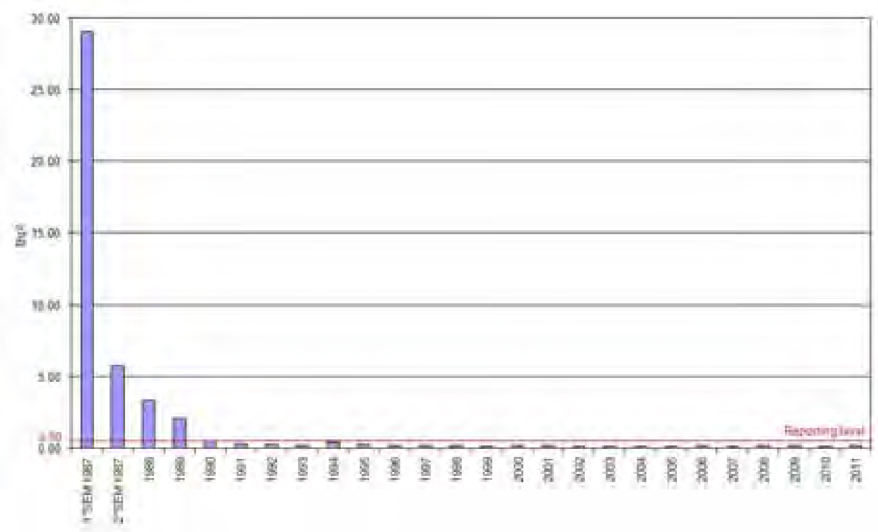

Figure 7.10: Trend for the deposition concentration of Cs-137 in dairy milk in Italy [10]

A reduction in the levels of contamination of dairy milk can be seen in the years following the Chernobyl accident, while value remained stationary in subsequent years, falling below the reporting level set by the EC (0.5 Bq/l).

The Fukushima accident of March 2011 made no noteworthy additional contribution to the presence of radionuclides in the matrixes affected, considering the extremely low levels that were registered in the immediate aftermath of the accident.

Still, in order to respond to the public demand for information, approximately 1,500 additional measurements were carried in the period of March to May 2011 beyond the normal monitoring programme.

In terms of response indicators, an overview of the situation in Italy is obtained through operation of the network monitoring program.

Table 7.1 shows the point rankings assigned in evaluating national monitoring, starting from 1997, based on the methodology drawn up on the occasion of the ECOEHIS project (Development of Environmental and Health Indicators for EU Countries).

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[9] Ibidem

[10] Source: ISPRA/ARPA/APPA data collected by the ISPRA Environmental Radiation Laboratory Department processed by ISPRA; OECD-ENEA, 1987, *The Radiological Impact of the Chernobyl Accident in OECD Countries*, Paris, ISPRA

The following matrixes were considered in assigning the annual rankings: airborne particulate, gamma dose in the air, dairy milk, surface water and drinking water.
The following factors were evaluated for each of these matrixes: frequency of measurement, sensitivity of measurement, territorial distribution of the controls, regularity of the monitoring, organisation of and participation in initiatives of comparison and joint analysis on a national scale.

Table 7.1: Evaluation of the state of implementation of monitoring by national networks [11]

Analysis of the implementation of the monitoring plan points to improvement over the last year, though coverage of the national territory remains uneven.

Year	Points	Judgment
1997	15	sufficient
1998	17	sufficient
1999	13	insufficient
2000	17	sufficient
2001	17	sufficient
2002	17	sufficient
2003	17	sufficient
2004	17	sufficient
2005	17	sufficient
2006	17	sufficient
2007	17	sufficient
2008	17	sufficient
2009	16	sufficient
2010	17	sufficient
2011	20	sufficient
2012	18	sufficient

Legend
Quality classifications: insufficient 0-14 sufficient 15-20 good 21-25

The judgment issued for the year 2011 is sufficient, though the point score is higher than that for the previous year, given that a number of laboratories, due in part to the Fukushima accident, took measurements on matrixes (such as air, fallout and milk) that they had not previously analysed. There remains a certain lack of uniformity in terms of the implementation of the programs and the measurements made by the different laboratories, and coverage of the national territory is not complete.

Specific regional characteristics

ARPA Aosta Valley

The Vale d'Aosta ARPA in collaboration with the Piedmont ARPA, is conducting analyses of an environmental matrix that, for a number of years now, has drawn the attention of research groups in the field of environmental radiometry: cryoconite. Cryoconites are accumulations of an airborne dust that deposits itself on the surfaces of glaciers and on their snowy covering, presenting a fairly complex composition that includes cosmogenic, geogenic, biogenic and anthropogenic matter. The initial radiometric results point to extremely high concentrations of radionuclide activity compared to the commonly analysed environmental matrixes, particularly with respect to levels of Cs 137 and, for the samples taken in 2011, the Cs 134 attributable to fallout in the wake of the Fukushima accident of March 2011. It was also possible to quantify the Bismuth 207 introduced into the atmosphere on the occasion of the thermonuclear tests of the 1960's, together with Plutonium 238, due primarily to the re-entry into the atmosphere in 1964 of an American satellite equipped with an electric generator containing radioactive material.

[11] Source: data processed by ISPRA/Emilia-Romagna ARPA

As a result of the serious accident that occurred at the Chernobyl nuclear power plant in the Ukraine on 26 April 1986, plus the fact that precipitation is more abundant in the mountainous north-western zones of the region, these areas of Piedmont were contaminated to a greater extent than low-lying zones. Of all the radionuclides that were deposited in the soil, Cs-137 can still be detected, on account of its half-life of approximately thirty years. In certain portions of the territory, therefore, medium to high concentrations of Cs-137 can be measured in the soil or in specific matrixes. Of particular note among animal matrixes are wild game, while the vegetable matrixes affected include mushrooms, raspberries, elderberries and blueberries. Given that the ground is not ploughed for growing in mountain areas, the Cs-137, already deposited at higher levels than in low-lying areas, is found primarily in the first 10 cm of soil. As a result, the small roots of shrubs and the stems of mushrooms are more likely to absorb Cs-137 and transfer it to their fruit. It follows that the wild animals who feed on these plants accumulate more Cs-137 than animals who live in less contaminated zones. The Piedmont ARPA has been studying the situation for a number of years, measuring levels of Cs-137 in mushrooms, berries, chestnuts, wild game etc.. The concentrations recorded, though at times significantly higher than those found in other food matrixes, are not of importance in terms of the dose to which the population is exposed. In fact, the dosage traceable to consumption of such foodstuffs is roughly 60 times lower than the dose of natural radioactivity and 25 times lower than the limit set under the pertinent legislation (Legislative Decree 230/95) for the dose of radioactivity of artificial origin, equal to 1 mSv/year.	**ARPA Piedmont**
A program for the measuring radon in homes in Abruzzo, based on a stratified, multi-stage sampling approach that provides a representative overview of the population, is nearing completion. Based on the partial results obtained to date, a significant revision can be made in the average regional level of radon exposure obtained from the results of a national radon survey carried out in the early 90's. This type of approach, which optimises the resources utilised by concentrating the measurement operations on a sample group of municipalities, can constitute a valid and economical alternative to measurement initiatives involving all the municipalities of a given region, especially during the initial phases of a process of radon mapping designed to identify areas classifiable as "radon-prone" under the provisions of art. 10-part six of Legislative Decree 241/2000. In terms of obtaining adequate knowledge of radon levels for the entire regional territory, the strategy already undertaken, and which can include further surveys of sample groups, involves mapping potential geogenic radon through the implementation of statistically models suitably calibrated with the available data and capable of utilising detailed geological and geochemical data on the entire territory in question.	**ARTA Abruzzo**

GLOSSARY

Decommissioning:
The phase of declassification, decontamination and dismantlement of a nuclear plant, for the purpose of demolishing the facility and removing all constraints due to the presence of radioactive materials at the site.

Deterministic effects:
Anatomical injuries that result in loss of functional efficiency of organs and tissues due to extremely high levels of exposure, such as those received following the Chernobyl accident by the operators of that plant. The seriousness of the clinical case increases with the dosage, based on a specific unit of measure for the “absorbed dosage”, the Gray (Gy).

Stochastic effects:
Effects that occur in random fashion to exposed individuals or their descendents, presumably even at low levels of radioactivity, such as those typically encountered in day-to-day life. A specific unit of measurement known as the Sievert (Sv), or the “effective dose”, is used to quantify the risk of incurring this effect.

Fallout:
Radioactive material found in the environment following a nuclear explosion.

Gamma dose intensity:
The energy transferred by gamma radiation to a unit of tissue mass over time, measured in Sievert/hour (Sv/h). The two main contributions to the gamma dose absorbed in the air are cosmic and terrestrial radiation. The terrestrial component varies in accordance with the features of the surrounding soil and whether or not the environment is outdoor or inside a building.

Ioinising radiation:
Particles and/or energy of natural or artificial origin capable of modifying the structure of the matter with which they interact by inducing ionisation.

Radioactive contamination:
Presence in a substance or in the environment of undesired or harmful radioactive elements.

Radionuclide:
An unstable nuclide that, as it decays, emits energy in the form of ionising radiation.

Radon:
A natural radioactive gas produced by the decay of the radium found in the soil and in certain materials utilised in construction. In the absence of significant nuclear accidents, its represents the main source of exposure to ionising radiation for the general public. Out in the open, it disperses rapidly, never reaching high concentrations, whereas in closed spaces (homes, schools, working environments etc.) it tends to accumulate, ultimately reaching, in exceptional cases, concentrations held to be unacceptable for health.

CHAPTER 8

ENVIRONMENTAL HAZARD

Introduction

Man has always faced hazards of natural origin, but in the last few centuries volcanic eruptions, earthquakes, tidal waves, floods, droughts, landslides etc. have produced catastrophic effects with increasing frequency, only to have man's multiple initiatives regarding the environment often amplify the natural disasters, or even bring them on. While the development of new and powerful technologies applied to the production of energy, goods and services has ushered in noteworthy improvements in terms of the quality of life, it has also introduced new and formerly unknown sources of hazard. The hazard lies in the probability that a given event (catalyst/cause of negative repercussions for man and/or the environment) will occur in a given area during a certain period of time; in the environmental field, it is often difficult to draw clear distinctions between hazards of natural origin and those of anthropic origin, given the frequent interconnections. Therefore, in defining the concept of environmental hazard, consideration must be given to the role of both natural and anthropogenic factors, as well as those arising from interaction between the two types. The environmental threat is only one of the components of environmental risk. The latter depends not only on the various hazards in play, but also on the vulnerability and value of the exposed resources. Risk (R), expressed in terms of the economic value of the potential damage caused to individuals, infrastructures and historic-architectural-cultural and environmental resources, is the product of three parameters, based on the equation R = P * V * E, where P indicates the hazard, V indicates the vulnerability, or the propensity of an exposed resource sustain damage as a result of a certain calamitous event, and E is the exposure, meaning he value of the sum total of the elements at risk within the exposed area. This chapter considers only the topic of hazard, with a few references to vulnerability. Of the hazards of natural origin, it was decided to focus on the seismic and geological-hydraulic subjects, which constitute two critical problems for our country, in terms of both loss of life and economic damage. It should be noted that the components of natural hazard illustrated herein pertain directly to the geosphere, while the components of anthropogenic hazard regard industrial activities.

While the development of new and powerful technologies applied to the production of energy, goods and services has ushered in noteworthy improvements in terms of quality of life, it has also introduced new and formerly unknown sources of hazard.

Seismic and geological-hydraulic hazards represent two critical problems for Italy.

NATURAL HAZARDS

Natural phenomena that can give rise to threats fall under two main categories, based on their genetic mechanism: endogenous phenomena (i.e. volcanic eruptions, earthquakes) related to the internal dynamics of the Earth and phenomena of exogenous origin (i.e. floods, landslides, avalanches etc.) that occur on the Earth's surface. The extension and frequency of these phenomena can vary along a vast scale.

Natural phenomena can be of endogenous or exogenous origin.

Certain occurrences tend to take place in a manner that is sudden and clamorous, while others act in a slower, more continuous way (such as subsidence or, on occasion, coastal erosion). Both types can wreak significant damage on mankind and its activities. Natural hazards are essentially traceable to processes that develop within the territory according to the dynamics of the geosphere. But there can be no ignoring that reciprocal interactions take place between natural phenomena and anthropic activities and structures. All too often inappropriate modes of use and management of the territory lead to an amplification of instabilities underway or trigger new ones.

Inappropriate use of the territory can result in amplification of instabilities underway or trigger new ones.

SEISMIC HAZARD

The situation

The position of the Italian peninsula within the Mediterranean geodynamic framework (convergence of the European and African plates, interposition of the Adriatic micro-plate, development of the Alpine and Apennine mountain chains, opening of Tyrrhenian basin) place Italy among the European countries facing the greatest seismic hazard. The areas most at risk are those located along in the Friuli Region and along the Apennine ridge (especially in the central-southern intra-Apennine basins), as well as throughout the length of Calabria and in eastern Sicily (Figure 8.1). These are the zones where the most powerful earthquakes in Italian history have occurred, reaching, and in some cases exceeding, Magnitude 7 in Calabria, eastern Sicily and along the central-southern Apennine arc, and Magnitude of over 6.5 in the eastern Alps (Figure 8.2).

Given its position in the geodynamic context of the Mediterranean, Italy is one of the European countries facing the greatest seismic hazard

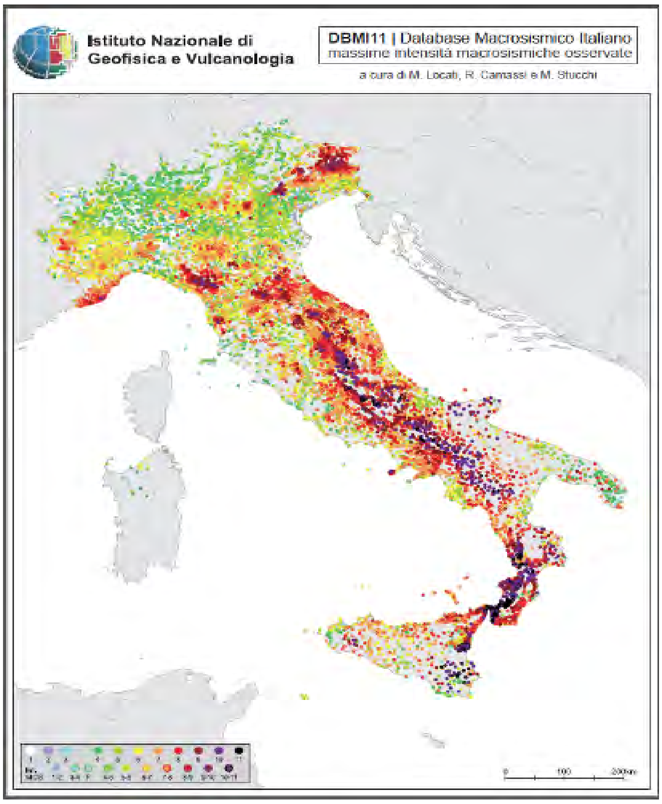
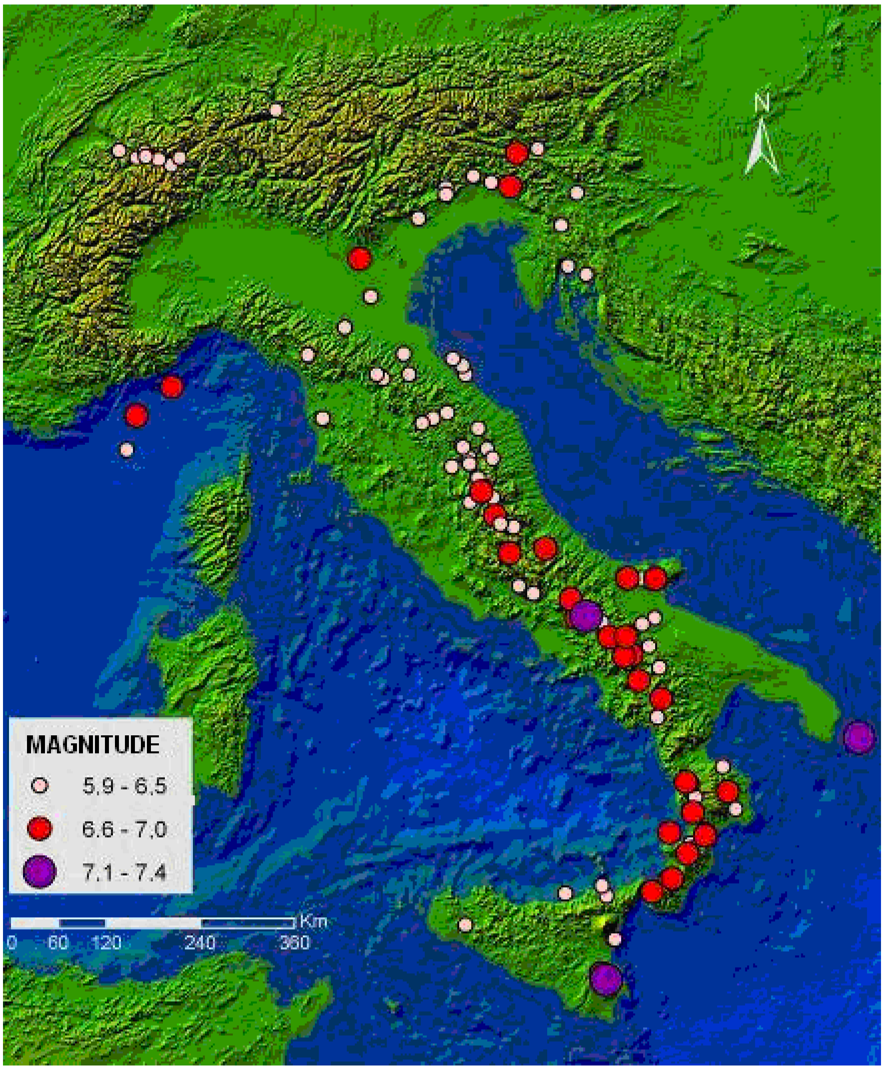


Figure 8.1: Maps of maximum intensities observed up to 2011[1]

[1] Source: INGV. DBM11 – Macroseismic database of Italian earthquakes 2011. http://emidius.mi.ingv.it/



The zones presenting the greatest seismic threat are the Friuli Region, the Apennine ridge (especially the central-southern portion), the edge of Calabria along the Tyrrhenian Sea and southeast Sicily.

Figure 8.2: Distribution over national territory of historical seismic events with local magnitude ≥ 5.9[2]

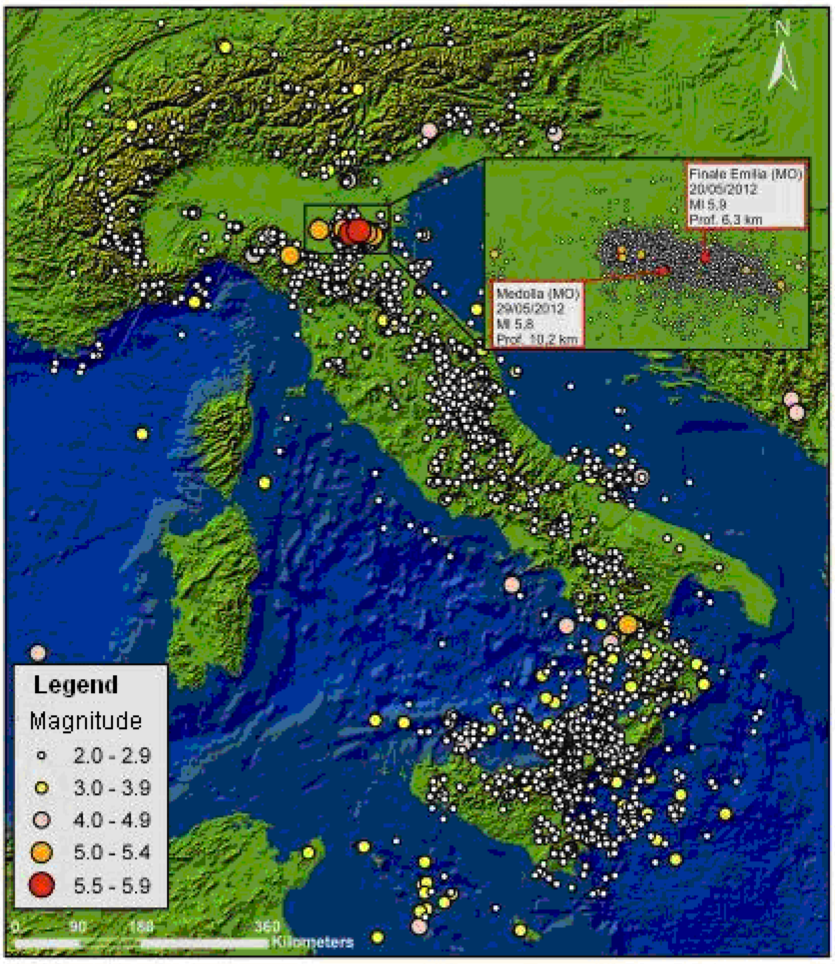
In addition, records of earthquakes of lower magnitudes can be found throughout the national territory, with greater or lesser probability depending on the location. Figure 8.3 shows the seismic events with a local Magnitude of 2 or more that occurred in Italian territory between 1 November 2011 and 31 December 2012, together with a close-up of events that hit the Modena and Ferrara area.

From 1 November 2011 to 31 December 2012 there were 4,129 earthquakes of a magnitude of 2 or more.

There were 4,129 earthquakes of a Magnitude of 2 or more, approximately twice the number registered in the previous year. There was also a noteworthy increase (from 1 to 10) in the number of earthquakes of a Magnitude greater than or equal to 5. This was essentially the result of the seismic sequence in the Po valley from May to June 2012. The geographic distribution of the seismic events is comparable, on the whole, with that for the same period of the preceding year, being essentially concentrated along the entire Apennine arc, as well as in Calabria and northern and eastern Sicily, plus, albeit to a lesser extent, along the Alpine arc. The area where

[2] Source: INGV data from CPTI11 processed by ISPRA (Parametric Catalogue of Italian Earthquakes. http://emidius.mi.ingv.it/CPTI) and ISIDe (Italian Seismological Instrumental and parametric database. http://iside.rm.ingv.it)

the highest seismic levels were concentrated during the fourteen months considered was the portion of the Po plain holding Modena and Ferrara, the epicentre of the events showing the highest magnitudes registered, together with the related foreshocks (those preceding the main quake) and aftershocks (subsequent or repeat quakes) (Figure 8.3).



The area with the greatest seismic concentration from 1 November 2011 to 31 December 2012 was the portion of the Po plain holding Modena and Ferrara, the epicentre of the events with the highest magnitudes.

Figure 8.3: Seismic events that occurred between 1 November 2011 and 31 December 2012 in Italian territory with a local magnitude of 2 or more. In the close-up: the main features of two earthquakes in Emilia-Romagna with Magnitudes of more than 5.8[3]

The focal mechanisms point to the movement of a compressive tectonic structure, with the focal depths registered generally ranging from a few kilometres to 10-12 km, and with few deeper events (down to 30 km).

Though the seismic sequence did not produce surface faults, it did deform the topography of the epicentre area[4].

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[3] Source: INGV data from ISIDe processed by ISPRA (Italian Seismological Instrumental and parametric database. http://iside.rm.ingv.it)

[4] Salvi S. et al., 2012, *Activation of the SIGRIS Monitoring System for Ground Deformation Mapping during the Emilia 2012 Seismic Sequence*, using COSMO-SkyMed InSAR data. ANNALS OF GEOPHYSICS, 55, 4, 2012

The faults responsible for the two main shocks can be considered "capable" (as per IAEA 2009), in that their dislocation, significant at a depth of a few kilometres, produced a deformation of the terrestrial surface documented by satellite (SAR interferometry - Figures 8.4 and 8.5).
The SAR data are in agreement with the seismological data, which show the main fracture plain descending to the south.
Based on the fracturing model, the dislocation should terminate at approximately 500 metres from the surface.

The seism of 20 May in Emilia-Romagna raised the terrain by up to 15 cm.

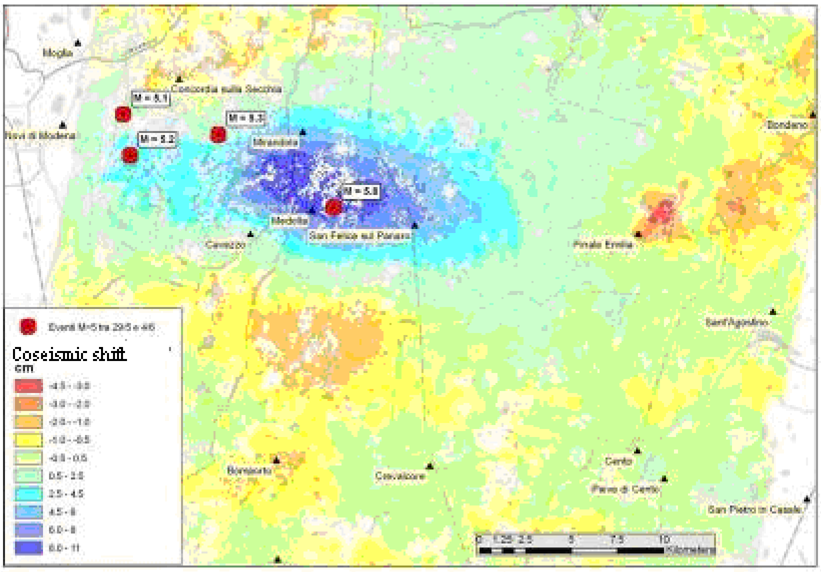
Still, the satellite information showed a rise of the ground surface, with a maximum, during the quake of 20 May 2012, of approximately 15 centimetres.
This surface deformation also produced some lengthy surface cracking in the vicinity of the surface projection of the seismogenic fault and aligned with the same.
For this reason, the cracking is considered to be a side effect of the coseismic surface deformation.

The cataclysmic events that occurred in Emilia-Romagna on 20 and 29 May 2012 had major environmental side-effects on an area of approximately 700 km^2.

The two paroxysmal events of 20 and 29 May 2012, in addition to resulting in the loss of 27 human lives and causing massive damage to homes, industry and architectural-cultural resources, had major repercussions on the environment, especially in the vast area of approximately 700 km^2 (Figure 8.6) that was the site of widespread instances of liquefaction, ground cracking and hydrogeological anomalies (fluctuations in the level of the water table)[5].
Most of the ground effects were concentrated in areas holding paleochannels, as in the case of the zone between San Carlo (an outlying district of the town of Sant'Agostino in the Province of Ferrara) and Mirabello (Figure 8.7), where liquefaction and ground cracks were distributed in a S-N direction, coinciding with the course of a paleochannel of the Reno River, active up to the end of the 18th century.

A stratigraphic sequence in which sand alternates with thinner layers of silt and clay, plus the topographical effect traceable to the presence of the old channel bank, contributed to amplifying the effects, resulting in damage that made necessary the evacuation of many homes in San Carlo.
But liquefaction and ground cracking also occurred in areas not marked by the passage of paleo riverbeds, as was the case to the north of Mirabello, as well as in Scortichino and Burana (districts of the town of Bondeno, all in the Province of Ferrara) and in San Martino Spino (a district of the town of Mirandola in the Province of Modena).

[5] Di Manna P. et al., 2012, *Ground Effects Induced by the 2012 Seismic Sequence in Emilia: implications for seismic hazard assessment in the Po Plain*. ANNALS OF GEOPHYSICS, 55, 4, 2012; doi: 10.4401/ag-6143 (http://www.eeecatalog.sinanet.apat.it/emilia/earthquake/index.php)



Note
The zones in blue are those that rose (up to a maximum of 12 cm), while the green areas were stable and the red ones fell (by approximately 3 cm)

Figure 8.4: Map of coseismic shifting caused by the earthquake in Emilia-Romagna, measured by satellite between 27 May and 4 June 2012 in the Mirandola area (Province of Modena)[6]

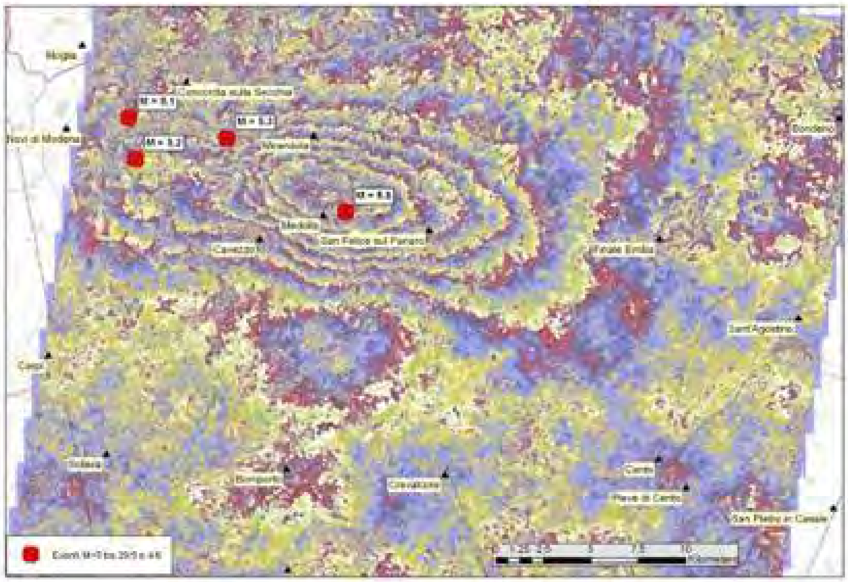
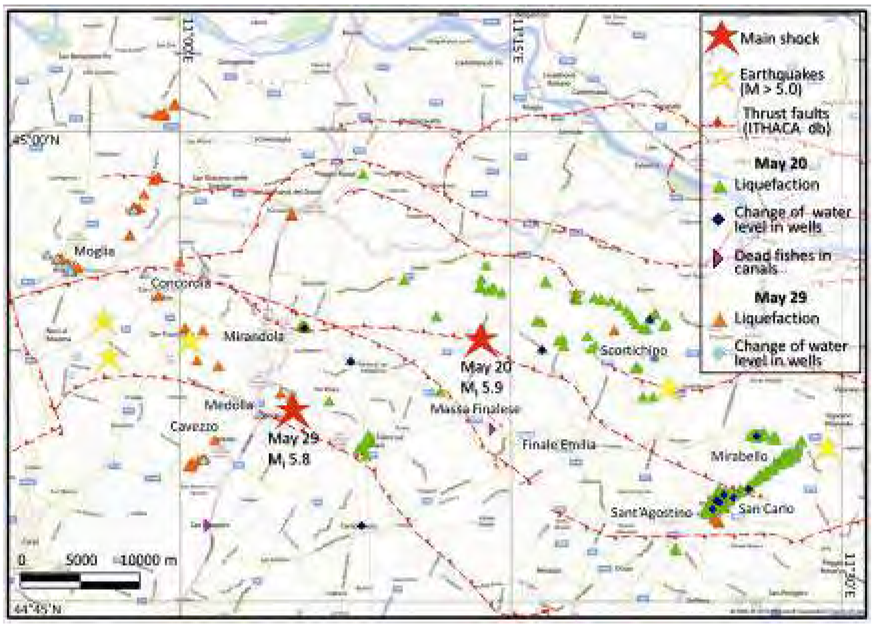


Figure 8.5: SAR interferogram for the dates of 27 May and 4 June 2012 (regarding the second main quake, which occurred on 29 May)[7]

The SAR interferogram shows the deformation of the land that occurred between the dates of the two satellite images, providing a map of the movements of the terrain, projected according to the direction from which the satellite views them, in terms of cycles of colour. Each cycle (or fringe) indicates a deformation of the terrain between the two dates of 1.5 cm (in the case of the COSMO-SkyMed satellite).

[6] Source: Atzori S. et al., (2012). Second Analytical Report on SAR Data and Modelling of the Earthquake in Emilia. INGV

[7] Source: ASI-INGV



Note

The location of the environmental effects of the events of May 20th and 29th is also indicated, along with the "capable" tectonic structures, taken from the ITHACA catalogue (http://sgi1.isprambiente.it/GMV2/index.html?config=config_sismaMO.xml)

Figure 8.6: Epicentral area of the earthquakes that occurred in Emilia in the months of May and June 2012[8]

The majority of the ground effects of the earthquake were concentrated in areas where paleochannels were present, as in the case of the zone between San Carlo (an outlying district of the town of Sant'Agostino) and Mirabello, both in the Province of Ferrara.).

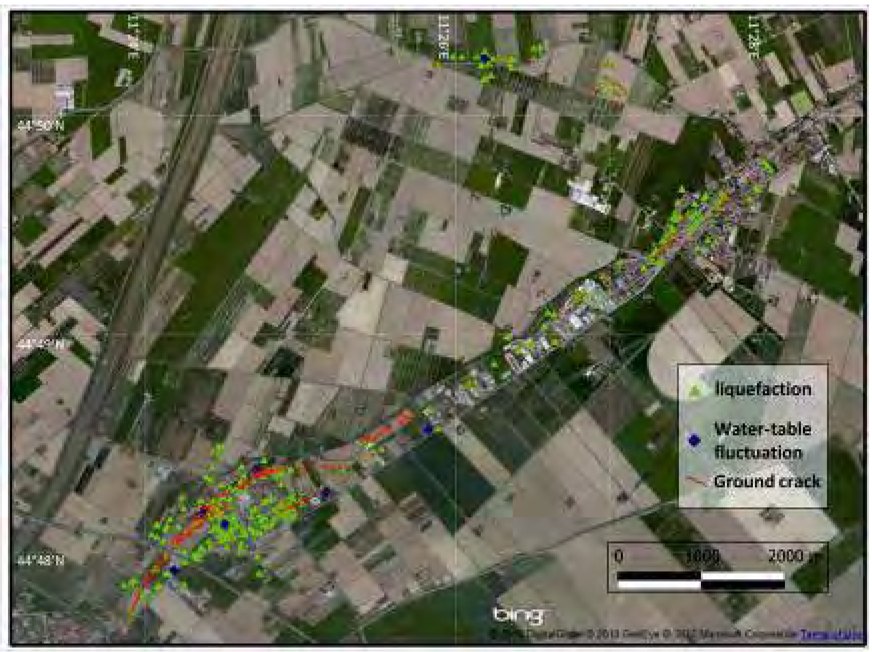


Figure 8.7: Location of the liquefactions and cracking in the ground that severely damaged both civil structures and industrial plants, between Sant'Agostino and Mirabello (Province of Ferrara)[9]

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[8] Di Manna P., et al., 2012, *Ground Effects Induced by the 2012 Seismic Sequence in Emilia: implications for seismic hazard assessment in the Po Plain*. ANNALS OF GEOPHYSICS, 55, 4, 2012; doi: 10.4401/ag-6143

[9] Source: ISPRA

After the earthquake of May 20th, ground cracks were observed (Figure 8.8) between the district of San Carlo and the cemetery of Sant'Agostino. There were upthrows of significant size (up to 50 cm), plus openings in excess of 50 cm, which grew further in the days that followed.

Cracks were observed in the terrain, with upthrows of up to 50 cm and openings as large as up to 1.m.

Figure 8.8: Ground cracks occurred between the district of San Carlo and the cemetery of the town of Sant'Agostino (Province of Ferrara) following the earthquake of 20 May 2012[10]

In a number of locations, such as south of Burana (Province of Ferrara), swellings and cracks were observed in the beds of artificial canals due to rising sand and water under pressure (Figure 8.9).

Induced effects of the earthquake: Swelling and deformation of an artificial canal south of Burana (Province of Ferrara).

Figure 8.9: Bed of an artificial canal south of Burana (Province of Ferrara), deformed and swollen due to rising sand[11]

[10] Source: ISPRA
[11] Source: Ibidem

A similar occurrence was observed in San Carlo, where the basement floor of a church underwent significant deformation and swelling. Instances of liquefaction, in addition to being associated with cracks in the terrain (Figure 8.10), could be easily identified by the presence of sand boils (upsurges of sand) no higher than 30-40 cm (Figure 8.11).

Liquefaction, with water and sand rising out of the cracks, was the most widespread induced effect.

Figure 8.10: Sand that arose from cracks in the terrain in the San Carlo district of the town of Sant'Agostino (Province of Ferrara)[12]

Numerous hydrological variations were reported in the epicentre area, such as a rise in the groundwater level, especially following the two main seismic events, though at times the level rose a few hours earlier. Also worthy of note is the flowing of water (at times, at an anomalous temperature) and sand from many water wells servicing local habitations, an occurrence that sometimes lasted for dozens of minutes (in certain cases, for a few hours), resulting in the deposit of sediment on areas that could extend for as much, or more than, a thousand square metres (Figure 8.12).

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[12] Source: ISPRA

Induced effects of the earthquake: little volcanoes of sand.

Figure 8.11: A typical example of sand volcanoes (between San Carlo and Mirabello, Province of Ferrara), a phenomenon tied to the widespread liquefaction that occurred in the epicentral area[13]

Induced effects of the earthquake: water and sand flowing out of a well.

Figure 8.12: An area (approximately 1000 m^2) covered with sand between San Carlo and Mirabello (Province of Ferrara) after water and sand had flowed out of a well (visible in the background) for many dozens of minutes following the quake of 20 May[14]

[13] Source: ISPRA

[14] Source: Ibidem

Countermeasures

There is no way to lessen the seismic threat, so, countermeasures to reduce environmental risk must essentially be directed at lowering the vulnerability of buildings found in areas subject to such threat.

In areas characterised as being subject to seismic threat, the vulnerability of buildings must be reduced.

An extremely useful instrument for accomplishing this is the seismic classification of the national territory, which reflects the state of the art in terms of knowledge of seismic hazard in Italy.

The classification was further developed following the Irpinia earthquake of 1980 and the seismic event of 2002 in Molise through the issue of Prime Minister's Ordinances no. 3274 of 20 March 2003 and no. 3519 of 28 April 2006.

At present, the reference tool for planning and design is the map of seismic hazard within the national territory, drawn up by the National Institute of Geophysics and Volcanology (Figure 8.13). Ordinance 3519/2006, which states that the new classification must be based on the effective seismic hazard faced by a given territory, regardless of administrative borders or limits, has supplied the Regions with the criteria to be used in classifying municipalities as seismic zones.

The new rules introduced under the ordinance were transposed, following further refinement, into the technical measures on construction found in a decree issued by the Ministry of Infrastructures, with the accord and contribution of the Civil Defence Department, on 14 January 2008. This decree established new regulatory guidelines for planning and design, making direct reference to "*basic seismic hazard*", meaning the map of seismic hazard provided by the INGV (Figure 8.13).

For antiseismic planning and design, Decree 14/1/08 of the Ministry of infrastructures refers directly to the map of seismic hazard provided by the INGV

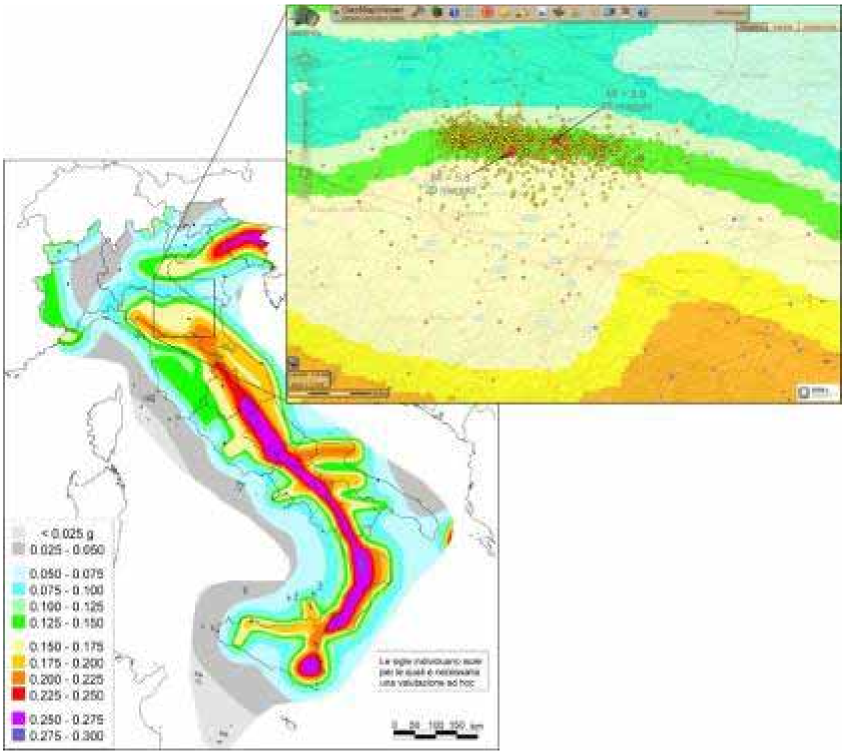
This map provides levels of peak acceleration (a_g) for the points of a reference grid whose nodes are separated by no more than 10 km (a grid of 0.05°), together with the different probabilities that these maximum levels will be exceeded in fifty years' time and/or for different periods of return (Tr).

Using the map, peak ground acceleration under conditions of rigid soil can be identified (Vs_{30} > 800 m/s; cat. A, point 3.2.1 of the Ministerial Decree of 14 September 2005).

In the area of the Emilia-Romagna Region struck by the earthquake of May 2012, with the main shocks on the 20th (Ml 5.9) and the 29th of May 2012 (Ml 5.8 and 5.3), the amplification of the seismic moment, which depends on site-related factors, led to the local registration of acceleration figures that were 20% greater than the acceleration of gravity, while the peak acceleration levels foreseen on the map were on the order of 15% of gravitational acceleration (box in Figure 8.13). The higher force of the quake registered on the ground surface, as compared to the expected level, is a result of the local characteristics of the subsoil. Local conditions, and in particular the susceptibility of the foundation terrain for liquefaction, were key factors in the severity of the damage resulting from the seism. These aspects, which cannot be taken into consideration by the "basic seismic hazard" determined on a national scale, are addressed by studies of Seismic Microzonation (SM). Such studies, whose guidelines were issued by the Civil Defence Department in 2008 (the Guidelines and Criteria for Seismic Microzonation approved on the date of 13 November 2008 by the Department of Civil Defence and

Seismic microzonation is a fundamental tool for preventing and reducing seismic risk through its application to urban planning and post-quake design and reconstruction.

by the Conference of Regions and Autonomous Provinces), gained particular favour following the seism of May 2012 in Emilia-Romagna, with SM becoming a fundamental tool for the prevention and reduction of seismic risk through its application to urban planning and post-quake design and reconstruction. Unfortunately, a noteworthy portion of the buildings in our country do not respect the necessary antiseismic requirements, both because the historic stock of structures has only rarely been brought in line with current antiseismic regulations and due to the fact that the intensive urban expansion which characterised the years from the post-war period to the present has suffered from a lack of attentive land-use planning plus, all too often, lamentable levels of unauthorised construction.



Note
The box shows the acceleration levels for the zone struck by the seismic sequence of May-June 2012

Figure 8.13: Map of seismic hazard in the national territory (2004)[15]

The map illustrates seismic hazard in terms of peak ground acceleration (a_g), illustrating the probability of exceeding the peak by 10% in 50 years for rigid terrains (Vs_{30} > 800 m/s; cat. A, point 3.2.1 of the Ministerial Decree of 14 September 2005). The acceleration figures (a_g) are provided for points in a reference grid whose nodes are separated by no more than 10 km (a 0.05° grid).

A number of different instruments are available for determining the vulnerability of buildings. Local and regional governments, as well as the Civil Defence Department, have done studies on the vulnerability of public buildings (such as the 1999 Census on the Vulnerability of Public, Strategic and Special Buildings in the Regions of Abruzzo, Basilicata, Calabria, Campania, Molise, Apulia and Sicily), documents that should effectively be taken into account by government authorities, so as to guarantee the safety of citizens. Apart from seismic vulnerability assessed in terms of the potential effect of the quake on the structure, consideration should also be given to the surface dislocations produced by the reactivation of seismogenic structures, effects that are not explicitly dealt with under antiseismic

Studies done by regional and local governments, as well as by the Civil Defence Department, should be taken into consideration by public authorities, in order to guarantee the safety of citizens.

[15] Source: Prime Minister's Ordinance 3519 of 28 April 2006, Appendix ll. 1b Seismic Hazard Levels in the National Territory

measures. This topic is addressed by the full version of the Yearbook of Environmental Data, and has been for a number of years now, through two specially designed indicators: "Surface Faulting (Capable Faults)" and "Index of Surface Faulting in Urban Areas". There are a large number of capable faults in Italy, meaning faults that, based on the definition of the International Atomic Energy Agency, or the IAEA, could produce noteworthy dislocations (surface fractures) and/or deformations of the earth's surface (or in its proximity) in the near future, on the occasion of strong, or even moderate, earthquakes (IAEA, 2010)[16].

During the seismic sequence that began in the Emilia Region on 20 May 2012, the reactivation of capable faults already catalogued in ITHACA was observed.

The mapping and cataloguing of these faults is an important tool when it comes to mitigating the risk tied to fracturing or to surface deformation.

Information on these faults, including the position in which they lay, their geometry, kinematics, associated earthquakes and average rate of deformation, is gathered together in a catalogue (ITHACA - *ITaly HAzard from CApable faults*) managed by ISPRA and consisting of a constantly updated database, plus detailed cartography, all operated with GIS software. Figure 8.6 illustrates the capable faults catalogued in ITHACA for the epicentre area of the seismic sequence that struck the Emilia-Romagna Region starting from 20 May 2012.

By interpreting the data from the SAR interferometry, the pattern of coseismic deformation produced on the surface by the reactivation of the seismogenic fault (Figure 8.14) could be traced, with the result being an area that was raised by approximately 15 cm. Specifically, the types of fractures found at the fault that generated the seism were discontinuous and lacking any noteworthy vertical dislocation (Figure 8.15).

The magnitude and the type of coseismic deformations observed on the occasion of this event were in agreement with the deformations expected for similar capable faults, being characterised by inverse kinematics and a maximum Magnitude of around 6.0.

[16] IAEA (2010), *Seismic Hazards in Site Evaluation for Nuclear Installations Specific Safety Guide*. Series No.SSG-9, September 15, 2010, http://www-pub.iaea.org/MTCD/publications/PDF/Pub1448_web.pdf

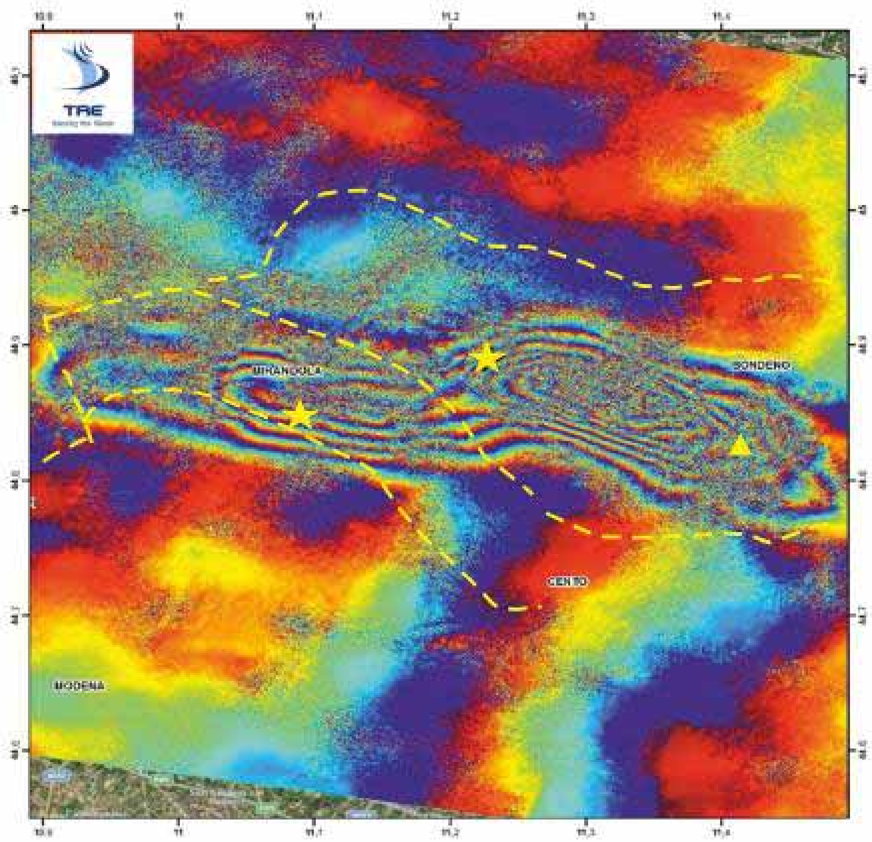


Figure 8.14: Pattern of deformation drawn from the RADARSAT interferogram and locations of corresponding capable faults (dotted yellow line, from ITHACA), plus the fracture in Figure 8.15[17]

The pattern of coseismic deformation established from the interferometry data and from observation of the terrain is in agreement with what was expected for this type of capable fault.
Induced effects of the earthquake of 20 May 2012: aligned, discontinuous fractures with outflow of sand and no upthrow.

Figure 8.15: aligned, discontinuous fractures with outflow of sand but no upthrows (below, Obici district), observed at the surface projection of the seismogenic structure that produced the quake of 20 May 2012[18]

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[17] Source: TRE (European Remote Measurement) interferogram processed by ISPRA
[18] Source: ISPRA

Italian legislation based on European antiseismic regulations (Eurocode 8) stipulates, though only with regard to certain types of sites of strategic importance, "*There be no construction in the immediate vicinity of faults that have been recognised as seismically active in official documents published by the competent national authorities*" (par. 4.1.1). Only in Sicily, and specifically in the municipalities of the Etna area, where surface faulting is especially intense and can have a noteworthy impact on buildings and infrastructures, have measures limiting construction on capable faults been introduced into regulatory plans.

Only in Sicily, and specifically in the municipalities of the Etna area, have measures limiting construction on capable faults been introduced into regulatory plans.

National legislation, on the other hand, does not include instruments designed to regulate territorial planning in the vicinity of capable faults, meaning the introduction of constraints on construction, as opposed to what is done in other countries (the USA, particularly in California, and Japan) which establish zones of respect around faults following detailed studies.

It should be noted, however, that the problem of surface faulting was addressed in the "Guidelines and Criteria for Seismic Microzonation" published by the Department of Civil Defence in March of 2009. In this document, whose regulatory measures consist of nothing more than non-binding guidelines, it is recommended that detailed seismotectonic and paleoseismological studies be carried out (through the excavation and analysis of exploratory trenches), in order to draw up cartography of the fault zone (primary outline and zone of respect or "setback") at a scale of 1:5,000.

Looking forward, there can be no ignoring the need to deal with the presence of capable faults from a regulatory perspective. To this end, it is to be hoped that specific measures regulating urban expansion in the vicinity of capable faults are introduced on the subject of territorial planning.

SPECIFIC REGIONAL CHARACTERISTICS

ARPA Calabria

In certain regions of Calabria with elevated seismogenic potential (the Crati valley, the Ionian portion of the Sila plateau, the western plain of Lamezia Terme), the main active faults are characterised by major concentrations of radon-gas activity in the ground. Calabria presents a peculiar geographic structure, consisting primarily of rocks containing uranium ore, which makes it possible, through radon measurements, to identify or better define the geometry of tectonic structures. The chemical-physical characteristics of radon gas, such as half-life and solubility, result in the transport of the fluid over significant distances, eventually with the aid of effective transporters, such as carbon dioxide and water.

The faults can cause a significant increase in the fracturing of the rocks they pass through, providing a preferred outlet route for the radon gas.

A mapping of concentrations of radon in the ground can provide elements of use in defining both the geometry and the seismic potential of the faults, as well as the environmental risk tied to the heightened probability of radon accumulation in confined settings.

Comparisons of tectonic elements, seismic data and radon

measurements appear to confirm the regional trend, showing a close correlation between the layout of the tectonic structures and the distribution of concentrations of radon.
In Calabria, rocks containing uranium ore are found in almost all the formations of the subsoil.
From a geological point of view, the Calabrian arc is an arched segment of the Apennine–Maghrebide orogen extruded on the ocean crust of the Ionian basin in the final phases of the processes of collision between Africa and Europe.
In this elaborate geological framework, the radon spreads more easily through the fractures in the crust, eventually reaching the underground and near-surface levels of living environments, with a resulting rise in concentrations of volumetric activity and, as a consequence, in the risk of exposure.

HYDROGEOLOGICAL HAZARD

The situation

The Italian territory is particularly susceptible to hydrogeological instability, due both to its geological and geomorphological characteristics and to the impact of factors of weather and climate, not to mention the widespread, uncontrolled presence of man and his activities.

Over the centuries, settlement has focussed primarily on plains and coastal areas, giving rise to pressures capable of creating imbalances in hydraulic and morphological dynamics.

It is estimated that 6,153,860 people are exposed to flooding in Italy.

The population exposed to flooding in Italy totals 6,153,860 inhabitants.

This estimate was arrived by using GIS software to cross-analyze areas subject to hydraulic problems with sections of the ISTAT 2001 census.

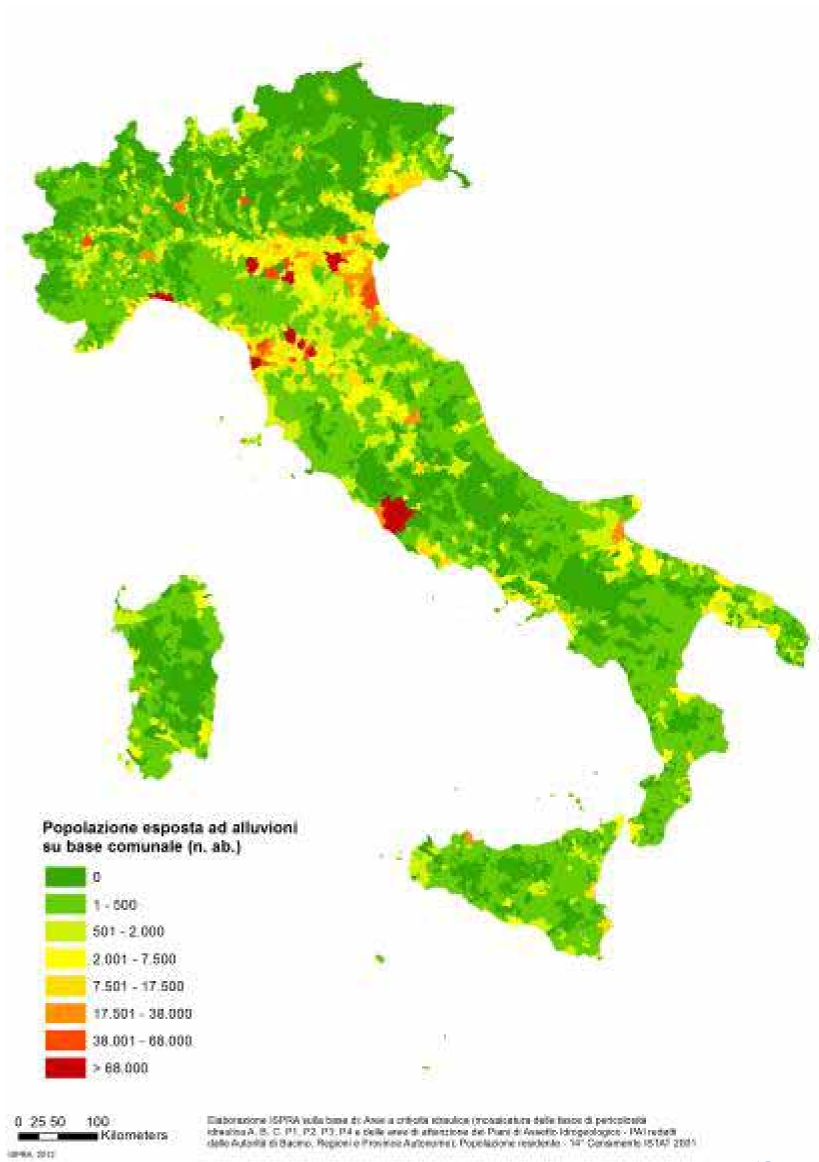
The areas facing critical hydraulic menaces were plotted by piecing together the zones of hydraulic hazard (A, B, C, P1, P2, P3, P4) with the areas focussed on by the Hydrogeological Management Plans (Piani di Assetto Idrogeologico - PAI) drawn up by basin authorities, regional governments and autonomous provinces.

The number of people exposed was estimated by taking the percentage of the area of each census section subject to hydraulic hazards and multiplying it by the resident population of that section.

"Population exposed to flooding" means the resident population exposed to the risk of personal damage (dead, missing, injured and evacuated individuals).

The municipalities falling under the first category (number of inhabitants exposed to flooding = 0) could present a risk to the population that is greater than nil, seeing that their territories could contain areas subject to flooding along the lesser river basin, and thus not subject to mapping under the PAI.

The population estimate was arrived at under the simplified assumption that the resident population was uniformly distributed within each census zone, as there was no information available on the exact location of residential buildings within the sections.



The "population exposed to flooding" means the resident population exposed to the risk of personal damage (dead, missing, injured, evacuated individuals).

Figure 8.16: Population exposed to floods by municipality[19]

Since 2002 ISPRA catalogues the main flood events that occur in Italian territory, collecting information on levels of rain, on the types of disruptions that result, on the number of people involved and on the measures taken to address the event.

In the last few decades, hydrogeological instabilities have become a problem of noteworthy social relevance, apart from their economic ramifications. They occur at varying intensities and take different forms, depending on the interrelations between the natural occurrences and anthropic actions. Floods and landslides are natural processes that can develop in unpredictable fashion, even under similar types of conditions.

Starting in 2002 ISPRA began systematically cataloguing the main flood events that took place in Italian territory, gathering information on levels of precipitation, the types of disruptions that resulted, the numbers of people involved and the measures taken, quite often on an emergency basis, to address the event and/or remedy the damage.

The present edition reports the rain-metering data for the flooding events that occurred in 2012, gathered by analysing the main technical reports published by the regional environmental protection agencies, civil defence organisations (national, regional, provincial and municipal), operational centres and the regional

[19] Source: ISPRA, in collaboration with ISTAT

agrometeorological centres, together with general information on the populations involved, on the economic damage and on the legislative measures enacted, gathered by using as primary sources ISTAT, CNR, DPC, CIA, MiPAAF, press agencies and acts and decrees of the Italian government.

This information appears in detail in the fact-sheet for the "Flooding Events" indicator published in the database of the Yearbook of Environmental Data[20].

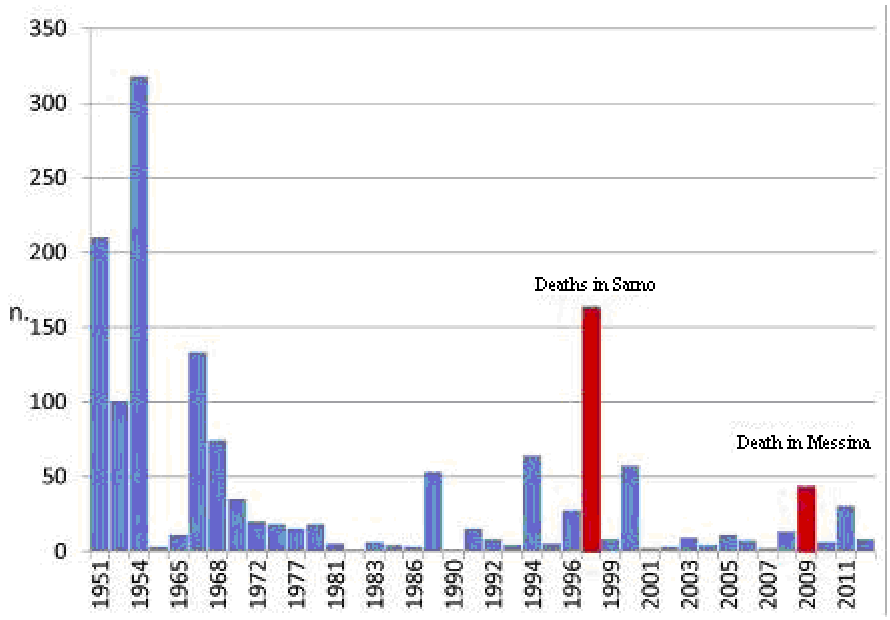
With regard to the populations affected by the flood events, Figure 8.17 shows an increase in the number of victims during the period 2008-2012, a break with the earlier downward trend (2001-2007).

The figures for estimated damage are often overestimates or qualitative assessments, being the result of evaluations carried out during the emergency phase.

The figures for estimated damage and allocated funds are summarised on a national basis on Table 8.1 for the period from 2006 to 2012.

The amounts for the economic resources utilised are almost always underestimated, due to a series of factors, such as the difficulty of quantifying all the different types of spending by local government bodies (emergency decrees and measures, financing for multiple purposes etc.) and the lengthy delays in issuing decrees/ordinances and/or measures of financing, in many cases approved and released years after the event.

Estimates of damages,when they have been drawn up, are often qualitative or overestimated, being the result of hasty assessments carried out during the emergency phase without subsequent revision or refinement, and only rarely do decrees and/or ordinances issued on the subject include numerical estimates as well.



Floods in Italy caused the deaths of 1,519 people from 1951 to 2012.

Note
The deaths in Sarno and Messina were caused by landslides

Figure 8.17: Deaths from the main floods in Italy[21]

[20] http://annuario.isprambiente.it

[21] Source: Coldiretti, CIA, MiPAAF, CNR; DPC, press agencies, the Civil Protection Department data processed by ISPRA; Benedini & Gisotti (1990) *Il dissesto idrogeologico*, the "Flood" Directive 2007/60/EC, ISTAT

Table 8.1: National summary of the estimated damages caused by flood events and of the funds disbursed

The figures for the economic resources employed almost always turn out to be underestimates.

YEAR	Estimated damage	Funds allocated
	Millions of euros	
2006	262	445
2007	230	163
2008	862	282
2009	1.600	295
2010	1.065	573
2011	1.570	315
2012	1.160	354

Brief reports are provided below on the most significant flood events in the year 2012.

20-22 February 2012 - Calabria and Sicily: 4 days of rain without interruption fell on almost all of the Calabria Region and on much of central-eastern Sicily. Numerous effects were observed on the terrain, including flooding from overflowing streams and from coastal tidal surges. The provinces hardest hit by disruptions in the form of slides triggered by the abundant precipitation were Crotone, Messina and Catania. For the most part, these events had negative repercussions on roadway traffic, as numerous state roadways were interrupted and many towns and villages were cut off.

4-5 August 2012 – Lombardy and Trent-Alto Adige: during the night between Saturday 4 August and Sunday 5 August, violent thunderstorms struck in the upper Valle dell'Isarco and the Val di Vizze (both in the Province of Bolzano) and in the Valtellina (Province of Sondrio).

The Vizze stream overflowed downstream of the town of Prati di Vizze when floating wood dammed up a bridge.

The main instances of flooding occurred in the large fan basins of the Val di Vizze and along the left limit of the Isarco, where the streambeds were unable to contain the flow of water and sediment, resulting in flooding in critical points, such as those where the streams changed gradients, where they curved, or reached bridges or narrowed sections. One of the major problems was the timber carried away and deposited along the entire course of the Isarco, up to the Fortezza dike, where the accumulated "carpet" of wood covered a surface area of approximately 1.9 hectares.

The Vizze stream overflowed downstream of the town of Prati di Vizze precisely because the floating timber had dammed up a bridge.

In the space of 1 hour, approximately 90 millimetres of rain fell on ground that had already absorbed large amounts of water (from storms in June), setting off landslides. Widespread landslides and flooding in the drainage basins of the Adda and Serio Rivers, as well as the Finale stream and the Isarco river, led to noteworthy disturbances for both roadway and railway traffic. Two women died in two different districts of the town of Val di Vizze due to landslides of mud and debris, while a man died in Valtellina from the flooding of a stream.

12-15 September 2012 - Marche, Abruzzo and Campania: a storm initially caused by a low-pressure area in the Gulf of Naples hit the Campania Region on 12 September before moving towards the mid-Adriatic coast, bringing with it continuous and abundant precipitation. In the early hours of Thursday 13 September 2012, the northwest portion of the Province of Salerno, together with a part of the Province of Avellino, were hit by intense, self-regenerating storms that dropped more than 60 mm of rain in less than two hours' time. The enormous quantity of precipitation on the ground set off a series of disruptions, but without causing any victims.

A strong storm front hit the Campania Region on 12 September 2012. The enormous quantity of precipitation triggered a series of disruptions of the terrain.

In Abruzzo more than 260 mm of rain fell in slightly more than 48 hours (at the rain-metering station of Ortona), with catastrophic repercussions, especially in the territories of the provinces of Chieti, Pescara and Teramo: landslides and flooding affected both public and private buildings, as well as the roadway network.

With regard to the drainage pattern of the Marche Region, situations of a particularly critical nature were registered in the basins of the Metauro, Tronto, Ete Vivo, Aso and Nera rivers. In the provinces of Macerata, Ancona and Pesaro, flooding occurred along the ordinary roadways, with numerous arteries interrupted on account of landslides as well.

26-27 October 2012 - Liguria and Friuli-Venezia Giulia: in the space of a few days, two different frontal systems caused a variety of meteorological events to occur in Liguria.

An initial storm phase, with the development of an intense, V-shaped system in the sector to the southeast of Genoa, lead to widespread but locally persistent rain, followed by snow and hail along the Tyrrhenian coast, together with strong winds and tide surges.

Eastern Liguria was the zone hardest hit, with over 300 mm of rain accumulating in the space of 48 hours.

At the meteorological station of Calice al Cornoviglio (Province of La Spezia) approximately 247 mm fell in 24 hours.

Widespread flooding was reported throughout the town of Sestri Levante after the Petronio overflowed its banks at Casarza. Along the whole eastern portion of the shore, a strong tidal surge resulted in the sinking of a number of boats and caused damage to the structures used by fishermen and to the Fincantieri facility.

In Friuli-Venezia Giulia, the abundant precipitation that fell in the catchment basin of the Isonzo River (225 mm in 24 hours, Piedimonte station, Gorizia) combined with exceptional tide surges along the Gorizia coast. The town of Grado suffered especially heavy damage from flooding: 60,000 m^3 of eroded beach, approximately 40 thousand euros of damage to the Nazario Sauro dike and damage to the Belvedere-Grado cycling path, which was covered with debris and algae.

31 October - 1 November 2012 - Emilia-Romagna, Lazio, Campania and Apulia: an intense storm struck the south-central portion of the Italian peninsula, discharging noteworthy quantities of precipitation on the ground.

The heavy rains of 31 October and 1 November 2012 caused massive damage in Emilia-Romagna, Lazio, Campania and Apulia.

The intense rain caused cloudbursts and flooding, while the strong winds were responsible for a number of tidal surges.

In Lazio, a person died in the town of Gaeta on account of flooding that raised the water level by as much as 1.5 metres; strong tide surges also struck the shoreline of the town of Anzio, causing massive damage.

In Emilia-Romagna, the "Halloween storm" gave rise to intensive tidal surges along the coast: flooding from the sea, due to the raised tide level and the wind from the east, together with the abundant rain, caused problems for roadway traffic along the shore. The bridge over the Lamone River was closed to vehicles when an embankment collapsed, and flooding occurred in Marina di Ravenna at the ferry docks.

In the Campania Region, the provinces of Avellino, Naples, Salerno and Caserta were hit by strong winds and abundant precipitation, with the largest quantities of rainfall measured in the greater Avellino area (accumulation of more than 200 mm at the Montevergine Station, Avellino).

In Apulia, the hardest hit area was the Salentino zone, with peak rainfall of 123.6 mm registered in Otranto in a 24-hour span between 31 October and 1 November 2012.

In the city of Lecce, as well as the rest of the province, widespread flooding affected numerous underpasses.

11-12 November 2012 - Friuli-Venezia Giulia, Veneto, Lombardy, Emilia-Romagna, Tuscany, Marche, Umbria and Lazio: the eastern Triveneto zone was hit by an exceptionally intense storm in the morning of Sunday the 11th, lasting into the early afternoon, with widespread rain and cloudbursts of noteworthy volume (170.4 mm/24h, station in Chievolis, Province of Pordenone; 143 mm/24h, station of San Lorenzo in Montagna, Province of Treviso) in the mountains, foothills and northern plains (maximum accumulation of 430 mm in 48 hours at Chievolis, Province of Pordenone).

Numerous zones ended up underwater, especially on account of the flooding of the main rivers and streams (the Bacchiglione, the Piave, the Livenza etc.); there was also flooding in Venice, with the water rising by 1.5 m.

In Lombardy and Emilia-Romagna, heavy storms, moving from the western sectors towards the east, first hit the Po and the Adda river basins, followed by those of the rivers Parma, Enza, Secchia, Panaro and Reno.

The main effects on the terrain were erosion along the banks of the major rivers, plus limited transport of solid debris in smaller streams, with localised landslides along certain roadbeds.

The northwest and southern portions of Tuscany underwent rainfall of significant quantity and intensity. The overflowing and flooding of the main rivers and canals caused massive damage not only to roadways, but to agricultural and small-scale industrial activities as well.

Various landslides took place in the Province of Siena and in other towns and cities, including Carrara. The Province of Grosseto recorded the worst outcome in terms of loss of human life: six dead due to flooding and to the collapse of a bridge.
In the Marche Region, the Province of Pesaro registered massive precipitation concentrated in a span of less than 24 hours, with localised flooding, especially along smaller rivers and streams.
In Umbria, the rains that fell in a period of 36 hours (station in Allerona, Province of Treviso, 212.2 mm in 24 hours) caused a sudden increase in the water levels of many of the tributaries of the Tiber, which, for its part, broke its banks, flooding the Torgiano zone. Numerous landslides were also registered in the Orvieto and Perugia areas.
In the case of the Lazio Region, the watersheds of the Fiora and Tiber Rivers were the hardest hit by the heavy rains.
Damage was especially heavy in the Province of Viterbo, with the Tiber flooding its banks in that area. The intake facility of the Vulci dike was damaged, and the Fiora River flooded at Marina di Montalto.
In the territory of the City of Rome, there were instances of sinking along the banks of the Tiber, in the section between the Ponte Milvio bridge and the Acqua Acestosa riverside, while sewers leaked in the vicinity of the point where the Aniene River flows into the Tiber in the Castel Giubileo area.

Intense precipitation hit the areas on the border between the Liguria and Tuscany Regions during the night between 27 and 28 November 2012, causing the Parmignola stream to overflow.

28 November 2012 - Liguria and Tuscany: intense rainfall hit areas on the border between the Liguria and Tuscany Regions during the night between 27 November and the 28th, causing the Parmignola stream to flood. The precipitation event, which affected first Liguria and immediately afterward Tuscany, resulted in noteworthy accumulations of precipitation in the eastern Po River Region and in the Province of Carrara. In the space of 24 hours, the rain gauge of Piampaludo (Province of Savona) registered 146 mm, while that of Carrara recorded a total of approximately 200 mm.
In Liguria, there was flooding in the towns of Ortonovo and Marinella di Sarzana, both in the Province of La Spezia, while the Tuscany Region experienced flooding, disturbances in roadway traffic and small-scale landslides.

The danger of landslides is particularly high in Italy, due to the geological and morphological characteristics of the territory (75% mountain-hills).

With regard to landslides, between the years 1116 and 2007, more than 487,000 mass movements have occurred, involving an area of 20,800 km^2, equal to 6.9% of the national territory[22]. Such occurrences are widespread, due to the geological and morphological characteristics of Italian territory (75% mountainous-hilly), and they represent the type of natural disaster that occurs most frequently, ranking second only to earthquakes in terms of the number of victims and the extent of damages caused to population centres, infrastructures and environmental, historical and cultural heritage.
An overview of the distribution of landslides in Italy can be

[22] The data differ from those published previously because the Basilicata Region extended its census of landslides to areas previously not surveyed.

drawn from the “landslide index”, which indicates the ratio between landslide area and total surface area, calculated on a grid of 1-km squares (Figure 8.18). These data are taken from the Italian Landside Inventory (*Inventario dei Fenomeni Franosi in Italia - Progetto IFFI*) carried out by ISPRA, Regions and Autonomous Provinces to identify and mapping landslides according to standardised procedures.

The data on Calabria and Sicily are underestimated with respect to the true situation of landslide number and distribution, seeing that, to date, censuses of landslides have focused primarily on urban areas or near road and rail networks.

The most frequent types of movement are rotational/translational slides, slow flows, fast flows and complex movements.

The most frequent types of movement, classified on the basis of the predominant type of movement, are rotational/translational slides, slow flows, rapid flows and complex movements. Many existing landslides are reactivated during period of intense and/or prolonged rainfall, after period of inactivity lasting even several years or centuries.

First-time failures are most common for rapid movements, such as rockfalls of mud and debris flows.

Not all landslides are equally dangerous. Landslides with rapid movements and involving noteworthy volumes of rock and soil generally cause the greatest number of victims and damage.

More than 487,000 landslides had been recorded in Italy, involving an area of 20,800 km^2, equal to 6.9% of the national territory.

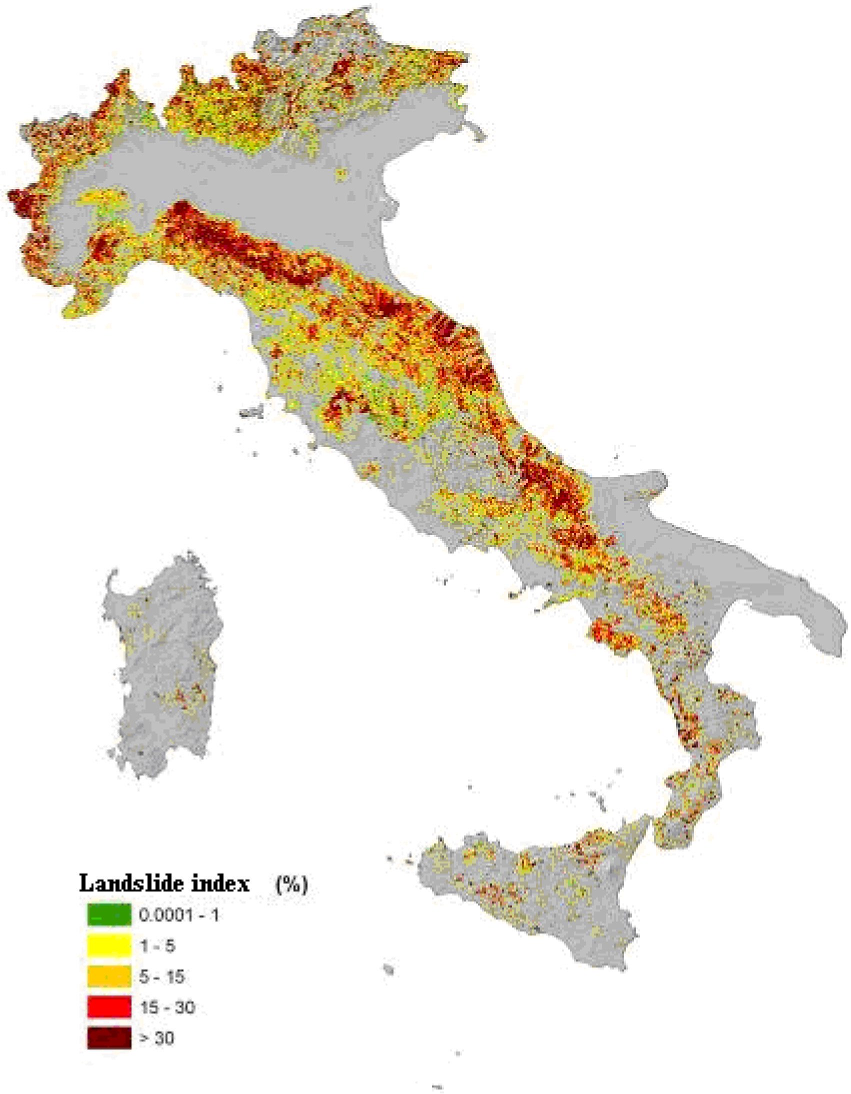
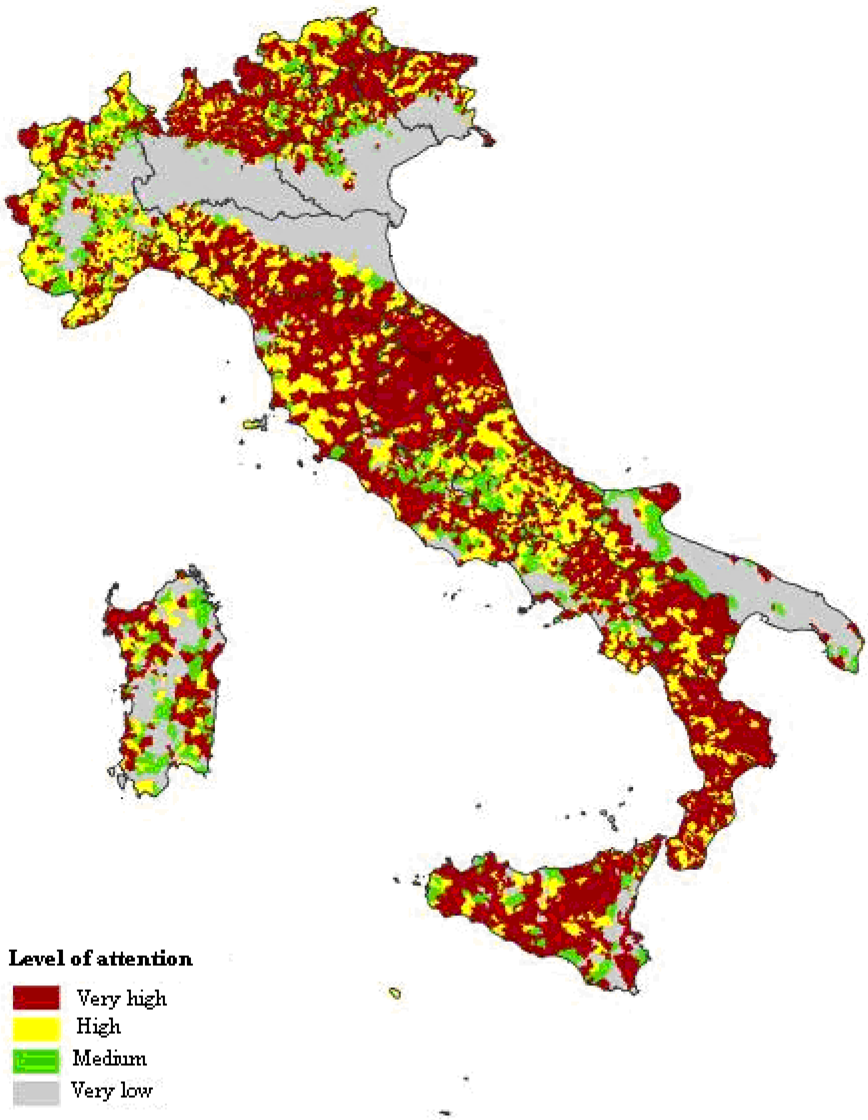


Figure 8.18: Landslide index[23]

Italian municipalities affected by landslides number 5,708, equal to 70.5% of the total: 2,940 municipalities have been classified at very high level of attention (intersections between landslides and continuous and discontinuous urban texture, as well as industrial or commercial areas), 1,732 municipalities at high level of attention (intersections between landslides and the highway, railway and road networks, areas used for mining, dumping and construction sites), 1,036 municipalities at moderate level of attention (intersection between landslides and arable lands, wooded territories, and semi-natural environments, green urban areas and sports and recreation areas). The remaining 2,393 municipalities rate a very low level of attention, as no landslides have been registered (Figure 8.19). These figures have been obtained by GIS overlay of the IFFI landslides with the exposed elements (urban centres, infrastructures etc.) taken from *Corine Land Cover* and *TeleAtlas*.

[23] Source: ISPRA



In Italy there are 5,708 municipalities in which landslides have occurred: 2,940 are classified at very high level of attention, 1,732 a high level and 1,036 a medium level. The remaining 2,393 municipalities rate a very low level of attention.

Figure 8.19: Level of attention to landslide risk by municipality[24]

The population exposed to landslides in Italy totals 987,650 inhabitants.

The estimate was obtained overlaying the IFFI landslides with the sections of the ISTAT 2001 census.

The number of exposed people was estimated by multiplying the percentage of landslide area within each census section by the resident population in that section.

The term "population exposed to landslides" refers to the resident population exposed to damage (dead, missing, injured, evacuated individuals).

.[24] Source: ISPRA

The municipalities falling within the first category (number of inhabitants exposed to landslides = 0) can have a risk for their populations that is not necessarily nil, as landslides could occur in their territories.
The population estimate was carried out assuming that the resident population is uniformly distributed within each census section, seeing that the exact location of the residential buildings within the sections is not available.

The population exposed to landslides in Italy totals 987,650 inhabitants.

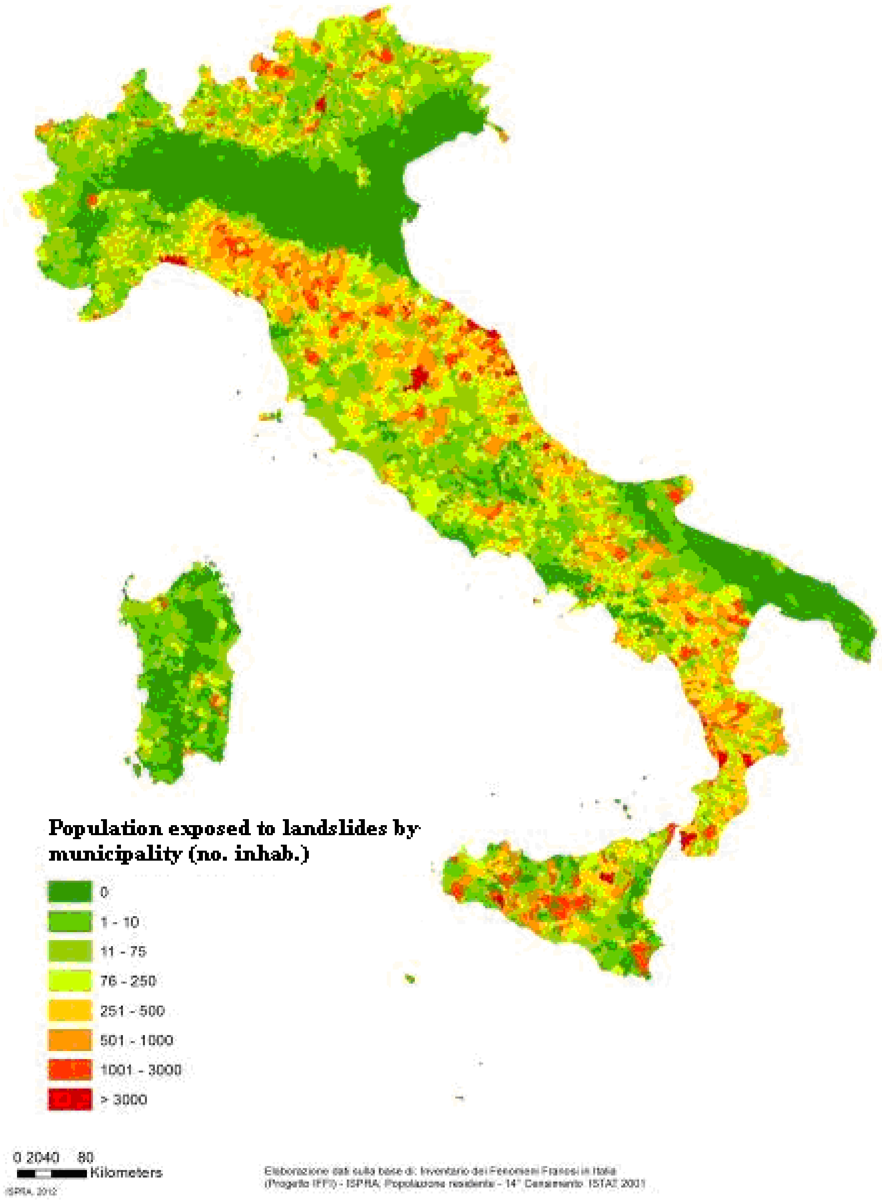


Figure 8.20: Population exposed to landslides by municipality[25]

[25] Source: ISPRA, in collaboration with ISTAT

An overview of the damage caused by landslides in Italy can be drawn from the AVI (Italian Vulnerated Areas) project carried out by the CNR-GNDCI by collecting information found in local daily newspapers, technical and scientific publications and interviews with experts.

During the period 1900-2002, landslides caused 5,278 dead and missing people, 2,216 injured and more than 162,300 evacuated and homeless.

Italy is one of the European countries most affected by landslides, together with the other states of the Alpine Region, as well as Norway and Turkey.

A total of 712 thousand landslides have been collected in the national inventories of Europe, as shown by a study carried out in 2010 by ISPRA, in collaboration with *EuroGeoSurveys*[26].

With regard to landslides, ISPRA, by collecting the information found in journalistic sources and in technical reports by the governments of the Regions and the Autonomous Provinces, the provincial and regional environmental protection agencies, the Civil Defence, operational centres and local government bodies, recorded for 2012 a total of 85 major landslides responsible for 5 victims and for causing damage primarily to roadway and railway networks (Figure 8.21).

[26] *Mapping the Impacts of Natural Hazards and Technological Accidents in Europe – An overview of the last decade*. EEA Technical Report no. 13/2010

In 2012, ISPRA recorded 85 major landslides.

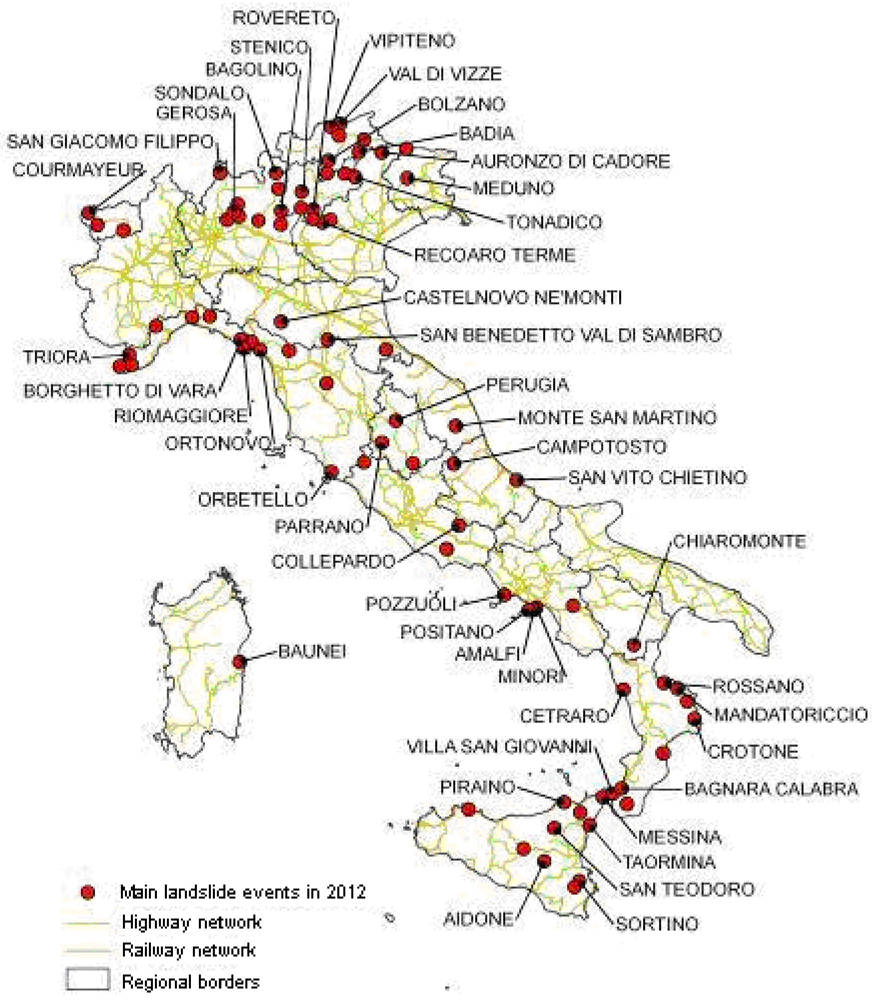


Figure 8.21: Main landslides events occurred in 2012[27]

Brief descriptions are provided below for some of the main landslides that took place in 2012.

21 February 2012: a landslide on the tracks of the Siracusa-Messina railway line, in the Spisone district of the town of Taormina (Province of Messina), resulted in the derailment of the locomotive and a car of a regional train in transit. Light injuries were suffered by the two train drivers, while all 70 passengers were unharmed.

23 February 2012: exceptionally intense, persistent rainfall triggered landslides on 17 provincial roads in the Crotone province (in the towns of Strongoli, Capo Colonna, Cutro, Scandale, Mesoraca, Roccabernarda, Umbriatico, Cirò and Carfizzi) some of them of noteworthy size. In the Papanice district of Crotone, two landslides left five homes uninhabitable and also affected the power, telephone and sewage networks. Provincial roadway No. 52, which connects Crotone with the districts of Papanice and Apriglianello, was filled with mud.

[27] Source: ISPRA

14 April 2012: in Minori (Province of Salerno), a boulder from a cliff fell on a tented sports structures that was being used by the middle-school students and teacher. Fortunately none of them were hurt.

27 July 2012**:** a landslide of three hundred cubic metres in the Val Rabbia, in the town of Sonico (Province of Brescia) interrupted state roadway No. 42 between Malonno and Edolo, isolating the Camonica valley. 11 residents of Sonico and 4 from Malonno were evacuated. The landslide material also invaded the bed of the Oglio river, near the point where it joins with the Rabbia stream.

4 August 2012**:** between 4:00 pm and midnight, the upper Val d'Isarco in the Province of Bolzano was affected by heavy storm rainfall that caused intensive hydro-geological events.

On 4 August 2004, the upper Val d'Isarco (Province of Bolzano) was the site of heavy storm activity that site off intensive hydrogeological events.
The weather conditions were atypical, with the persistent presence of storm cells due to complex interrelations between the local topography, air flows on the ground and high-altitude currents.
The interactions of these factors led to the repetition of the intensive precipitation in the exact same zone

The weather conditions were atypical, with the persistent presence of storm cells due to complex interrelations between the local topography, air flows on the ground and high-altitude currents.

The interaction of these factors caused the storm cells to regenerate themselves, so that the intense precipitation was repeated in the exact same area.

During the event, the rain gauges in Vipiteno and the Vizze district registered respectively cumulated rain of 81.0 mm and 61.3 mm. An analysis of the rain data for elapsed times of 1, 3 and 6 hours shows figures for precipitation intensity with return time periods of 100, 200 and 300 years. In addition to the precipitation that occurred during the event, the antecedent rainfalls were well above the seasonal average: the precipitation registered by the Vipiteno rain gauge in July 2012 (258.0 mm) proved to be the highest ever registered for that month from 1921 to the present.

The precipitation was undoubtedly an exceptional event. It triggered debris flows or floods along about 60 streams, in particular in the upper portion of the catchments. The numerous debris flows carried large volumes of material into the main streams, which reached flood levels, transporting solid objects and floating timber. The flows hit scattered homes, resulting in the deaths of two elderly individuals in the districts of Avenes and Tulve.

Flows along the Rio Risa stream also reached the town of Vipiteno, putting the Brenner highway at risk. Serious damage was sustained by the farming sector, with stalls and outbuildings taken out of operation, the death of numerous livestock and the destruction of agricultural and industrial vehicles and machinery.

The debris flowed onto approximately 60 hectares of farmland. Roughly 70 transportation arteries were affected by instances of hydraulic or geological instabilities.

The situation along the roadways of the Val di Vizze was especially critical, as the flows of water and debris cut off the upper portion of the valley.

A surge along the Rio Plaza stream, in the town of Brenner, led to the Brenner railway line being interrupted for two weeks.

Following the event, the Autonomous Province of Bolzano had to carry out extremely urgent work at a cost of approximately 6 million euros to remove the material left by the landslides, to restore the roadway infrastructures to safe conditions, to repair damaged bridges and roadway barriers, to place water and sewage systems back in operation, to remove debris from the detension basins built to protect population centres and infrastructures from flooding, to reclaim forestry infrastructures and to remove the timber transported by rivers and streams.

Following the heavy storm precipitation of 4 August 2012, the Autonomous Province of Bolzano had to carry out extremely urgent work costing approximately 6 million euros.

The exceptional precipitation of 4 August triggered flows of debris or flooding along roughly 60 rivers and streams.

Figure 8.22: Debris flow that occurred in the night between August 4th and 5th, 2012, affecting a small group of homes in the Val di Vizze (Province of Bolzano)[28]

Figure 8.23: Debris flow that occurred in the night between August 4th and 5th, 2012, affecting the Brenner railway between Vipiteno and Valle Isarco (Province of Bolzano)[29]

[28] Source: Autonomous Province of Bolzano

[29] Source: Ibidem

24 September 2012: a rockfall from a rocky slope hanging overe a trail known as the Path of Love, between the towns of Riomaggiore and Manarola, in the Cinque Terre zone (Province of La Spezia), caught four Australian tourists near the entrance to a tunnel on the Riomaggiore side, hurting two of them seriously.
The Path of Love and the Blue Trail (Monterosso-Manarola section) were closed to hikers so that safety conditions could be checked by the Forestry Corps and the Italian Alpine Club, coordinated by the park authority and the towns of the Cinque Terre zone.

A landslide on the Path of Love in the Cinque Terre district (Province of La Spezia) caught four Australian tourists, seriously injuring two.

Figure 8.24: Cinque Terre district – Landslide on the Path of Love[30]

27 September 2012: in Valchiavenna (Province of Sondrio) a landslide carrying approximately 200 cubic metres of boulders and debris interrupted State Roadway no. 36 of the Spluga Pass at around 9:45 pm in the Cimaganda district (town of San Giacomo Filippo). No vehicle was involved in the landslide.

[30] Source: Cinque Terre Park

On September 27th, a rockslide interrupted State Roadway no. 36 of the Spluga Pass in the town of San Giacomo Filippo (Province of Sondrio).

Figure 8.25: A rockfall in the Cimaganda district (Province of Sondrio)[31]

9 October 2012**:** in the Brenta mountains, a large rock formation, roughly a hundred metres high and thirty metres wide, broke off from a cliff above the town of Vedretta dei Camosci (Province of Trent). A number of boulders fell on a tent where a female excursionist was camping at an altitude of almost 2,800 metres, killing her.

28 October 2012**:** a massive boulder detached itself from a rocky cliff side and hit a car that was travelling along the provincial roadway between Ceriana and Poggio (Province of Imperia). A female passenger in the vehicle was lightly injured.

5 November 2012**:** in the town of Collepardo (Province of Frosinone) a falling boulder in the Ponte dei Santi district crashed through the wall of a restaurant without causing any injuries. Provincial Roadway 224 was closed to traffic.

11 November 2012**:** a flow of debris seriously damaged an ice rink in Bolzano. Roughly twenty cubic metres of rock and mud knocked down one of the front walls of the structure, where a young people's tournament had just been concluded.

[31] Source: www.vaol.it

On November 11th, a flow of debris severely damaged an ice rink in Bolzano.

Figure 8.26: Landslide on an ice rink in Bolzano[32]

13/13 November 2012**:** between November 11th and 14th, 2012, Umbria sustained heavy and persistent precipitation throughout the Region, and especially in its southwest sector: 307 mm in 72 hours in Allerona (Province of Terni), 230 mm in Compignano and 252 mm in Ponticelli (both in the Province of Perugia). More than 450 landslides were reported in the Region. One of them, moving along a front of more than a hundred metres, was reactivated on the south/southeast side of the core of the town of Parrano (Province of Terni), in a zone subject to landslides since 1908.

Intense precipitation triggered more than 450 landslides in Umbria between November 11th and 14th.

Figure 8.27: Landslide in Parrano[33]

[32] Source: Photo Manfred Klotz
[33] Source: www.orvietosi.it

20 November 2012: around 6:00 am in Cetraro (Province of Cosenza) a landslide caused the Arenazzo bridge to collapse. Two cars were caught, resulting in one death and one injury.

13 December 2012: in the Val Badia (Province of Bolzano) a landslide of approximately 2 hectares of terrain destroyed 3 homes in the districts of Anvì and Sottrù. 32 people were evacuated.

24 December 2012: in Borghetto di Vara (Province of La Spezia), a landslide moving along a front of 700 metres threatened homes, the Forestry Corps barracks and the Aurelia State Roadway, resulting in the evacuation of 3 families in the Ripalta district. The landslide had already been active during the event of 2011.

The causes

Italian territory is vulnerable from a hydraulic and geological standpoint, particularly on account of its distinguishing geomorphological and climatic conditions, as well as the hydraulic and slope dynamics, together with its coasts, plus the effects of anthropic pressures.

Due to its distinguishing geological, geomorphological and climatic factors, together with anthropic pressures, Italy is vulnerable from a hydraulic and geological standpoint.

Natural events are continually modifying existing balances through *structural* causes, also referred to as *predisposing* (morphological conditions and geological-structural arrays), or due to *occasional* causes, also considered to be *triggering* (meteorological events and anthropic activities), which lead to situations of instability that give rise to disruptions.

The Earth has always been subject to ongoing transformation. Among the main factors that shape the terrestrial surface are gravitational processes and rain events, of particular importance in our country, given its distinctive geological structure. When these take place, they pose a threat to the anthropic elements. Indeed, the damaging effects depend not only on the severity of the natural events, but also, indeed primarily, on the presence of developed areas and infrastructures.

The natural environment is a dynamic, variable force, and not one easily subjected to simplistic models.

The physical mechanisms underlying the triggering and subsequent development of critical hydraulic events are extremely complex and non-linear. The interrelations between rain levels and landslides or flooding, for instance, are influenced by numerous factors that can give rise to different results in different locations.

Precipitation, either short and intense or prolonged, is the most important factor in triggering the instability of slopes and hillsides.

Of the various predisposing causes of landslides, anthropic factors play an increasingly important role.

An increasingly significant role is played, among the causes of instability, by those of anthropic origin, seeing that they are tied to a use of the territory which fails to give adequate consideration to the characteristics of the terrain or to its geomorphological or hydrological balances. Continuous urban expansion, combined with artificial defence of anthropized spaces, necessarily conflicts with the evolution of the environment in accordance with its own natural dynamics.

The abandonment of forestry practices, the numerous fires, plus excessive urban development and construction in valley zones, have lessened the extent to which water can infiltrate the ground and heightened the level of streaming.

The result is a concentration of ever greater volumes of water on the occasion of weather events, even ones that are not extreme.
Roadways cut through hillsides, excavation, the overloading, under-sizing and poor management of hydrological works, as well as the failure to carry out initiatives of ordinary and extraordinary maintenance on the land, all represent additional important and recurring causes that predispose towards instabilities.
In hilly areas and on plains, the development of single-crop practices, often carried out in intensive fashion, with the levelling of the terrain and the removal of trees, shrubs and gullies, has favoured erosion and rapid runoff of water over time, increasingly resulting in the transport of solid materials in rivers and streams.

The straightening of bends in rivers shortens their beds, increasing the speed and erosive capacity of the waters.

In order to maximise the available surface area in plains zones, the paths of rivers have frequently been straightened, cutting out the bends that arose through natural evolution while depriving the flood plains of their vegetation (meaning the "alluvial forest", which has the ability to slow flood waters).
The straightening of river bends also shortens the beds of the rivers, increasing the speed and the erosive capacity of the waters.
The occupation of flood plains by residential developments, infrastructures and production activities, together with the uncontrolled excavation of materials for construction from riverbeds, has reduced the space available for the natural runoff of water while, at the same time, lowering the riverbeds in moments when there is little water. What is more, the large number of artificial barrages along waterways intercept noteworthy quantities of the solid materials transported, with repercussions on coastal systems, to which rivers and streams carry increasingly lower quantities of sediments, causing beaches to shrink.

Many beaches are eroding, due in part to the reduced quantities of sediments deposited by rivers and streams.

Figure 8.28: Erosion at the Pelosa beach (Stintino, Province of Sassari)[34]

[34] Source: ISPRA

Recent studies estimate that the factors underlying the increase in hydraulic and geological hazard in recent times can be traced primarily to the heightened vulnerability of the territory as a result of areas at risk being occupied by infrastructures and residential developments. The fact is that many floods have occurred in recent years following relatively unexceptional weather events, with the increased hydrological risk being directly related to the growing number and value of the elements exposed to flooding, together with the heightened hazard brought about by, among other things, excessive anthropization.

The increase in hydrological risk is directly tied to the greater number and value of the elements exposed to flooding, as well as to the increased hazard brought about by excessive anthropization.

In recent years, a new type of disruption has been observed in mountainous areas (and especially along the Alpine arc), as the effects of masses of debris being mobilised and rendered instable by the melting of glacial terrain (permafrost) have gradually increased and been amplified.

These effects consist of an increase in the frequency and extension of gravitational slope movements (debris flow and rock fall), which have begun to occur at lower altitudes than was the case in the past.

New situations of noteworthy hazard, brought about by increased temperatures, are tied to the formation of small lakes within the glaciers, whose natural barriers of containment downstream can give way, placing the resources exposed in the Alpine valleys below in conditions of elevated risk.

The solutions

An environmental policy capable of ensuring an adequate quality of life for individual citizens by focusing on the "sustainable development" that has become the guiding principle of both European and national policies must necessarily include proper management of the territory.

Proper management of the territory improves the quality of life of individual citizens.

Planning of urban areas that takes into consideration natural hazards (from the repercussions of earthquakes to the induced effects of intense weather events) must play a pivotal role in political and administrative decisions.

Risks from hydrological factors and landslides must be mitigated through joint initiatives of forecasting and prevention carried out in ordinary way.

Risks from hydrological factors and landslides should be mitigated through joint initiatives of forecasting and prevention carried out in orderly fashion.

As regards slope instabilities, the forecasting includes an exploratory phase geared towards surveying, collecting and updating information on landslides, monitoring movements with instrumental networks for remote measurement on the ground and via satellite, identifying the areas of the territory susceptible to landslides, setting the rain-level thresholds for triggering such events and simulating scenarios in which they occur.

With regard to flooding, the forecasting activities include hydrological studies (the modelling of rainfall based on return times and rainfall-runoff models), plus assessments of hydraulics (analysis of how the flood surge develops in the riverbed or streambed, based on hydrometric levels). If the flood wave is greater than the maximum runoff capacity of the river or stream, its banks will overflow.

The areas subject to flooding are identified and mapped with boundaries suing hydraulic models based on different return times.
The most probable events, meaning those most statistically frequent, correspond to the conditions of greatest hazard and vice versa.
A knowledge of the dynamics that give rise to flooding underlies the choice of initiatives of prevention, and the setting of their dimensions, in such a way as to mitigate risk by reducing the hazard posed by the event, together with the vulnerability of the exposed resources.
Indeed, prevention should be understood as including all activities geared towards containing damage, meaning both structural and non-structural initiatives that contribute to attenuating the destructive power of the disastrous event.
Structural initiatives would include engineering works carried out to ensure the hydrogeological conditions needed to render existing developments and infrastructures safe and secure.
Such initiatives call for massive economic investments whose size must be proportionate to the level of risk.

Prevention is carried out through structural and/or non-structural initiatives capable of attenuating the destructive force of the disastrous event.

Figure 8.29: Structural work (anti-boulder barrier and fence) in the town of Aymavilles (Province of Val d'Aosta)

Structural initiatives include engineering works carried out to create the hydrogeological conditions needed to render existing developments and infrastructures safe and secure.

Considering the limited economic resources available for carrying out land-defence works, non-structural initiatives take on a role of primary importance.
Through the application of constraints and the regulation of land use during the territorial-planning phase, such initiatives prevent hazardous situations in areas at risk from increasing.
Activities of prevention also include territorial maintenance in the sectors of farming and forestry (restoration of surface drainage networks in farming areas and protection against erosion, plus reforestation and management of wooded areas, protection against forest fires, maintenance of terraces for farming, optimization of small-scale drainage channels) or integrated management, with the function of governing water surges in existing manmade reservoir.
Important tools for defending against disasters include emergency Civil

Activities of prevention include territorialmaintenance in the fields of farming and forestry operations, plus the integrated management (with the function of governing water surges) of artificial inlets.

Protection planning and efforts to inform the general population of the various types of risks and the correct form of conduct to defend one's own wellbeing and that of others.

To date, policies on defence of the land are governed in Italy by Legislative Decree 152/06 – Environmental Measures, as subsequently modified – whose provisions are designed to ensure safeguarding and reclamation of the soil and the subsoil, the hydrological restructuring of the territory and the transformation of hazardous situations to safe.

In the sector of geological and hydraulic instability, the measure referred to above can trace its roots to Law 183/89 – Regulations and Standards for the Organizational and Functional Restructuring of Land Protection, as well as to Legislative Decree 180/98 (referred to as the "Sarno Decree", subsequently converted into Law 267/98), issued in 1998 following the tragedy in Sarno (Campania Region) and subsequently supplemented with further, related measures.

Basin planning is the main technical-regulatory tool for territorial-governance policies for the defence of the land.

Basin planning (introduced in Italy under Law 183/89) is the territorial planning tool that subsumes other plans drawn up on the regional, provincial and local levels as specifically regards land protection and water management.

A Basin Plan consists of excerpted sector plans, such as the Hydrological Management Plan (PAI), whose purpose is to reduce hydraulic ang geological risk and safeguard the wellbeing of individuals.

PAI are draw up under guidelines laid down in a central government measure of coordination (the Prime Minister's Decree of 29 September 1998 "Act Providing Guidelines and Coordination for the Identification of Criteria regarding the Required Procedures referred to under article 1, paragraphs 1 and 2, of Legislative Decree 180/98"), which establishes the criteria and procedures for the identification, drawing of boundaries, classification and taking of measures of protection regarding areas under hydraulic or landslide risk.

To mitigate hydraulic and geological risk, structural works in the areas subject to the risk identified in the PAI are planned and financed on the national level.

These are urgent initiatives to be taken in locations where the vulnerability of the territory is tied to increased hazards for individuals, objects and environmental resources (areas at high risk, or R3, and at very high risk, meaning R4).

To this end, the Ministry of the Environment and the Protection of the Land and Sea financed 3,220 urgent projects between 1999 and 2008 to reduce geological and hydraulic risk, doing so in accordance with Legislative Decree 180/98 and subsequent laws and at cost of more than 2.4 billion euros. Since 2010, when Program Agreements (PA) were reached between the Ministry of the Environment and the regional governments, programs of urgent, priority initiatives for the mitigation of geological and hydraulic risk have been draw up with the collaboration of the Basin Authorities, the National Civil Protection Department and ISPRA.

From 1999 to 2008, the Ministry of the Environment allocated more than 2.4 billion euros to finance 3,220 urgent initiatives for the reduction of geological and hydraulic risk.

Since 2000, ISPRA has monitored the initiatives financed under the provisions of Legislative Decree 180/98, plus subsequent modifications and additions. The data are kept on file in the Repertory of mitigation measures for National Soil Protection (ReNDiS).

Since 2000, ISPRA has monitored the initiatives financed under Legislative

The purpose of the Repertory is to provide a unified, systematically updated overview of the works and resources employed for the soil protection, to be shared with all the other government bodies and agencies active in the planning and implementation of such initiatives.

Decree 180/98, as subsequently amended. The data are kept on file in the National Repertory of Initiatives for Land Defence (ReNDiS).

In this context, ReNDiS serves as an instrument of knowledge potentially capable of improving coordination and planning, in this way optimizing national spending on protection of the land.

Furthermore, by publishing the data on the web (Figure 8.30), the Repertory provides easily accessible information on the land protection initiatives completed.

On the level of the European Community, policies for evaluating and managing flood risk make reference to Directive 2007/60/EC.

The "Flood Directive", transposed into Italian law as Legislative Decree 49/2010, aims at minimising the damaging effects of floods through joint, trans-national protection against that risk.

The Directive contemplates a differentiated strategy that includes a preliminary assessment of flood risk, the drawing of risk maps and the formulation of risk-management plans for the threatened areas.

The dissemination of information on natural hazards to government bodies and the general population is an element of key importance in the prevention of risk

As already noted, the dissemination of information natural hazards (landslides and floods) to central and local government bodies, as well as to the population, is an element of key importance in the prevention of risk.

Well informed citizens are bound to be more aware of the risks facing their territory and of exactly what they should do before, during and after the event.

With this in mind, ISPRA has established an on-line service for consultation of the IFFI Project cartography[35], making it possible to query the databank and obtain information on landslides, in addition to viewing documents, photos and filmed pieces (Figure 8.31).

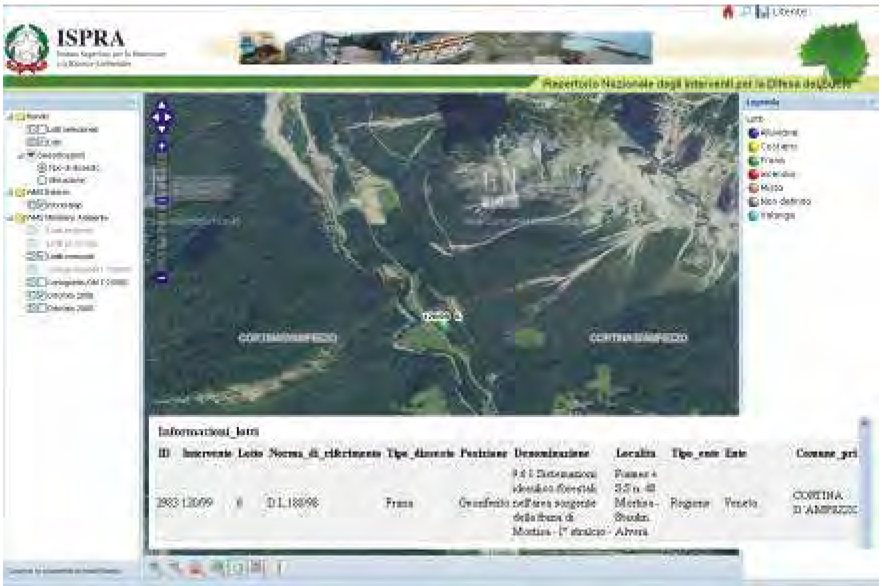


Figure 8.30: Web page of the Repertory of mitigation measures for National Soil Protection (ReNDiS) on the Fiames area (town of Cortina d'Ampezzo, Province of Belluno)

[35] www.sinanet.isprambiente.it/progettoiffi

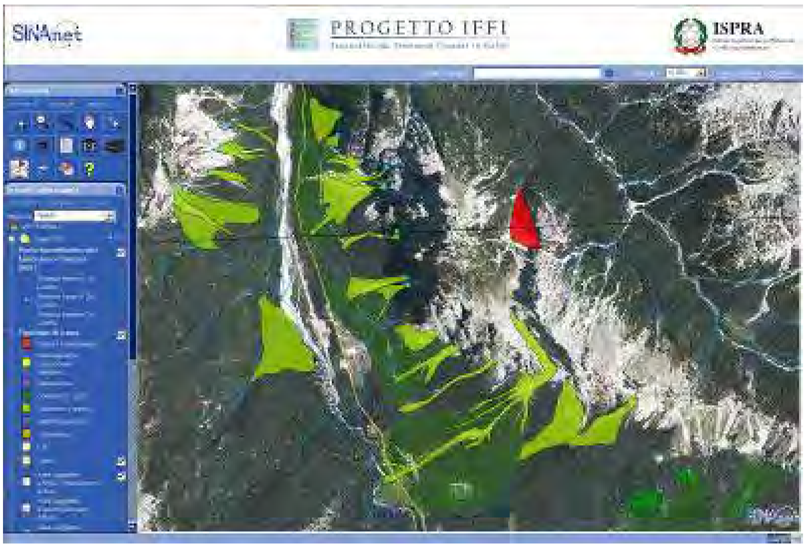


Figure 8.31: WebGIS of the IFFI Project for the Fiames area (town of Cortina D'Ampezzo, Province of Belluno)

ANTHROPOGENIC HAZARD

In addressing anthropogenic hazards in this issue of the Almanac of Environmental Data, it was decided to highlight the Integrated Environmental Authorisations and our country's contaminated sites.

INTEGRATED ENVIRONMENTAL AUTHORISATION AND IEA APPROVAL PROCESS

There are approximately 50,000 plants in the European Union subject to the Integrated Environmental Authorisation (IEA), 5,80 of them in Italy.

The European Community directive on integrated prevention and control to reduce pollution (IPPC Directive 96/61/EC)[36] initiated proceedings to issue the Integrated Environmental Authorisation (IEA) in the countries of the EU, where there are approximately 50,000[37] plants subject to the IEA, of which more than 5,800[38] are found in Italy under the different categories of IPPC activities .

The IPPC supplements rather than substitutes efforts to reach levels of quality for the various environmental matrices, within margins of improved environmental performance for plants that, through further technological development, could achieve the levels the EU Council expects, leading to noteworthy, ongoing pollution reductions at equal level of production capacity for the European system as a whole.

With respect to these activities, the IEA sets the limits of operability compatible with the environmental quality of the surrounding territory, together with measures for avoiding – whenever possible – or reducing the overall impact on all the environmental matrices while, at the same time, optimising the consumption of resources and the resulting management of waste, all in accordance with the best technical procedures available in the sector and through a comparative analysis of the operative environmental performance of each plant, together with the environmental upgrades applicable to the specific cases.

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[36] The Directive was abrogated and replaced by Directive 2008/1/EC of 15 January 2008, and later abrogated by Directive 2010/75/EU

[37] Report of the EU Commission on the data collected with the questionnaires regarding implementation of the IPPC directive for the three-year period 2005-2008

[38] Of which 5,510 already in existence at the time the directive went into effect (November 1999), plus at least 283 other plants that, though application was made for the IEA, are no longer subject to the IPPC obligations (due to closing or downsizing)

In Italy, this authorisation is regulated by Legislative Decree 152/2006[39] with regard to the activities listed in Appendix VIII to the Second Part ad in accordance with the initiatives designed to achieve the integrated prevention and reduction of pollution directly at the source of its issue into the environment.
Once issued, the IEA replaces any authorisations granted previously[40], after which it is valid for 5 years, extendable to 6 or 8 years if Environmental Management Systems are put in place for the activities subject to authorisation, in accordance with the ISO 14001 Standards or with EC Regulation 1221/2009 (EMAS).
Issue of the IEA entails a noteworthy reduction in the pollution of the environment surrounding the IPPC plants through the application of new technologies and technological operating improvements, with beneficial effects on the environment obtained through the enactment of new ceilings on pollutants issued at the source, together with instructions of plant operating procedures issued following the preliminary technical controls.
In terms of proceedings for first issue of IEA, at the end of 2012, the preliminary procedures completed numbered 5,548 while approximately 250 were still underway, of which only ten or so present problems with satisfaction of the EU requirements.
In 2009, approximately 4,663 had been completed and over 1,200 were underway, of which 608 were judged by the European Court of Justice to be in a state that merited censure of Italy for delay in fulfilling EU obligations.
Figures 8.35 summaries the issue of IEA in Italy from 2005 to 2012.

There are 161 "strategic plants" subject to I.E.A. in operation.

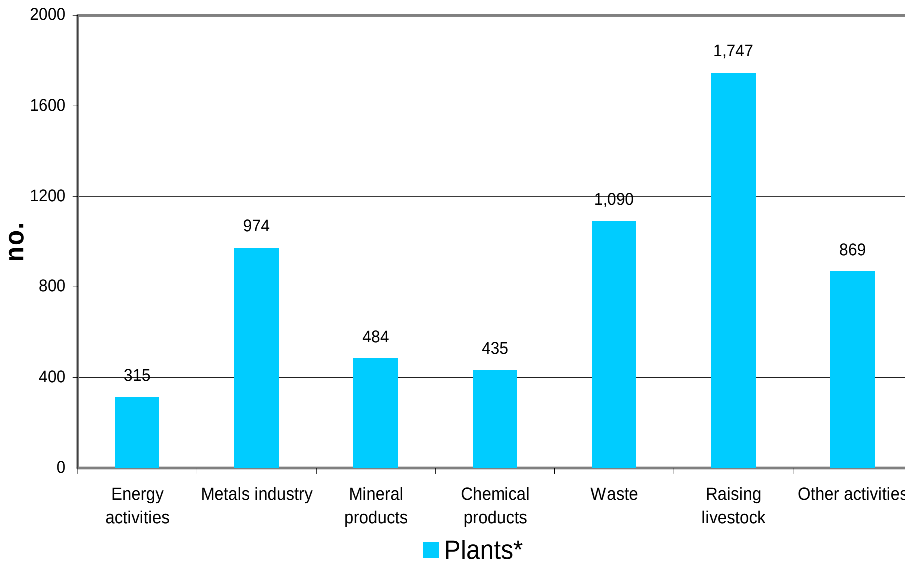
The IPPC production activities subject to AIA in Italy are found in all the Regions, with the "strategic plants" subject to IEA issued by the central government[41] numbering 161 in operation, while there are 177[42] IEA applications, and the remainder of the IPPC plants fall under the jurisdiction of the Regions[43].
The central government issues IEA[44] under decrees of the Ministry of the Environment, following a specific Services Conference held in the wake of a technical preliminary control carried out by the AIA-IPPC examining commission of ministerial appointees, with ISPRA contributing both technical support for the preliminary control and planning for the monitoring of the pollutants released into the environment.
In terms of first central-government IEA issued by the Ministry of the Environment, as of 31 December 2012, 149 procedures had been concluded (45 as of December 2009) and 23 are underway, with 11 regarding renewals of earlier IEA issued by other authorities under obsolete regulations and 12 involving the replacement of earlier sector-based authorisations.

[39] Second part, Section III-b, as modified by Legislative Decree 128/2010
[40] Such as those for air pollution, dumping of waste water in surface waters, on the ground and in the subsoil, discharges into sewage networks, the construction, modification and operation of plants for the disposal or recycling of waste, or for the spreading of liquid waste from livestock operations on the ground or the use in agriculture of sludge generated by purification processes
[41] Under Legislative Decree 152/2006 for activities listed in Appendix XII to the Second Part
[42] Including 6 plants that closed during the preliminary controls
[43] The majority of the regions, and all of those with more than 300 plants, delegated all or a part of their responsibility to the provinces
[44] Ministry of the Environment

Categories of IPPC facilities subject to AIA in Italy

In the European Union[45], there are approximately 50,000 IPPC plants subject to IEA, of which more than 5,800 in Italy. The following graphs show the distribution of the plants in Italy and the percentage incidence of the different categories of activity, indicative of the impacts that the plants can have on the environment. It should be noted that the most numerous activities are livestock raising, metal industries and waste management.

There are plants where various activities falling under different categories are carried out.



Note
* there are plants where various activities falling under different categories are carried out

Figure 8.32: Distribution of plants by category of IPPC activity in Italy[46]

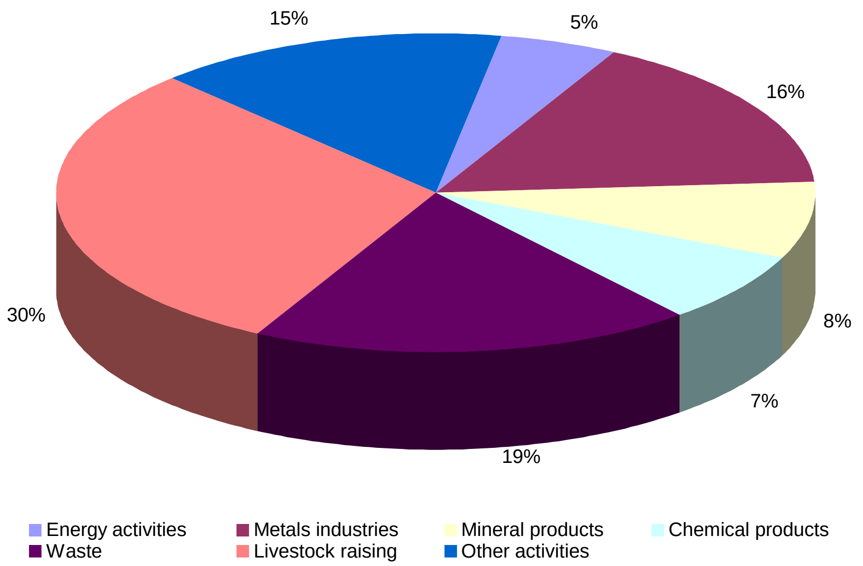


Figure 8.33: Percentages of plants by category IPPC activity in Italy[47]

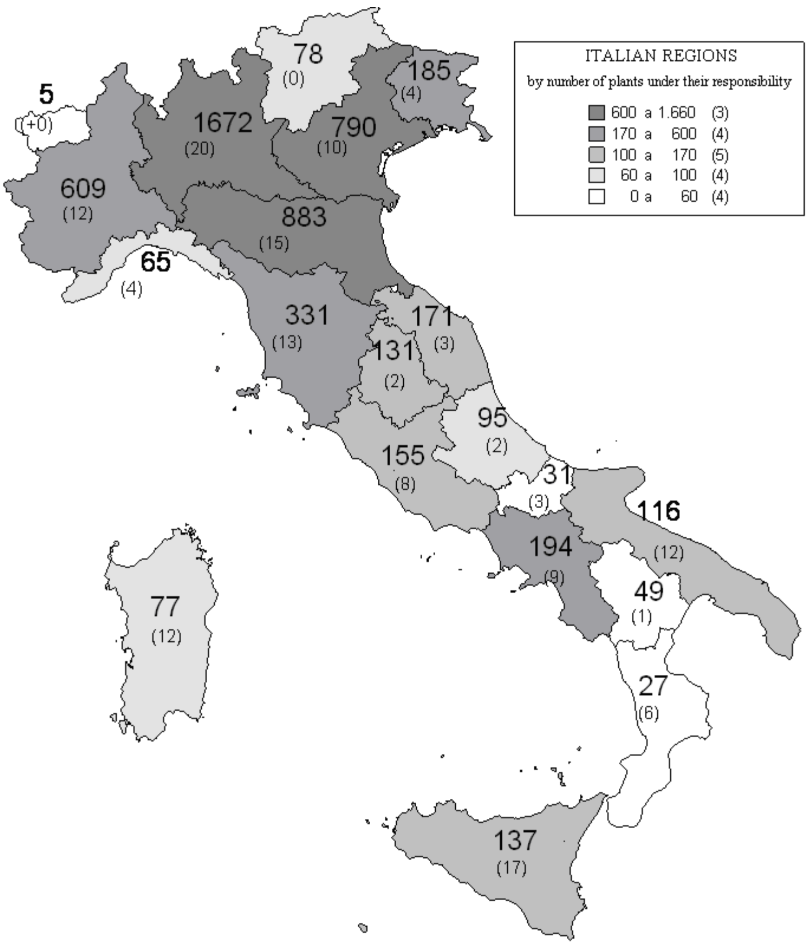
[45] Report of the EU Commission on the data collected with the questionnaires on the enactment of the IPPC Directive for the three-year period 2005-2008
[46] Source: Ministry of the Environment
[47] Source: Ibidem

When the Directive went into effect (November 1999), approximately 5,510 of these IPPC facilities already existed, while another 283 plants were no longer subject to IPPC obligations due to closing or downsizing, though IEA applications had been made.

IPPC facilities subject to IEA in Italian territory

In Italy, as already stated, IPPC production activities are found in all the Regions, including 161 so-called “strategic” plants subject to a central-government IEA – of which 114 existing, 41 new but already authorised and 6 new with authorisations pending as of December 2012[48] - consisting of 15 refineries, 33 large chemical plants, 2 integrated steel mills, 111 large thermoelectric power plants and offshore plants.

The other IPPC plants fall under regional jurisdiction, though most of the Regions, and especially those with more than 300 IPPC plants, have delegated all or some of their responsibility to the provinces (Piedmont, Lombardy, Veneto, Trent-Alto Adige, Liguria, Emilia-Romagna, Tuscany, Lazio, Sardinia).



x number of IPPC plants
(x) number of plants under central government jurisdiction

Figure 8.34: Distribution of authorised IPPC plants by Region as of December 2012[49]

[48] Updated to 2012 by the Ministry of the Environment with data from questionnaire 2009-2011
[49] Source: Ministry of the Environment

As shown by figure 8.34, the majority of the IPPC plants are concentrated in northern Italy (Lombardy, Emilia-Romagna, Veneto and Piedmont). Furthermore, Lombardy, Emilia-Romagna, Veneto, Piedmont, Tuscany, Campania, Marche, Lazio, Umbria, Sicily and Apulia are the Regions with the most IPPC plants under regional jurisdiction, while Lombardy, Sicily, Emilia-Romagna, Tuscany, Piedmont, Apulia, Sardinia and Veneto are those with the most plants subject to central-government IEA.

IEA preliminary controls for IPPC facilities in Italy

The IEA is issued by the Ministry of the Environment for strategic plants, or by another authority (indicated by the Region or the Autonomous Province with territorial jurisdiction) and it is valid for 5 years. It can also last for 6 or 8 years, if the plant employs a management system that complies with the ISO 14001 Standards or the EMAS Regulation.

The IEA issued by the Ministry of the Environment for plants falling under central-government jurisdiction, or by another authority (indicated by the Region or the Autonomous Province with territorial jurisdiction) for other plants, at the conclusion of a technical control carried out after a specific application is presented by the operator of the plant. The authorisation may be updated to cover any request for modification made by the operator, or it may be reviewed at the initiative of the competent authority, and it must always be renewed every 5 years; it can last for 6 or 8 years, if the plant employs a management system that complies with the ISO 14001 Standards or the EMAS Regulation. For the issuing of the IEA, the representatives of the competent authorities take part in the Services Conference (the Ministry of the Environment, the Regions, the provinces, municipal governments), together with representatives of the Ministries of Economic Development, Health, Labour and Internal Affairs, and of the Prime Minister’s Office. The industrial activities subject to the national IEA include the most significant industrial plants in terms of pollution, which are grouped by the directive under 5 main categories:

1. crude oil refineries (not including enterprises that produce only lubricants from crude oil), plus gasification and liquefaction plants that handle at least 500 tons a day of coal or bituminous shale;
2. thermal power plants with thermal power of at least 300 MW;
3. integrated steel mills for first fusion of pig iron or steel;
4. sets of chemical plants with overall annual production capacity greater than minimum thresholds falling between 100 and 300 million kg, depending on the class of product
5. all other plants subject to IEA and located entirely at sea.

The environmental benefits pursued through the issue of the IEA include the elimination, whenever possible, or at least the reduction, of polluting substances introduced into the air, the water and the soil, thanks to enactment of the Best Available Techniques (or BAT), as described in the BRef, or BAT Reference Documents, published by the European Commission, as well as in the national guidelines, with a further benefit being the initiation of monitoring of environmental pollution at the source – meaning at the point where the polluting substances are introduced into the environment – in order to ensure that the activities involved are carried out within the limits stipulated to comply with the conditions of environmental quality in the surrounding territory, and called for under the IEA, with a further consideration being the question of resource efficiency with respect to raw materials, energy, waste etc.

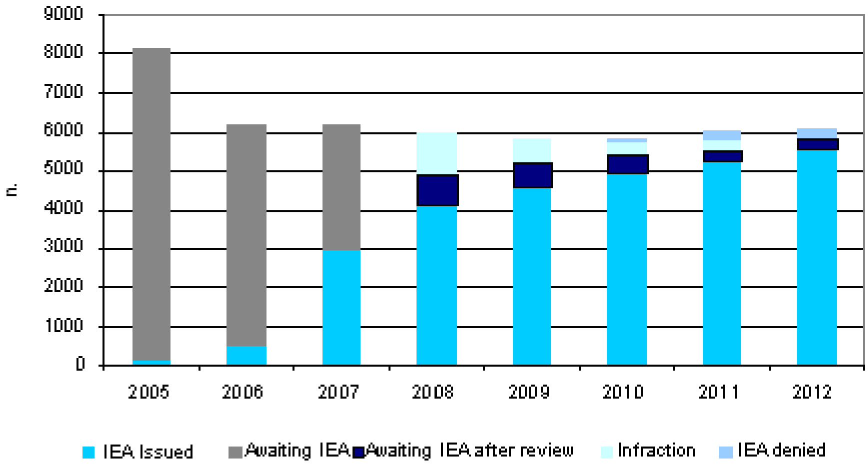


Figure 8.35; Authorisation status of IPPC plants in Italy

The issuing of the IEA eliminates or reduces emissions of polluting substances in the air by employing the best technologies and initiating monitoring at the source to confirm operation within the stipulated limits, so as to respect the conditions of environmental quality of the surrounding territory.

The general principles that the competent authority must take into account when issuing the IEA include an indication of implementation of all the measures necessary for preventing accidents and limiting any consequences that might affect the surrounding environment. It follows that the IEA must also refer to accidents (such as fires, spills, leaks and accidental emissions of hazardous substances), malfunctions, breakdowns, disservices or unfavourable environmental conditions that could occur in the plants of these industrial facilities and engender emergency situations hazardous to man and/or the environment, in addition to which it must identify/stipulate the systems and procedures that are to be employed for the prevention and management of the above, based on the category and vulnerability of the territory in which they are found.
To ensure a high level of protection of the environment as a whole, the IEA are issued in accordance with general principles (art. 6, paragraph 16, of Legislative Decree 152/06, plus subsequent modifications and additions) and in compliance with the standards of environmental quality (art. 29-part seven of Legislative Decree 152/06, plus subsequent modifications and additions) and they specifically contain.

- emissions ceilings set for polluting substances, and in particular for those listed in Appendix X, which can be emitted by the plants in question in significant quantities, considering their nature and their potential for transferring pollution from one element of the environment to another (water, air, soil), plus further ceilings for acoustic pollution (though the emission ceilings can never be less rigorous than the levels currently in force in the territory in question);
- additional provisions that guarantee protection of the land and of underground water, together with suitable provisions for the management of the waste produced and for reducing acoustic pollution;
- appropriate prerequisites for the control of emissions, including the parameters chosen, the methodology and the frequency of measurement, plus the related procedure of evaluation;
- the obligation of communicating the data needed to confirm compliance with the conditions of the IEA, plus the procedures for reporting and the data on emission controls required under the IEA;
- suitable provisions for the maintenance and oversight of the measures implemented to prevent emissions;

• measures regarding operating conditions different from normal ones (start-up, shut-down, leaked emissions, malfunctions, accidents etc.).

The IEA also takes into consideration conditions other than normal operation, though in such cases compliance with the same instructions established for normal operation is not usually required, especially in terms of the emission limit values (ELV) expressed as concentrations or as specific emissions (per unit of product).

It remains necessary, however, to assess and evaluate such conditions, give the obligation to consider the emission to be significant, to guarantee an elevated level of protection for the environment in its entirety and to avoid noteworthy instances of pollution.

It follows that, at least for persistent pollutants, the ELV expressed as mass per unit of time must also take into account the other than normal operating conditions.

IEA an environmental operating authorisation, it is not responsible for, nor does it develop, specific evaluations regarding eventual medical effects on the population, or considerations on the risk of significant accidents, or on occupational health, or on the environmental compatibility of the plant, al of which are assessed independently by other, competent authorities using different instruments: ordinances on unhealthy industrial activities, "Seveso" safety plans, requirements of the boards of health with territorial jurisdiction, environmental impact statements (for plants and modifications dating from after 1986) and tools of regional environmental planning.

During the Services Conference of the IEA proceeding, findings are gathered to ensure that the IEA ruling proves compatible with the above considerations.

As an environmental operating authorisation, the IEA is not responsible for, nor does it develop, specific evaluations of any health effects on the population, or considerations on the risk of significant accidents, or on occupational health, or on the environmental compatibility of the plant, all of which are assessed independently by the competent authorities.

The procedure for evaluating the plant-engineering proposal for which the IEA is requested

As part of preliminary controls on IEA applications presented by operators of plants falling under central-government jurisdiction, ISPRA performs an integrated evaluation of the plant-engineering proposal for which the IEA is being requested, based on controls of compliance with the criteria of compliance undertaken by the operator with respect to:

- the prevention of pollution by following the BAT;
- absence of noteworthy pollution;
- reduction, recovery and elimination of waste;
- efficient use of energy;
- implementation of measures to prevent accidents and limit their consequences;
- conditions for site restoration after the end of activities.

Particularly, IEA, being an authorisation for the operation of the plants of IPPC facilities, focuses its evaluation primarily and specifically on the operation of such plants, whether they are already constructed or to be built.
In the course of the technical and scientific activities performed in support of the IPPC Commission, ISPRA has had the chance to develop, through its assessments of IEA applications and analysis of the preliminary controls on the documentation presented by the operators for the various IPPC plants, a specific stock of experience on considerations of risk analysis relating to determined production activities, with the outcome being certain elements of interest and relevance in both general and specific terms.

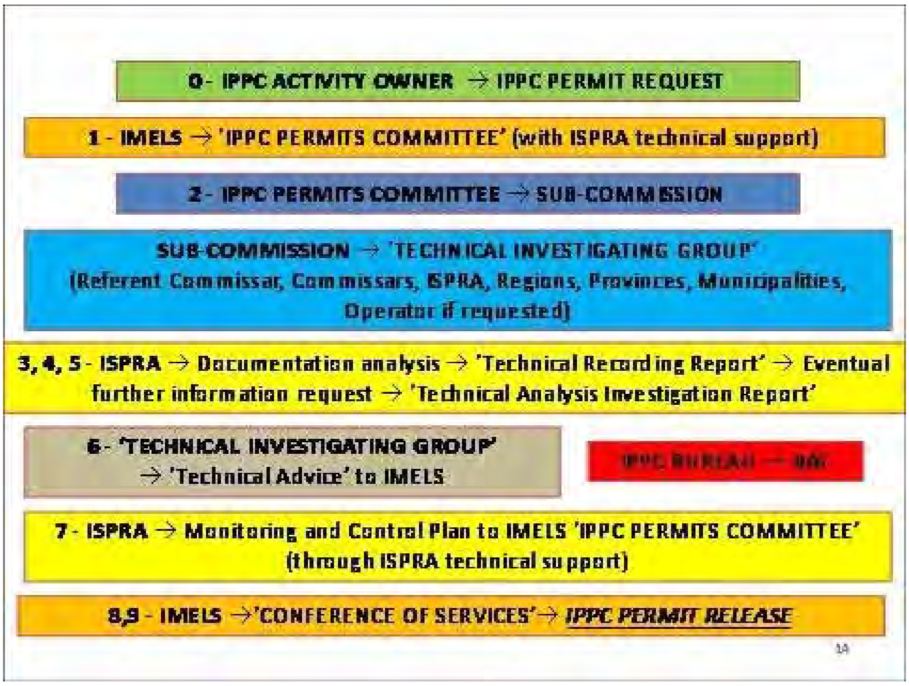


Figure 8.36: IEA issuing procedure for strategic plants under central-government jurisdiction[50]

Determination of the authorisation requirements

The IEA indicates a number of requirements that the operator must meet within the time periods stipulated for arriving at the optimal levels of environmental quality.

IEA decrees also indicate a number of requirements that the operator must meet within the stipulated periods of time in order to arrive at the optimal levels of environmental quality expected following enactment of the limit values set under the IEA.
The authorisation requirements, together with the Monitoring and Control Plan (PMC) drawn up by ISPRA (on the national level), or by a provincial or regional environmental protection agency, express the additional conditions for the commitments entered into by the operator at the time of the compilation and signing of the IEA application, complete with the related forms and annexes, for the purpose of obtaining the issue of the Integrated Environmental Authorisation from the competent authority.
These requirements are mandatory, and they are approved, in the course of the Services Conference, on the basis of the proposals found in the preliminary analysis of the environmental performance of each

[50] Source: Ministry of the Environment

plant, which are then cross-analysed with the values indicated in the Guidelines and the BRefs of the specific BAT applicable to the case in point.
In the case of plants under the jurisdiction of the central government, the requirements are formulated within the Technical Advice drawn up by the Technical Investigating Group specially organised to evaluate each IEA application and consisting of members of the IPPC Permit Committee, as well as experts designated by the local government bodies (Regions, Provinces and municipalities) involved.
These prescriptions refer to all measures needed in order to assure a high level of environmental protection with regard to emissions into the air, water and soil, plus waste and noise, including whatever other measures are necessary to prevent accidents and limit their consequences, based on, among other things, the vulnerability of the territory that surrounds the IPPC plant addressed by the IEA.

SPECIFIC REGIONAL CHARACTERISTICS

ARPA Friuli-Venezia Giulia

As of December 2012, the Friuli-Venezia Giulia Region held 185 facilities subject to the Integrated Environmental Authorisation (IEA-IPPC) referred to under Legislative Decree 152/2006, plus 34 facilities at Risk of Significant Accidents (MAH), as per Legislative Decree 334/99 (the “Seveso” Act).

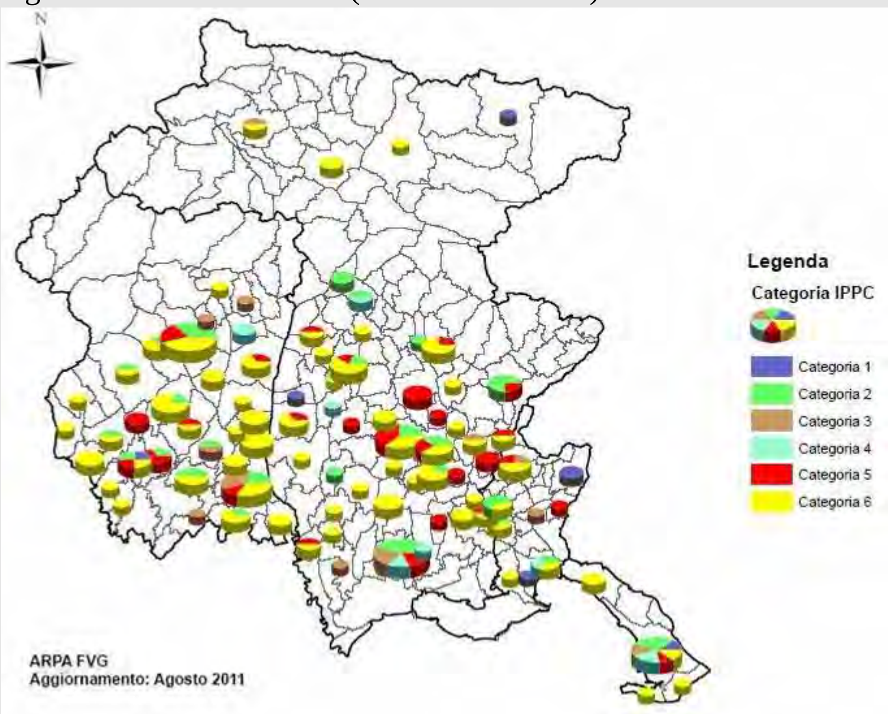


Figure 1: Facilities subject to Integrated Environmental Authorisations (Legislative Decree 152/2006)[51]

[51] Source: ARPA Friuli -Venezia Giulia - RSA 2011

The topics of the IEA and the MAH, although they were first brought up for discussion at different points in time, are definitely moving in the direction of a common objective: that of shifting the centre of gravity of controls of environmental and safety performance onto the managers of enterprises, in this way favouring the development of what is commonly referred to as the mechanism of self-supervision, which rests, in turn, on specific, well developed procedural elements that are part of what is referred to as the systems of management (environmental and regarding safety).

And so the activities of prevention carried out by the Environmental Protection Agency of the Friuli-Venezia Giulia Region under the concept of “command & control” have gradually given way to audit activities meant to determine the effectiveness and efficiency of systems of self-supervision. Naturally, all the police inspection activities undertaken to fight crime both by the Friuli-Venezia Giulia Environmental Protection Board and by other bodies delegated to the task remain unchanged, under the coordination of the courts (Ecological Squad of the Carabinieri Corps, Provincial Governments, Treasury Police, ASS, Fire Fighters Corps etc.).

The Tuscany Region has computerised its procedure for notification of sites of potential contamination within its territory.

Since 1 March 2011, the application SISBON (Information System on Sites Subject to Reclamation Procedures) has been in operation, making it possible to send notifications of potential contamination of sites not yet entered in the regional registry, complete with all the technical and analytical information called for under regional regulations on the reclamation of polluted sites.

SISBON is an IT tool created by the Tuscany Environmental Protection Agency in support of the flow of information to the "Databank on Sites involved in Reclamation Procedures”, an effort shared on the regional level with all the local governments involved and organised as part of the Regional Environmental Information System, or SIRA. The main innovation of the instrument is that a single databank can be shared not only among subjects in the public sector but also with those required to comply with procedures, meaning consulting firms. Each subject, based on its profile, can view and/or modify the data falling under its own responsibility.

SISBON also includes a geographic front-end that utilises regional cartographic supports to update geographic information over the web: the geo-referencing of the site in question (starting in the notification phase) and the establishment of its perimeter (in subsequent phases), all of which becomes an integral part of the databank.

CONTAMINATED SITES

Status

Contaminated sites are areas where, as a result of human activity already carried out or underway, it has been determined, based on the regulations currently in force, that a specific alteration occurred in the natural characteristics of the soil, due to any pollutant. The management of contaminated sites constitutes one of the chief environmental problems facing European countries. Soil contamination resulting from industrial activities, waste management, mining operations, leak from storage tanks and pipelines transporting hydrocarbons represents one of the main factors of environmental pressure. The presence of potentially hazardous substances in the soil, the subsoil, in sediments and in underground waters can have negative repercussions on the health of mankind and on that of ecosystems. The origins of specific contamination (for which sources can be identified, complete with their locations) fall under the following main categories:

The management of contaminated sites represents one of the main environmental problems for European countries.

- waste management activities (solid or liquid waste)
- industrial activities
- business activities
- mining activities.

Art. 251(Census and Register of Sites to be Reclaimed) of Legislative Decree no.152 of 3 April 2006, as was the case with Ministerial Decree 471/99 before it, stipulates that the Regions and the Autonomous Provinces, based on criteria defined by the APAT (now a part of ISPRA), are to establish the Register of Sites Subject to Reclamation Procedures, which must contain a listing of the sites subject to initiatives of environmental reclamation and restoration, together with an indication of the work done at those sites, plus identification of the subjects responsible for the reclamation, as well as the public institutes whose services the Region intends to draw on should the obliged subjects fail to meet their commitments. The same article further stipulates that: "*In order to guarantee effective collection and transfer of the data and the information, the Agency for the Protection of the Environment and for Technical Services (APAT) determines, in collaboration with the regional governments and the regional environmental protection agencies, the contents and the structure of the key data of the registry, as well as the procedures for their transposition into information systems connected with the National Environmental Information System (SINA)*" (paragraph 3).

The Regions and the Autonomous Provinces are to establish (art. 251 of Legislative Decree 152/06, as subsequently amended) the registers of sites subject to reclamation, which shall constitute key tools in the planning of such initiatives.

Therefore, in compliance with its assigned institutional tasks, ISPRA collects the data on the sites subject to reclamation procedures found in the regional registers, when such have been established, or in the available databanks, and publishes the information on these sites, together with the aggregate data available for the 39 Sites of National Interest (SNI) established to date by the Ministry of the Environment. The national outlook in terms of the progress made on the management of the contaminated sites is illustrated on Table 8.2, which lists the contaminated sites, and those in which risk reduction measures were completed, for each Region.

Table 8.2: Contaminated sites and reclaimed sites by Region[52]

Based on the data collected by ISPRA, the contaminated sites number 4,818, while in 3,063 risk reduction measures were completed and can therefore be reutilised.

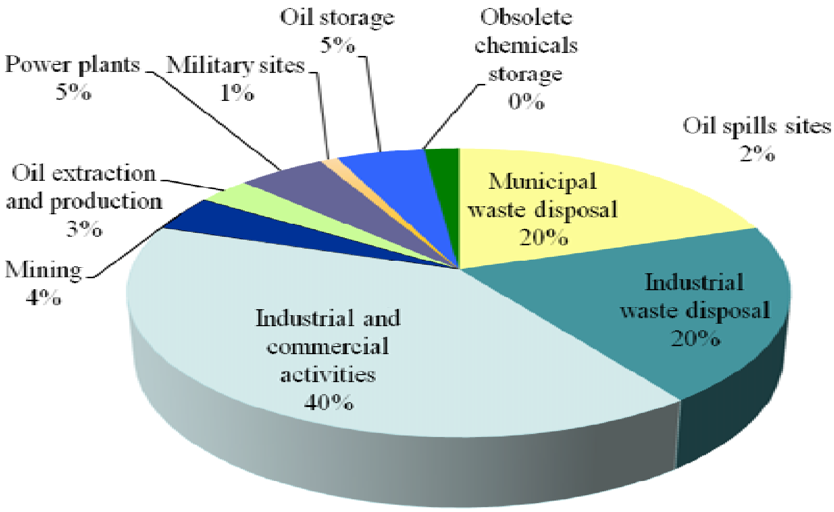
Region/Autonomous Province	Contaminated sites	Sites with risk reduction measures completed
	no.	
Piedmont[a]	343	211
Aosta Valley[a]	4	9
Liguria[a]	176	50
Lombardy[a]	853	1,300
Trent	52	188
Bolzano-Bozen	272	114
Veneto[a]	562	55
Friuli-Venezia Giulia[a 1]	-	94
Emilia-Romagna[a 1]	323	331
Tuscany[a 1]	1,050	257
Umbria[a 1]	64	12
Marche[a]	293	330
Lazio[a 1]	71	18
Abruzzo[a]	169	88
Molise[a 1]	2	0
Campania	176	12
Apulia[a 1]	198	4
Basilicata[a 1]	6	3
Calabria[a 1]	52	7
Sicily[a 1]	-	0
Sardinia[a 1]	171	5
Italy	**4,837**	**3,088**

Note
[a]: Does not include SNI
[1] figure not updated to 2012

The largest numbers of initiatives were carried out in the central-northern Regions.

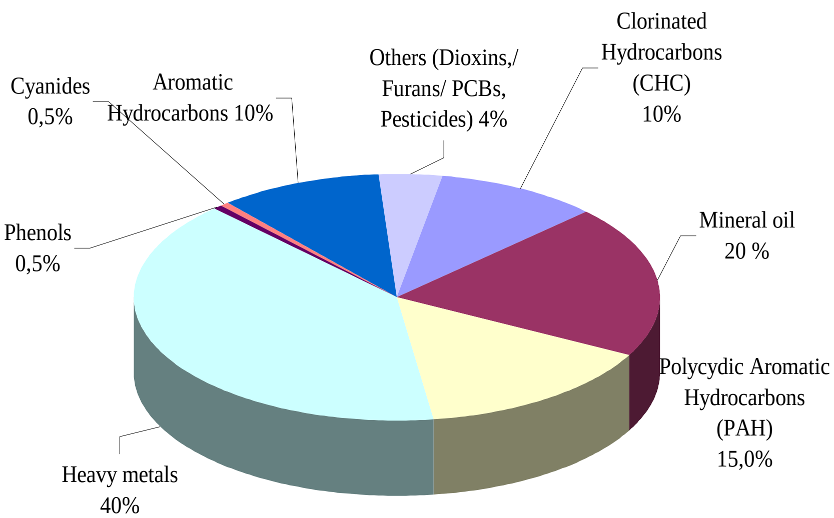
There is no ignoring that the larger part of the initiatives by far was carried out in the central-northern Region, whereas in the south both the identification of the contaminated sites and their reclamation move forward quite slowly.
Looking at the data on the economic activities that led to the contamination of the soil and the underground waters, there is a clear preponderance of industrial/business activities, along with those regarding waste management, with the percentages differing between central-northern Italy (where industrial/business activities prevail) and the south (where the main activities are those connected with the management of waste, and of dumping sites in particular).
Among the industrial/business activities that can give rise to contamination, a considerable portion can be addressed to fuel stations, which account for a large number of the sites recorded. As for the types of contamination found, heavy metals and hydrocarbons (aliphatics, aromatics and chlorinated) represent the families of substances most frequently found in the soil and in groundwater during the characterisation phase.
As such, it can be sad that the aggregate data for the 39 SNI accurately reflect the national situation.

[52] Source: ARPA/APPA data processed by ISPRA



The main activities that result in contamination are those involving industry and business, though in the south there are problems tied to the management of waste and dumping sites.

Figure 8.37: Contributions to soil contamination by type of source (figures for SNI)[53]



The main contaminating substances are heavy metals and hydrocarbons (aliphatics, aromatics and chlorates).

Figure 8.38: Main categories of pollutants found in the soil (figures for SNI)[54]

[53] Source: ISPRA, 2012
[54] Source: Ibidem

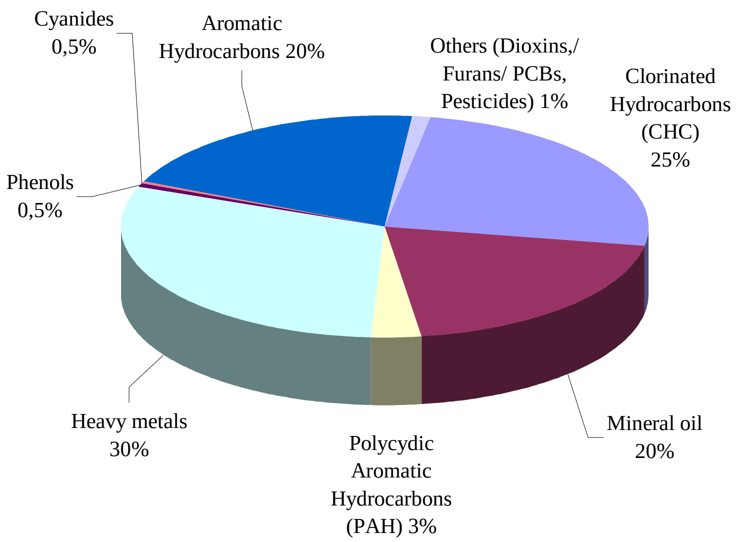


Figure 8.39: Main types of pollutants detected in surface and underground waters (figures for SNI)[55]

Responses

Considering that Europe Union lacks a regulatory framework for soil contamination, Italy can rightfully claim to be the first member state to equip itself with the administrative, technical and regulatory instruments needed to manage contaminated sites.

The first measure that contemplated specific administrative and financial instruments for environmental clean-up, and therefore reclamation, was Law no 349 of 1986 (governing area at elevated risk of environmental crises). The issue was next addressed by two successive legislative decrees, subsequently converted into Laws no. 441 of 29 October 1987 and no. 475 of 8 November 1988, used to deal with the emergency situations that had developed with regard to the disposal of industrial and urban waste. Art. 5 of Law 441/87 and art. 9-third part of Law 475/88 governed the identification and the financing of initiatives involving the reclamation of contaminated sites, assigning the tasks of formulating and approving the efforts to specific regional plans, but without setting the criteria for the drafting of these plans. Ministerial Decree no. 121 of 16 May 1989 was the first measure to set criteria and guidelines for the formulation and preparation of the reclamation plans, in addition to the procedures for financing the initiatives. After this ministerial decree was issued, a number of regional laws were also passed on reclamation activities. The first all-encompassing national legislation on contaminated sites arrived with Ministerial Decree 471/99, meaning the regulations of implementation for art.17 of Legislative Decree no. 22 of 1997 (the Ronchi Decree). This measure already provided the first definition of a contaminated site as one in which “the concentrations of contaminants exceed the limit values”.

Without a common European reference framework, the problem of contaminated sites is managed under divergent approaches in the member states. Italy was one of the first countries of the European Union to pass all-encompassing legislation on the management of contaminated sites

[55] Source: ISPRA

This measure rested, therefore, on the application of criteria in a table format, with the evaluation of the state of contamination arising from a comparison with the limit values for the soil (and for the assigned uses in industrial/business activities, or as greenery/residential space) and for underground water. Following the enactment of Legislative Decree 152/06, the technical procedures for the management of contaminated sites were further developed and extensive application of healthcare-environmental risk analysis was introduced to identify "site-specific" reclamation objectives, based on a "fit-for-use" approach that is widely used internationally, with the end goal being to encourage the performance of reclamation efforts. Legislative Decree 152/06 was subject to numerous updates and additions. During the last twelve months of Italy's 16th Legislature, a large number of regulatory measures were proposed on reclamation activities, though not for the purpose of once again revamping the legislative structure, but rather in order to render it clearer and more "flexible" than the current version.

Sites of National Interest (SNI)

Under the provisions of Arts. 17 and 18 of the abovementioned Legislative Decree 22/97, the Ministry of the Environment, taking into account the lists of areas subject to an elevated risk of environmental crisis, as per Laws 305/89 and 195/91, identified the Sites of National Interest. The criteria for their identification was established first under art. 15, paragraph 1, of Ministerial Decree 471/99, "Regulations Establishing the Criteria, Procedures and Methods for the Enactment of Safe Conditions, the Reclamation and the Environmental Restoration of Polluted Sites" (Art. 15, paragraph 1), and then under art. 252 of Legislative Decree 152/06 which state as follows (arts.1 and 2):

With a decree issued by the Ministry of the Environment on 11 January 2013, 18 of the 57 sites classified as SNI were transferred to the jurisdiction of the regional governments, meaning that the current number of SNI is 39.

1. For the purpose of reclamation, sites of national interest can be identified with respect to the characteristics of the site, as well as the quantities and level of hazard of the pollutants found there, plus observation of the impact on the surrounding environment in terms of medical or ecological risk, as well as negative repercussions for cultural and environmental resources;
2. The identification of sites of national interest is made under a decree issued by the Minister of the Environment, in agreement with the regional governments involved and based on the following guiding principles and criteria:
    - a) reclamation initiatives must involve areas and territories, including bodies of water, of particular environmental worth;
    - b) the reclamation must involve areas and territories protected under the provisions of Legislative Decree no. 42 of 22 January 2004;
    - c) the healthcare and environmental risk resulting from observed levels in excess of the threshold concentrations of risk must be especially high, based on the population density or the extension of the area involved;

d) the socioeconomic impact of the pollution of the area must be significant;
e) the contamination must constitute a risk for resources of historical and cultural interest and of national importance;
f) the initiatives to be enacted must regard sites located in the territory of more than one Region.

Art. 36-b of Legislative Decree 83/2012 introduced a series of measures on polluted sites of national interest designed, on the one hand, to influence the criteria for identifying the sites, while, on the other, modifying the list of sites (57 as of the date on which the measure was issued). Specifically, a new criterion was inserted among the guiding principles and criteria for identifying SNI, in order to take into account sites involved either at present or in the past, in activities of refineries, integrated chemical plants or steel mills. Sites involved in the production or removal of asbestos are also to be classified as sites of national interest, for the purpose of reclamation. Paragraphs 3 and 4 contemplate, respectively, the possibility of a decree being issued by the Ministry of the Environment, following consultation with the Regions involved, for recognition of sites classified as being of national interest despite not satisfying the prerequisites indicated under article 252, paragraph 2, of the Environmental Code, plus the possibility of redefining the perimeter of the SNI, at the request of the interested Region, through a decree issued by the Ministry of the Environment, after hearing the opinions of the local government bodies involved. Under a ministerial decree of 11 January 2013, issued in implementation of art. 36-b of Legislative Decree 83/2012, 18 of the 57 sites classified as SNI, though they did not satisfy the prerequisites stipulated in the decree itself ("presence on the site, currently or in the past, of activities involving refineries, integrated chemical plants or steel mills", or the "presence of activities involving the production or removal of asbestos") re transferred under the jurisdiction of the Regions. At present, therefore, the total number of SNI is 39.

Areas contaminated by activities involving the production or removal of asbestos are always classified as SNI.

Spending on reclamation activities

Formulating a financial overview of reclamation efforts involving contaminated sites may very well be an even more complex task than determining the progress made on the reclamation procedures themselves. The problem is that spending on the reclamation of sites is usually entered on regional and national budgets under spending items regarding defence of the territory or soil protection, making it impossible to determine the specific spending on reclamation.

An attempt at estimating the spending sustained by public and private parties on the reclamation of SNI was undertaken by Beretta[56]. It was determined that, during the years 2001-2012, the Ministry of the Environment made available, under a variety of measures, approximately 1.887 billion euros for initiatives of public interest.

During the same period, roughly 250 projects consisting of private initiatives were approved, working out to an equivalent amount of

During the years 2001-2012, the Ministry of the Environment made available, under a variety of measures, approximately 1.887 billion euros for initiatives of public interest. During the same period, roughly 250 projects involving private initiatives

[56] Beretta G. P (2013), *Lo stato delle attività di bonifica in Italia*, atti di SICON 2013

approximately 1.709 billion euros. Therefore, taking into due consideration the approximation, roughly 3.596 billion euros were invested, with a slight prevalence of public investment (52.5%) as compared to private (47.5%).
It should also be mentioned that Resolution no. 87/2012 of the Interministerial Committee on Economic Policy approved the allocation of 1.06048 billion euros, to be drawn from the Fund for Development and Cohesion, for the financing of initiatives in the Regions of Basilicata, Calabria, Campania, Apulia, Sardinia and Sicily involving extraordinary maintenance of the terrain, including initiatives in the reclamation sector.
When the figures reported are projected onto the national situation, with all the necessary adjustments made for scale, they point to the existence of a sizeable potential market revolving around the reclamation of contaminated sites and presenting growth potential for the coming years. Of particular note is the fact that the market is technology intensive, as shown by the international recognition accorded to experimental studies carried out in Italy by Italian researchers on technological advances in the decontamination of soil and underground waters, as well as the numerous Italian patents filed in the sector.

were approved, for an equivalent amount of approximately 1.709 billion euros.

When the figures reported are projected onto the national situation, with all the due differences of scale, they point to the existence of a significant potential market revolving around the reclamation of contaminated sites and offering opportunity for growth in the years to come.

Table 8.3:Spending on reclamation activities[57]

Region/Autonomous Province	**Year**	**Spending on reclamation activities**	**Annual estimated spending**	**Category**
		euro		
Piedmont	-	-	-	-
Val d'Aosta	-	-	-	-
Liguria	2000-2010	13,669,467.02	1,366,946.70	Regional financing
Lombardy	1992-2013	230,000,000.00	20,909,090.91	Regional financing
Trent	2012	1,179,000	1,179,000.00	Provincial financing
Veneto	2009-2012	90,000,018.40	30,000,006.13	Regional financing (95.8 miE) + ROP funds (12.6 million euros)
Friuli -Venezia Giulia	-	-	-	-
Emilia- Romagna	-	-	-	-
Tuscany	-	-	-	-
Umbria	-	-	-	-
Marche	-	-	-	-
Lazio	-	-	-	-
Abruzzo	-	-	-	-
Campania	-	-	-	-
Apulia	-	-	-	-
Basilicata	-	-	-	-
Calabria	-	-	-	-
Sicily	-	-	-	-
Sardinia	-	-	-	-

[57] Source: ARPA/APPA data processed by ISPRA

SPECIFIC REGIONAL CHARACTERISTICS

ARPA Toscana

The Tuscany Region has computerised its procedure for sending notification of potential contamination of sites within its territory. Since 1 March 2011, the application SISBON (Information System on Sites Subject to Reclamation Procedures) has been in operation, making it possible to send notifications of potential contamination of sites not yet entered in the regional registry, complete with all the technical and analytical information called for under regional regulations on the reclamation of polluted sites.
SISBON is an IT tool created by the Tuscany Environmental Protection Agency in support of the flow of information to the "Databank on Sites involved in Reclamation Procedures", an effort shared on the regional level with all the local governments involved and organised as part of the Regional Environmental Information System, or SIRA. The main innovation of the instrument is that a single databank can be shared not only among subjects in the public sector but also with those required to comply with procedures, meaning consulting firms. Each subject, based on its profile, can view and/or modify the data falling under its own responsibility.
SISBON also includes a geographic front-end that utilises regional cartographic supports to update geographic information over the web: the geo-referencing of the site in question (starting in the notification phase) and the establishment of its perimeter (in subsequent phases), all of which becomes an integral part of the databank.

GLOSSARY

Anthropization:
The human modification of the natural environment in order to adjust it to meet his needs and interests, constructing buildings, transportation arteries, infrastructures, etc..

Capable fault:
A fracture in the Earth's crust held to be capable of reactivating itself in the near future displacing significantly the ground surface, either associated to a seismic event or slowly moving by creep.

Damage:
The consequences of a hazardous event or human activity in terms of casualties or serious injuries (physical and psychological), material disruption, permanent or temporary loss of essential services, economic loss, detriment of the natural environment, including landscape.

Danger:
Anything that potentially has negative, undesirable consequences for a population and/or the environment. The intrinsic characteristics of a natural phenomenon or a human action can give rise to danger.

Geological hazard:
Geological phenomena and conditions that are potentially dangerous or pose a level of threat to human life, health, and property, or to the environment.

Geo-referencing:
The process to locate a point on the Earth's surface by assigning to it a pair of coordinates in a given map projection.

Hazard:
The probability that a potentially destructive event will occur with a given intensity in a given interval of time and in a given place.

Hydraulic or Flood hazard:
Floods are an overflow or inundation that comes from a river or another body of water (e.g., dam breach) and often threatens lives and properties. Therefore, any relatively high streamflow overtopping natural or artificial banks (e.g., levees) in any reach of a stream or along a coast can be termed a flood.

Natural Hazard:
A natural hazard is associated with geophysical processes that are an integral part of the environment and involves the potential for damage or loss for humans or the environment. When involving human communities, natural hazards have also social, technological, and political aspects. Natural hazards include geophysical hazards, i.e., hazards where the principal causal agent is climatic and meteorological (e.g., floods, hurricanes, and droughts) or natural hazards where the principle causal agent is geological and geomorphological (e.g., landslides, tsunamis, and earthquakes).

Risk:
The expected number of deaths, injuries or homeless individuals per year and/or the expected value of losses or damages to property (i.e. buildings) and/or economic activities on account of a negative event with a given level of hazard.

Vulnerability:
The propensity of an object or an element (individuals, buildings, infrastructures, economic activities) to sustain damage from a disastrous event.

CHAPTER 9

SOIL AND LAND

Introduction

In scientific community, a term such as “soil” can take on many different meanings, depending on the context.Soil scientists, geologists, agronomists, engineers, architects, urbanists, economists, politicians and even scholars, all have their own definitions of soil, ranging from “mother earth” to “native land”.

Lawmakers do not help much either since they give an all-inclusive definition of soil (soil: territory, land, subsoil, built-up areas and infrastructures), and, basically using the expression “soil protection” to mean protection of an area from hydrogeologic risks[1], they contribute to the confusion about the meaning of homonymous terms at the European level. In the following pages, the word “territory” will be used to mean “a circumscribed portion of the earth’s surface with characteristics that include all the attributes of the biosphere and geosphere and the results of present and past human activities”.

On the other hand we use the word “soil” to mean the porous and biologically active medium that represents “the top layer of the earth’s crust, formed by mineral particles, organic matter, water, air and living organisms. It is the interface between the earth, the air and the water and hosts most of the biosphere”[2] and that is “…capable of sustaining plant life, is characterised by typical flora and fauna and by a specific water cycle. It is divided into horizons, each with its own physical, chemical and biological characteristics”[3].

Along with air and water, soil is therefore crucial for the existence of the living species on the Earth and performs a number of functions that make it essential for environmental balance.

It plays a key role in protecting groundwater against pollution, in controlling the amount of CO_2 in the atmosphere, in regulating surface water flows with a direct impact on floods and landslides, in preserving biodiversity, on nutrient cycles etc.

Soil supplies the necessary elements to support human societies, which, too often consider it as a dump for the wastes from human production, or a resource to exploit, with scarce awareness of the effects caused by the loss of its functions.

Plant biomass depends on the state of health of the soil, with obvious effects on the entire food web.

Soil is an exceptionally differentiated biological laboratory, it can be regarded as a complex living body, constantly evolving, with some aspects that are still not very well known, which supplies humanity with the necessary sustenance.

Notwithstanding the essential services it provides to ecosystems, the soil is too often regarded merely as an aid to farming and as a physical basis for the conduct of human activities.

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[1] Leg. Dec. 152/06, Art. 54. Soil protection: the set of actions and activities related to the protection of the territory, of rivers, canals and catchment basis, lakes, lagoons, the coastal strip, groundwater, as well as the territory related to them, with the aim of reducing hydraulic risk, stabilising geological insecurity, optimising water use and management, valorising the related environmental and landscape features

[2] Commission of The European Community (2006) - Thematic strategy for soil protection. COM(2006)231 final

[3] *Soil Conservation Society of America* (1986)

This misconception about the vital importance of the soil leads to its use/abuse without a care for its fragility, for the fact that it is non-renewable and for the effects arising from the loss of its functions.
Improper agricultural methods, high urbanisation, economic activities and infrastructures in located areas, land use changes and local effects of global climate changes can give rise to serious deterioration processes that limit, or totally inhibit, the functions of the soil and often only become evident when they are irreversible or are in such and advanced stage that recovery is extremely difficult and economically inconvenient.
Furthermore, the evolution of these pressures is influenced by uncertainty related to unpredictable weather and to land use changes , agricultural methods and workers, which also depend on economic and political conditions.
Soil as a resource must therefore be protected and used in the best possible way, in relation to its intrinsic nature and to changes in the surrounding conditions, so that it can continue to play its irreplaceable and efficient role on the Earth.

The Italian situation

Knowledge about the factors that influence all the processes and phenomena affecting soil and land is of strategic importance for formulating regional policies aimed at sustainable development and therefore at combining the needs and demands of the community (socioeconomic factors), also in terms of safety, with cautious and careful management of the natural assets and the related resources (environmental factors). Whereas the information available concerning the use and knowledge of land, even if subject to improvement, enables us to trace a uniform picture of the Italian situation, knowledge about the soil is patchier.

Current knowledge about land use is fulfilling but rather uneven with regard to the soil.

Information on Italian soils has a rather long history, but it was only in the nineties that many Italian regions started collecting data systematically and producing maps and databases. Although there is a large amount of data available on the soil, even though not uniformly distributed, because there is a lack of central coordination they are somewhat uneven at the interregional level and in many cases this hinders the making of organised summaries at the national level.
In the present economic situation, the reutilisation of existing data produced by regional authorities has become not just a regulatory requirement but also a moral obligation.
The limitations imposed by unevenness can only be overcome through specific projects for harmonising the available information but these are not always easily to implement. Most of the data reported should therefore be treated as approximations worked out at the national level, which are gradually being added to.

Organic carbon (OC - Organic Carbon) accounts for about 60% of the organic matter contained in the soils and and performs an essential positive function on many soil properties: it favours the aggregation and stability of the soil's particles, thus reducing erosion, compaction, cracking and the formation of surface crusts; it bonds well with many substances thus improving the fertility of the soil and its buffering capacity; it improves microbial activity and the availability for plants of nutrients like nitrogen and phosphorus. Moreover, considering that, although the soil-vegetation carbon reserve is lower than the marine and fossil reserves, it is the most important one and can be influenced directly by human activities; knowledge about the amount of OC stored in the soils is the starting point for defining the role it can play in calculating the absorption of greenhouse gas.

Organic carbon has an essential positive effect on many soil properties.

According to the data of the Joint Research Centre (JRC), soils in the EU contain more than 70 billion tons of OC, equal to about 50 times the annual European greenhouse gas emissions[4].

The knowledge of the OC content in Italian soils is therefore an important factor in determining their condition. For example, with regard to cropland depending on the nature of the soils and the Italian climatic areas, an OC level of 1.2% (equivalent to about 2% organic matter) in most pedoclimatic contexts is able to guarantee maintenance of the soil's essential properties[5], such as the supply of nutrients for plants, the formation of organic and mineral aggregates, the water-retention capacity and many other important functions for the life of microorganisms and plants.

In Italian farming soils, an OC level of 1.2% is considered sufficient to guarantee maintenance of the soil's essential properties.

Figure 9.1 shows the European distribution of the percentage of organic carbon in the top 30 cm of soil. The map was developed by the JRC using data supplied by the European Soil Database, as well as from other related databases on climate, land use and topography. Most of the soils of plains and farmed hills present concentrations of organic carbon ranging between 1% and 2%, typical of tillage systems: whereas for the soils of uncultivated and mountain soils the carbon concentration is between 2% and 5% (locally between 5% and 10%). The different levels of carbon balance between the central and northern European environments and the Mediterranean regions is linked to the different climate conditions: in the former the conservation of carbon in the soil is due to a slower decaying of the organic matter and its consequent accumulation in the soil, whereas in the latter, the transformation of the organic matter is faster because they are favoured by higher temperatures and therefore, the carbon level traceable in the soil is definitely lower.

Figure 9.2 shows the amount of organic carbon stored in the top 30 cm of Italian soils, according to currently available regional data processed within the SIAS project (Development of Environmental Indicators on Soil).

This project, coordinated by the ISPRA e ARPAV, includes the regional Pedological Services, the research centres of the CRA (ABP and RPS)

The SIAS project aims to determine two soil indicators through harmonized maps , on the basis of a common and shared format and

[4] Commission of the European Community (2012) – *Implementation of the thematic strategy for soil protection*. COM (2012) 46 final

[5] Consiglio per la Ricerca e la sperimentazione in Agricoltura - Research Centre for agrobiology and pedology and Research Centre for the development of relations between plant and soil

and JRC-IES; it is aimed at creating harmonised maps of several soil indicators, on the basis of a common and shared format, according to the framework of INSPIRE Directive. The project is based on the revision and harmonization of the data contained in the regional databases. However, the use of existing data generated some malfunctions that show how difficult it is to manage data produced at different times by different bodies/laboratories/persons, even if a common procedure is followed. This situation therefore requires a further revision of the basic data.

according to the framework of INSPIRE Directive. The project considers the collection, revision and harmonisation of the data already stored in the regional databases.

As can be seen from Figure 9.3, in Italy the soils of the plain and of tilled hills are mostly included in the 25-50 t/ha and 50-75 t/ha classes, while the soils in hill-mountain areas, which mostly have natural vegetation systems, are mainly included in the 75-100 and 100-125 t/ha classes.

A further study on the OC stocks in Italian soils, carried out within the *CarboItaly* project, using the data collected in the SIAS initiative, shows that the amount of organic carbon existing in Italian cultivated soils varies significantly among different climatic areas and different soil landscapes, ranging from 41.9±15.9 t/ha of vineyards to 53.1±17.3 of arable crop fields and 63.3±27.9 t/ha of rice fields, with a slight decrease moving from the most temperate to the Mediterranean regions.

According to the mean values calculated for each uniform area and of the surfaces resulting from ISTAT 2000 Census, the organic carbon stored in Italian soils amounts to 490.0±121.7 million tons.

Considering the cultivated soils, the estimate average national amount is equal to 52.1±17.4 t/ha, similar to the one reported for other European countries (50-60 t/ha).

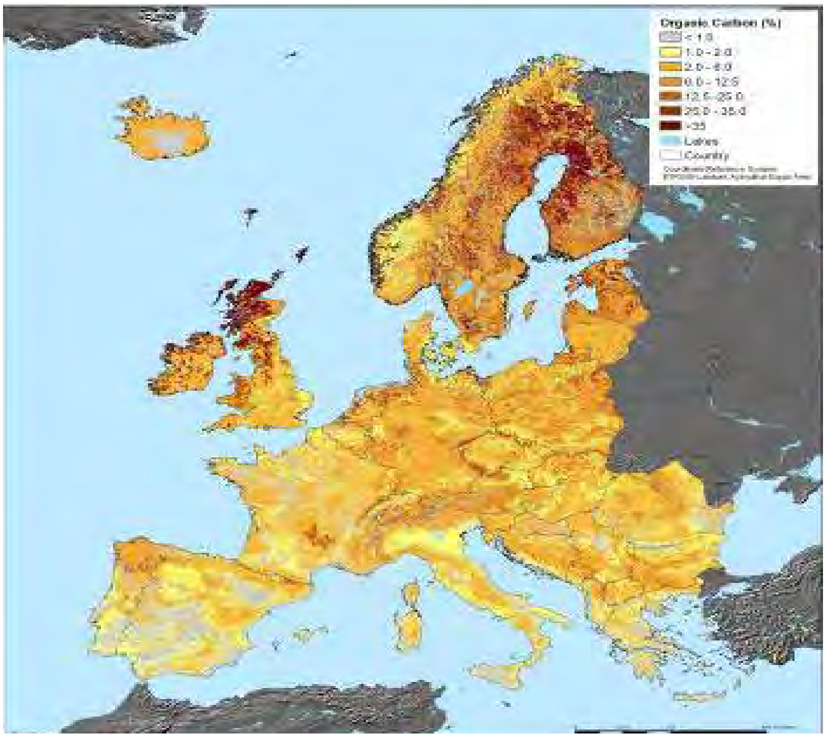
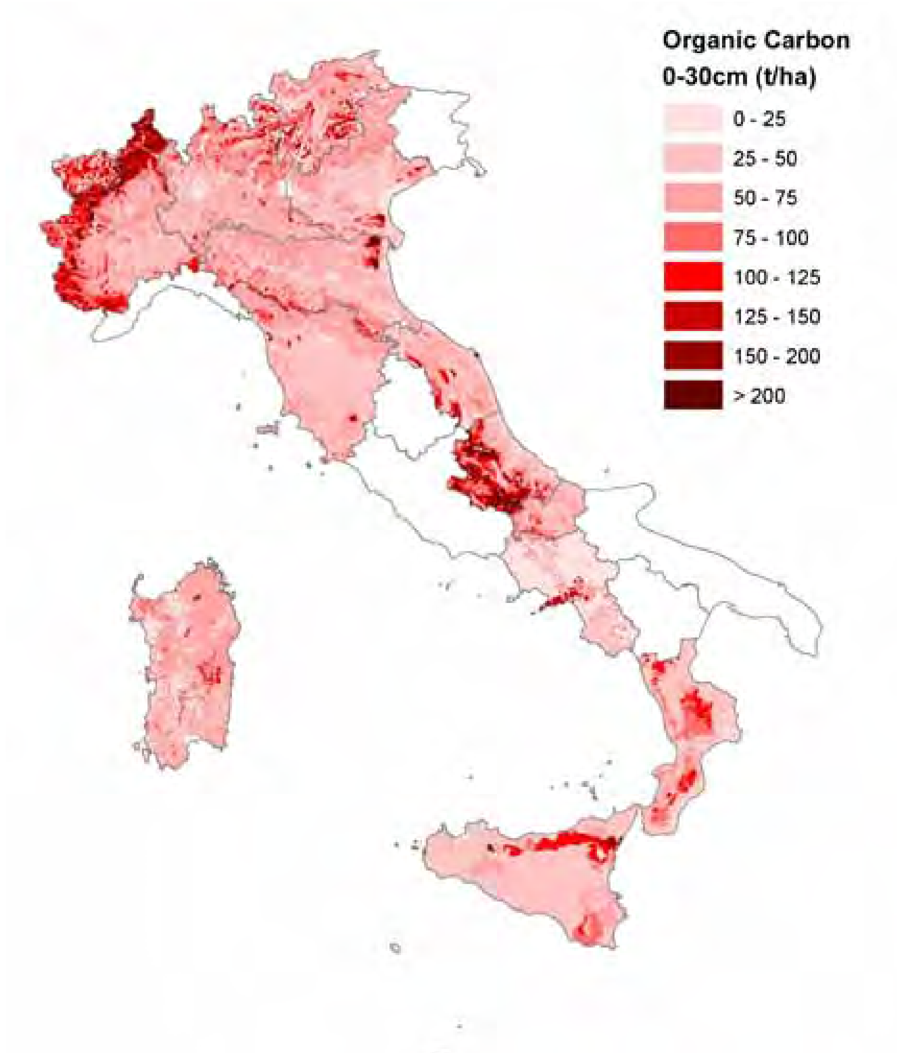


Figure 9.1: Percentage of Organic Carbon (OC) content in the surface horizon of soils in European (2003)[6]

The assessment developed at European level based on the available data, shows Italian soils in the arable crop (plain and hilly areas) organic carbon contents mainly ranging between 1 and 2%.

[6] Source: JRC



The preliminary results of the SIAS project have allowed the assessment of a detailed maps obtained through the harmonization of data owned by Regional Soil Services according to a common and shared exchange format.

Figure 9.2: OC content in tonnes (t/ha) per hectare of surface horizons of Italian soils (2012)[7]

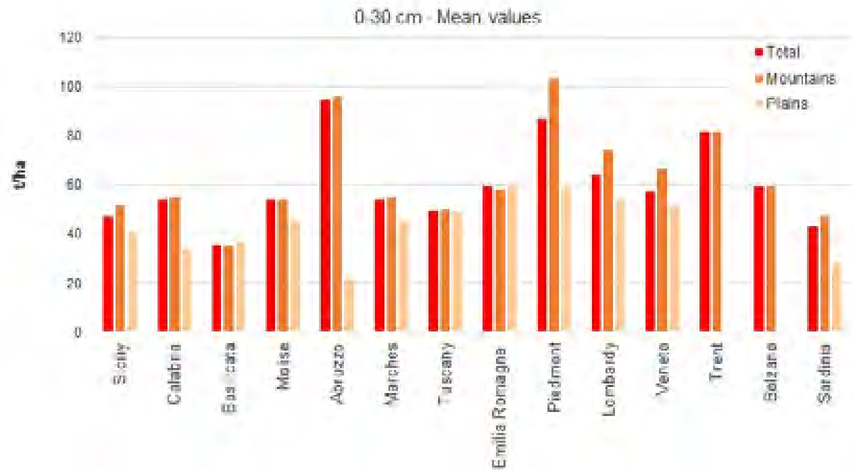


Figure 9.3: Average carbon content in mountains and plains in the top 30 cm of soil[8]

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[7] Source: ISPRA, ARPAV and Regional Services for the Soil (SIAS Project)

[8] Source: Ibidem

Soil plays a fundamental protective function of the environment by acting like a filter and a barrier that allows to mitigate the polluting effects.. With regard to the latter term, a clarification is necessary according to the proposal by Williamson (1973)[9]: a contaminant is “everything added to the environment causing a deviation from the average geochemical composition”.

Soil plays a fundamental protective function of the environment, by mitigating the polluting effects.

The pollutant, in order to be considered as such, must be a contaminant responsible for causing harmful effects to the environment, meant, in a broad sense, as a union of both natural and anthropic parts.

Legislative Decree 128/2010 defines pollution as “the direct or indirect introduction, through human activity, of substances, vibrations, heat or noise, or more generally physical or chemical agents, into the air, water or soil, that could damage human health or the environment quality, cause the deterioration of material goods, or damages or disturbances to recreational values of the environment or to its other legitimate uses”.

Therefore, in case of voluntary or accidental introduction of hazardous substances into the soil, if they exceed the concentrations deemed potentially harmful we should talk about soil pollution and not contamination.

However, the terms soil contamination, contaminated sites and remediation of contaminated sites, are now commonly used to indicate pollution and the remediation of soils, also in national (Legislative Decree 152/06) and international rules and regulations, and will therefore be used in this chapter.

Soil contamination can determine an alteration of soil features, such as to impair not only its protective functions, but its production and ecological functions as well.

The protective, productive and ecological functions of the soil may be impaired as a result of its contamination.

Soil contamination also affect surface water, groundwater, atmosphere and food chain, posing risks, even serious ones, for human health.

The economic consequences are related mainly to the huge financial commitments needed for the remediation and environmental recovery of the soil, but also to the loss of value of the contaminated areas, to the need for measures on environmental media indirectly affected by the impacts of soil contamination (particularly groundwater) and the possible rejection by consumers of products grown on polluted soils.

According to the data contained in the Impact Evaluation (SEC (2006)1165) of the Thematic Strategy for Soil Protection (COM (2006) 231) carried out by the European Commission, the annual cost of soil contamination ranges between 2.4 and 17.3 billion euro.

Contamination can be local or diffuse. Local (or punctual) contamination of the soil is confined to limited areas close to known sources of contamination (contaminated sites). Diffuse contamination of soils, on the other hand, can be due to the presence of contaminating substances of unidentifiable origin or to the presence of multiple sources, e.g. farming methods, vehicle traffic, natural processes of the transport and diffusion of contaminants.

Contamination can affect limited areas (local) or vast areas (diffuse).

[9] Williamson S. J. (1973), *Fundamentals of Air Pollution*. Addison-Wesley, Reading, 472 pp

The contaminated Sites of National Interest ("SIN") have been defined by specific statutory provisions on the basis of the characteristics of the site, the quantity and hazardousness of the pollutants, the extent of the health and ecological risks, and the detriment to cultural and environmental goods. Administrative responsibility for remediation procedures for these sites lies within the competence of Ministry of the Environment and protection of Land and Sea (MATTM).
The criteria for determining the SIN were recently rationalised by art. 36 bis of Law no. 134 of 07 August 2012.
In pursuance of that change in regulations, the current and/or prior existence of refineries, steel mills and integrated chemical facilities is a necessary requirement for a site to be identified as of national interest. On the other hand, the presence of asbestos mining and/or production activities is sufficient grounds for determining that a site is of national interest.
Based on these criteria, the 57 sites currently classified as of national interest were reviewed and their number was reduced to 39 by a Ministerial Decree of 11 January 2013 (Figure 9.4).
Administrative responsibility for the 18 sites that do not meet new criteria is assigned to the regions.

There are 39 contaminated Sites of National Interest. The MATTM is responsible for the administrative management of remediation procedures.

The Sites of National Interest are concentrated in areas subject to high anthropic impact.

Note
A Min. Dec. of 11/01/2013 reduced the number of SIN from 57 to 39

Figure 9.4: Location, areas and relevant legislations of the Sites of National Interest (2013)[10]

[10] Source: ISPRA

Besides the Sites of National Interest (SIN), there are also several thousand contaminated or potentially contaminated sites of regional competence that, according to the regulations in force, should be included in “Regional registers of sites to be remediated”.

Brownfields are abandoned, inactive or underused sites that in the past hosted production activities, usually industrial or commercial, and for which remediation is hindered by an actual or potential situation of long-standing pollution. Such sites are often located in urban areas and therefore have a high economic potential.

There are about 32.000 potentially contaminated sites. The state of contamination has been verified for 4,837 of them. To date over 3,088 sites have been remediated.

In Italy, the regions with the highest number of brownfields are in the North, particularly Lombardy, Piedmont and Veneto, due to the intense industrial development of the past decades.

On the other hand, the southern and central regions are characterized by a small number of large industrial areas

With regard to diffuse contamination, a uniform nationwide overview is still lacking, even if problems related to this phenomenon exist in almost all the Italian regions. There are high concentrations of heavy metals near road infrastructures (Pb), in winegrowing districts (Cu) and in farming areas.

There are cases of widespread contamination in almost every region but there is still no uniform nationwide overview.

With regard to pollution from nutrients, data available show a surplus of both nitrogen and phosphorus in almost every Italian region, with a progressively decreasing trend.

The highest values are recorded in intensive agricultural areas, in particular in some regions of the Po Valley. Although agricultural use of sewage sludge has positive effects in supplying partially stabilised organic substances and macro-nutrients, mainly present in organic form and therefore released slowly, it can lead to soil pollution problems. In fact, sludge contains heavy metals that can accumulate in the soil, even though some of them (such as copper and zinc) are microelements that are good for the vegetable cycle in small doses. According to the official data sent to the EC by the MATTM, the use of sewage sludge in agriculture increased by 49% during period 1998-2009, coming to 289,620 t of dry substance. In 2009, the greatest use was in Lombardy (38%), Apulia (32%) and Emilia-Romagna (18%), which taken together account for 88% of the national total.

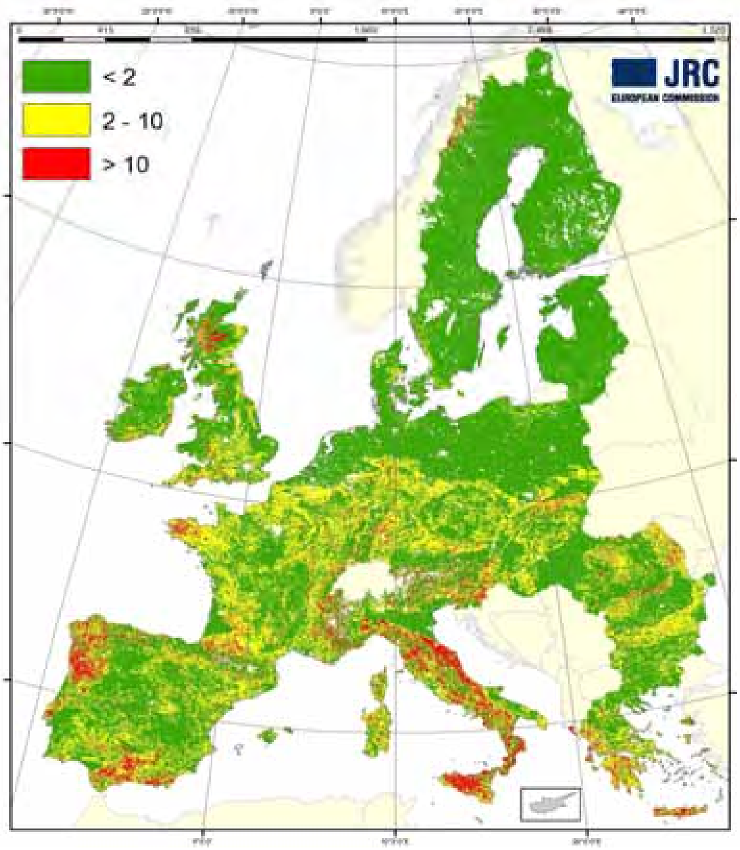
According to ministerial data, the emissions of polluting substances seems to be limited and during the period 1998-2009 the limits set by national and European laws were never exceeded.

Soil erosion by water has a high environmental and economic relevance, i.e. the removal of its top layer, which is rich in organic matter, by means of surface runoff. Damage caused by erosion is usually classified as damage appearing in the place where it occurs (on-site damage), which leads to the loss of soil, fertility, biodiversity etc., and damage taking place in areas far from those in which the erosion occurs (off-site damage); the final result are floods, damage to infrastructures, pollution of surface water due to the transportation of pollution by surface runoff etc.

Soil erosion by water causes the loss of soil, fertility and biodiversity.

Limiting this damage often requires correction measures that can be economically expensive, particularly in valuable cropland. Therefore one of the priorities in evaluating soil erosion should be the definition of the “tolerable erosion factor”. This value (t/ha*year) indicates the

amount of soil that can be lost while maintaining a good level of production. In agricultural areas, for example, an effort can be made to keep erosion within certain limits required by that particular soil environment so that it does not exceed the soil formation speed (pedogenesis).
The assessment of soil loss is based on models that are either empirical (e.g. USLE/RUSLE – Universal Soil Loss Equation/ Revised USLE) or physically based (e.g. PESERA – Pan-European Soil Erosion Risk Assessment). These estimates, affected by the approximations of the data and the scarcity of experimental stations for measuring and validating it, are still a benchmark for European and Italian planning, particularly with regard to rural development.
According to the application of RUSLE model, the area affected by the phenomenon in EU-27 comes to 1.3 million km^2, about 20% of which suffer a soil loss of more than 10t/ha/year[11].
The percentage increases in the Mediterranean region and it comes to around 30% in Italy (Figure 9.5), where soil loss reaches very high rates when there are particularly intense meteoric events.
In any case a more accurate representation, since it is based on the more detailed data available at the local level, is under preparation within the above mentioned SIAS project for harmonising regional information (Figure 9.6).



Soil loss by water erosion is generally assessed by using models Although these estimates give an interesting general information at European level, they can sometimes show results that are quite different from national/regional elaboration. .

Figure 9.5: Estimate of actual soil loss by erosion according to RUSLE model reclassified and subdivided into three classes[12]

[11] Commission of the European Community (2012) – *Implementation of the soil thematic strategy*. COM (2012) 46 final
[12] Source: JRC figures in: Commission of the European Community (2012) - *Implementation of the soil thematic strategy*. COM (2012) 46 final

SIAS project: harmonisation of data related to soil loss by water erosion based on the data available at regional soil services, using a common and shared format according to INSPIRE Directive.

Figure 9.6: Estimate of the actual soil loss by water erosion according to SIAS project (2012)[13]

If models sometimes give contradictory data, quantitative definition of the trend is even more difficult. The progressive increase in woodland areas at the expense of cropland, shown by studies related to land use change, points to a substantial reduction of the phenomenon in mountain areas. On the contrary, the intensification of mechanisation in hill agricultural areas and the spread of fires lead us to expect an increase in the phenomenon, also related to the increase in the erosivity of the rainfall recorded in recent years, with heavier rainstorms and events coming much closer together. Data regarding the effectiveness of the agro-environmental measures introduced by the new Common Agricultural Policy (CAP) and foreseen in the national Strategic Plan for rural development, show a significant reduction in erosion following application of those measures.

[13] Source: ISPRA, ARPAV and the regional services for the soil (SIAS project)

Soil salinisation, in other words the accumulation of salt in the soil, due to natural and anthropic causes, is particularly widespread in coastal areas and the salt can reach a level that compromises crop vegetation and production and has very negative effects on soil biodiversity and its resistance to erosion.
This phenomenon is considered one of the main factors leading to desertification and, in Europe (EU27), the JRC estimates that between 1 and 3 million hectares are affected by it.
In Italy there are still no detailed maps showing the characteristics and distribution of saline soils.
According to the results of a survey they are mainly found in the lower Po Valley, inlong stretches of the Tyrrhenian and Adriatic coasts, in the coasts of Apulia, Basilicata and Sardinia, and in large areas of Sicily (Figure 9.7). Several regions have produced more detailed documents.

Soil salinisation consists in the accumulation of salt in the soil so as to compromise its vital functions and is considered one of the main factors of desertification. It is estimated that in Europe (EU27) between 1 and 3 million hectares are affected by this phenomenon.

Figure 9.7: Distribution of saline soils (red areas) in Italy[14]

In Italy, saline soils are mainly distributed in the lower Po Valley, in long part of the Tyrrhenian and Adriatic coasts, on the coasts of Apulia, Basilicata and Sardinia and in large areas of Sicily.

In Veneto the phenomenon has been investigated in an area at about 25 km from the coast (Figure 9.8). Electrical conductivity values have been measured at three different depths: surface horizon (0-50 cm), deep horizon (50-100 cm) and the subsoil (more than 100 cm).
The data analysis showed that salinity, when present, is higher in the deep horizons than the surface ones and that the highest values are found in soils with a high organic matter content (in particular the remediated marsh areas of Adige and Po).

[14] Source: C. Dazzi, (2007), La salinizzazione. In: *Il suolo, la radice della vita*. APAT

In Veneto, salinity is higher in the deeper horizons than the surface ones. Higher values can be found in soils with a high organic matter content (particularly in the remediated marsh areas of Adige and Po).

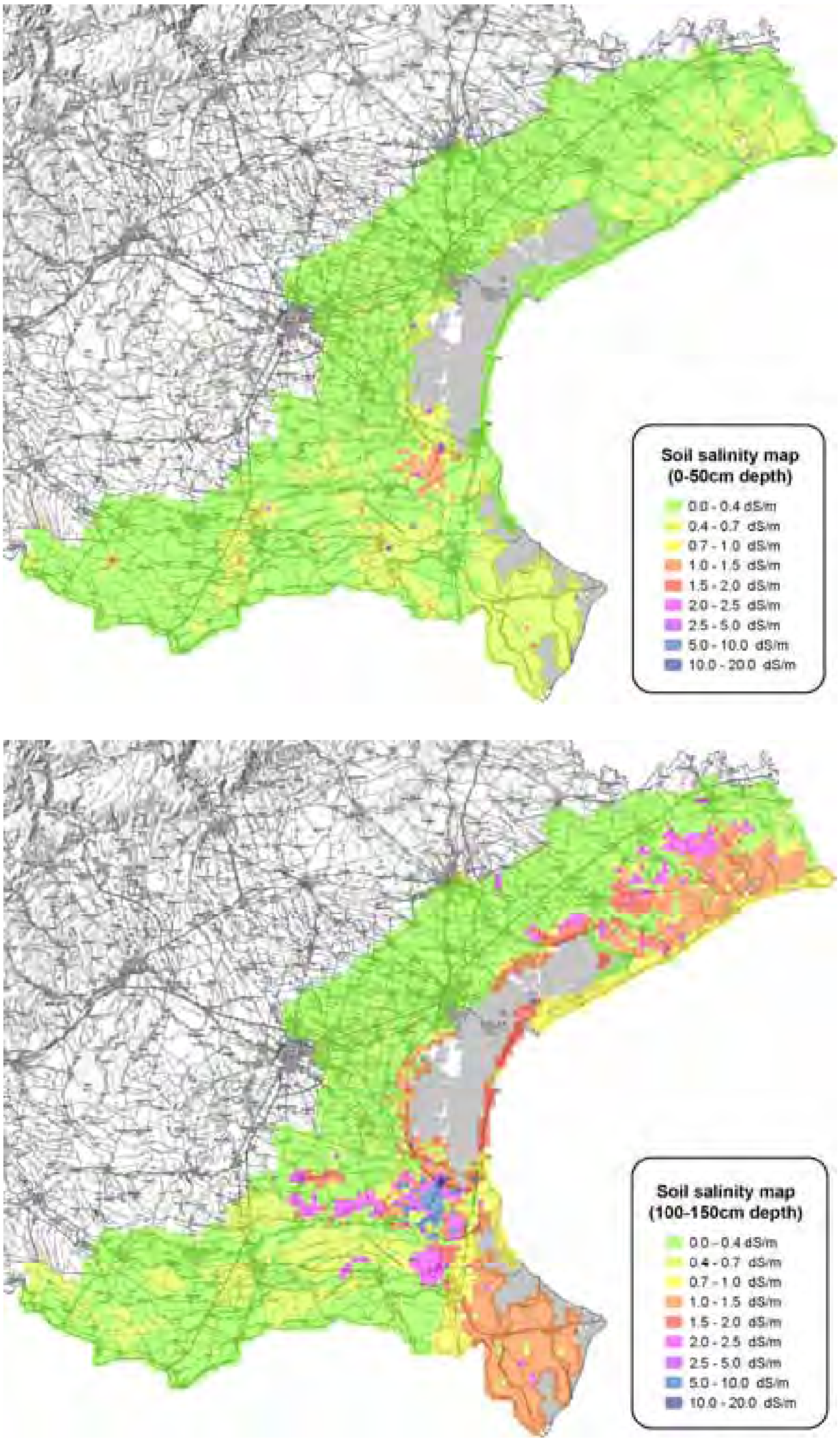


Figure 9.8: Soil salinity map in the surface horizons (0-50 cm and up) and in the substratum (100-150 cm and below) of the coastal area of the Veneto Region [15]

The intensity of soil salinisation in farming areas was also measured in Sardinia (Figure 9.9), and a model assessing the salinisation risk was made. This assessment made it possible to identify soils that, even though not showing high levels of salinity at the time of measurement, can be subjected to physical and environmental conditions that favour occurrence of the phenomenon.

[15] Source: ARPAV and CNR-IRPI, 2008

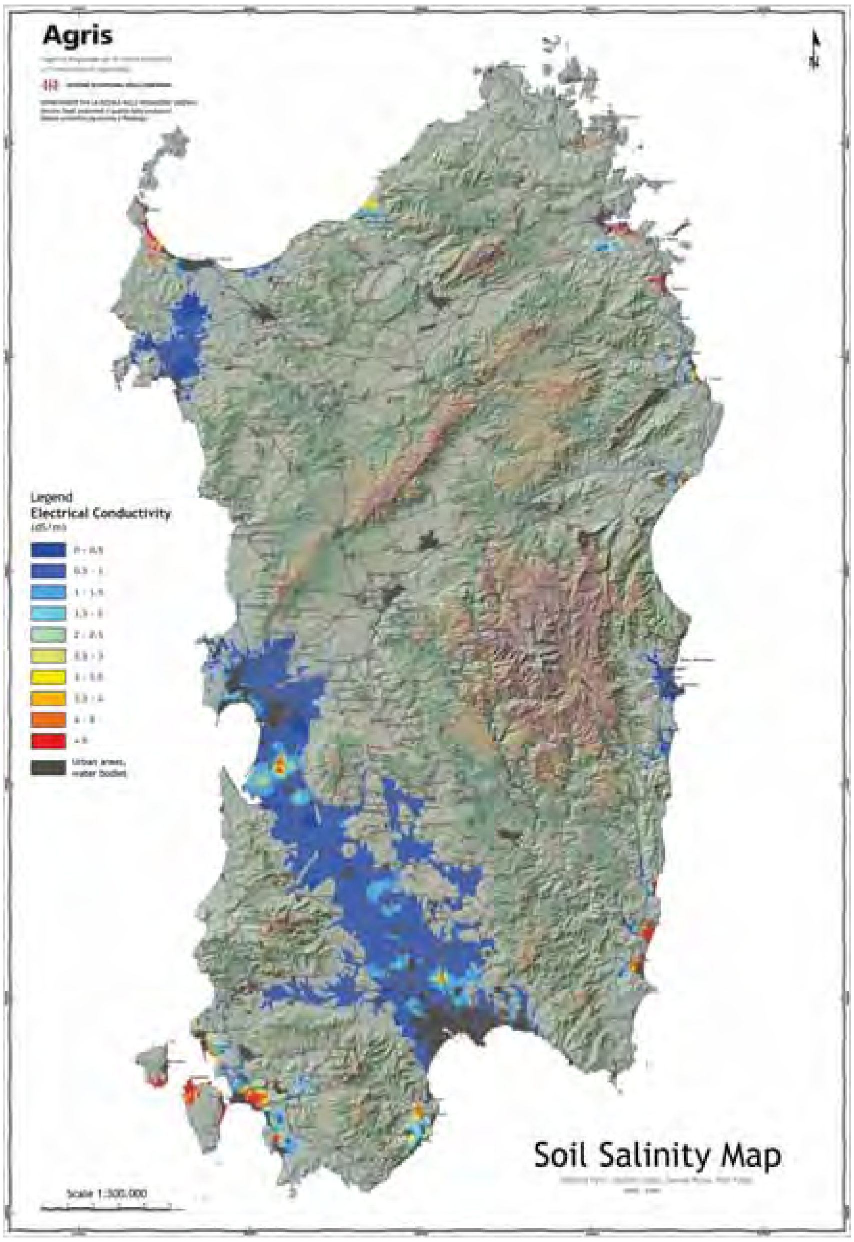


Figure 9.9: Soil salinity map in the Sardinian Region [16]

Soil compaction occurs following compression of the soil particles with reduced spaces between particles and pore continuity.

Areas where there is intensive farming can be subject to the onset of soil compaction. Compaction, mainly due to the use of agricultural machinery, can be defined as the compression of soil particles into a smaller volume due to reduction of the spaces between them. It usual happens when significant changes occur in the structural properties and behaviour of the soil, such as its thermal and water regime, and the balance and characteristics of its liquid and gas phases.

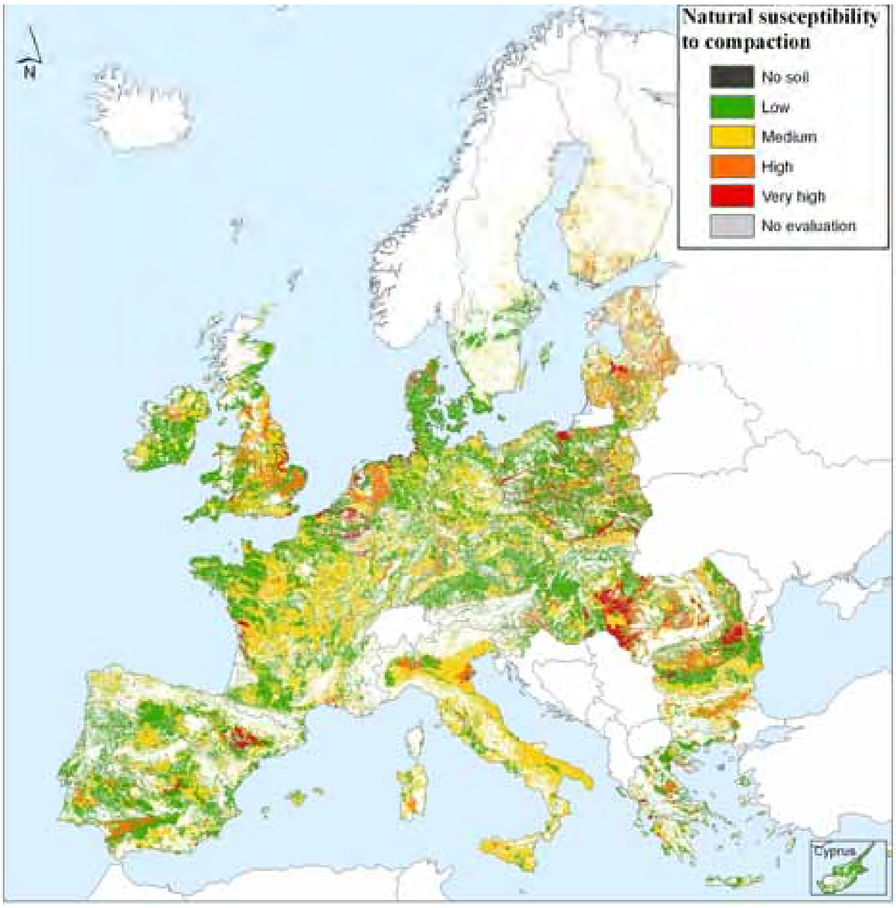
Apart from the surface layer, a compacted layer frequently forms at the working depth The result is not only a lower yield but a drastic reduction in water infiltration and consequently an increase in surface runoff.

[16] Source: AGRIS (2008) – *La salinizzazione dei suoli nelle piane agricole della Sardegna.* Autonomous Region of Sardinia

Frequent water stagnation in flat areas when there is heavy and concentrated rain and slip surfaces of landslides where there are compacted layers along the soil profile show that the problem is widespread in Italian farming areas, both plains and hills. However, there is very little quantitative data and it is limited to only a few areas studied. The only available national maps are related to the natural susceptibility to compaction of the soils, elaborated by JRC-IES European , which, however, does not give information on the actual extent of the phenomenon (Figure 9.10).

Soil compaction is considered an important factor in the great floods that have affected different European countries in the past years.

At a continental level, compaction is generally considered an important factor of the great Northern European floods of recent years, but there are still not enough studies on the actual incidence of the phenomenon in the amplification of river flooding in Italy.



Most Italian soils have medium-high susceptibility to compaction. However, more detailed studies are needed in order to assess the actual extent of the problem and its influence on floods in Italy.

Figure 9.10: Natural susceptibility to compaction of European soils (2007)[17]

With regard to land cover, a comparison of the Corine Land Cover 1990, 2000 and 2006 data (even though the minimum mapping unit is limited to 25 hectares, which does not allow the evaluation of the development of scattered urbanisation and the minor road network) enabled us to outline a trend that further shows, at the national level, a general increase in built-up areas in former agricultural areas and, to a lesser extent, of woodlands and semi-natural areas.

In Italy, like in the rest of Europe, agricultural land are shrinking due to the effect of the opposite trend of leaving the land and of

[17] Source: JRC -IES

urbanisation, with a gradual trend towards specialised farming and a reduction in the areas occupied by traditional mixed systems.

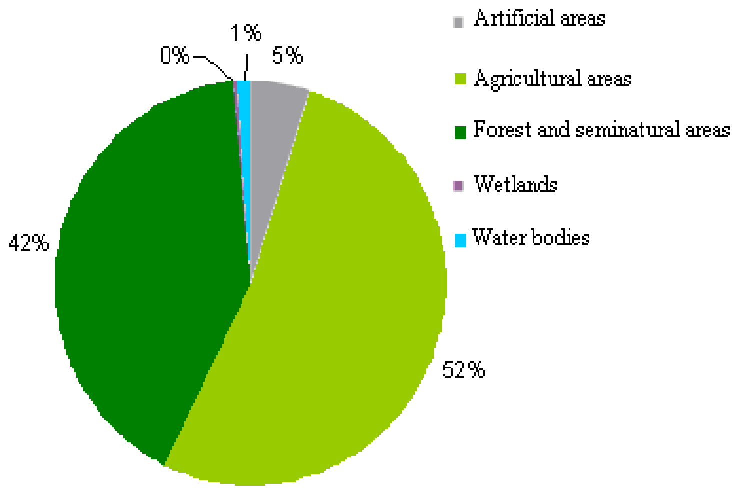
Therefore during the 1990-2006 period there was a progressive reduction in areas used for farming (143,000 hectares less between 1990 and 2000 and 40,000 between 2000 and 2006), with a recovery of woodlands or semi-natural soils.

During the period 1990-2000 143,000 hectares of agricultural areas were lost; another 40,000 hectares were lost between 2000 and 2006.

The increase in artificial areas, particularly in some Italian regions and in highly fertile farmland, is assuming alarming proportions because it involves the irreversible loss of the resource and of the related environmental functions (see special focus box).

In 2006, the regions with the highest percentage of artificial areas (> 6%) were Lombardy, Veneto, Friuli-Venezia Giulia, Campania and Latium while the less urbanised ones (< 2%) were Molise, Basilicata and Aosta Valley.

More than half the Italian territory consists of farming areas but 183 hectares of that area were lost during the period 1990-2006.



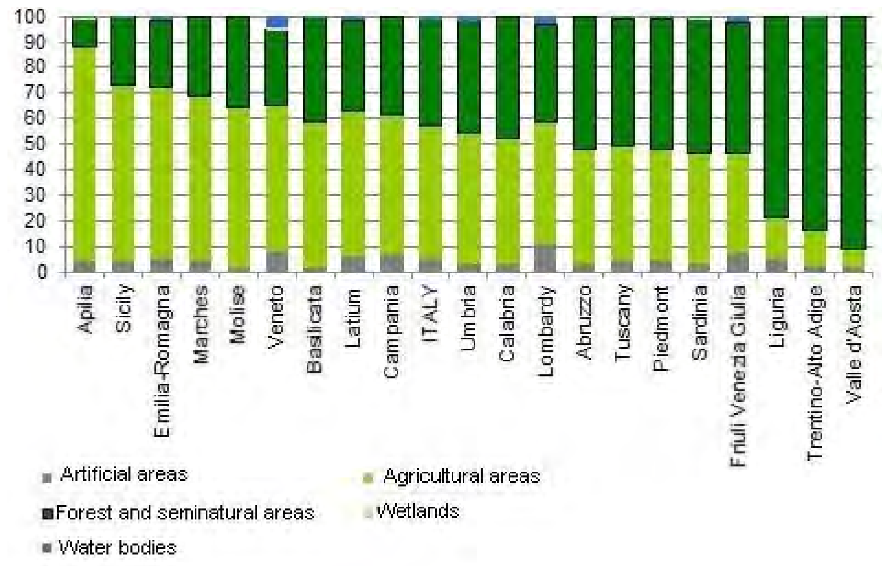


Figure 9.11: Percentage distribution of land cover for CLC first level classes at the national and regional levels (2006)[18]

[18] Source: ISPRA

The progressive loss of soil biodiversity is related to the above-mentioned phenomena.

The soil is a very complex habitat for the very high number of organisms, mainly concentrated in the topsoil. In the complex three-dimensional matrix of the soil, these organisms interact forming a close-knit food network, giving rise to a complex system of biological activities.

They actively contribute to many critical functions for the ecosystem, such as: soil formation water and nutrients retention capacity; the decomposition of organic matter and consequently the availability of the elements contained; nitrogen fixation and carbon sink; the suppression or induction of plant parasites and diseases, through biological processes (bioremediation) of contaminated and degraded soils (through contaminant detoxifying processes and the restoration of the properties and of physical, chemical and biological processes).

The organisms that populate the soil play an invaluable environmental role, but only a very small percentage of the species is known.

Despite their importance only a very small percentage of organisms that live in the soil has been identified and classified, to date, and with regard to the most known species, much basic information is still lacking even about the better known species (taxonomy, status, breakdown, dynamics).

A higher number of invertebrate species in the soil than in other European countries has been recorded in Italy.

For its varied geological, climatic, morphological and vegetation features, Italy is the European country with the highest biodiversity of soil. An edaphic biodiversity is associated to this diversification, which, according to censuses conducted (Table 9.1), reaches values ranging from two to ten times that of other European countries.

At present, lacking a specific monitoring network, the precise distribution cannot be known and the extent of the populations cannot be quantified.

In order to make up for this deficiency , also in relation to the requests coming from the European Community, ISPRA created a working group for the planning of this network; experts of other Institute and representatives of many public and private sectors are taking part in the group.

The first document produced[19] contains the proposal for the National Monitoring Network (ReMo).

It can be stated that, in Italy, the areas subject to a loss of soil biodiversity mainly correspond

to the areas concerned also by the other above mentioned threats. Nevertheless, the information already available in the literature shows that inside the protected areas is a huge number of edaphic organisms

[19] REMO Programme. Rete nazionale monitoraggio biodiversità e degrado dei suoli, Quaderni *Natura e Biodiversità* 4/2012, http://www.isprambiente.gov.it/it/pubblicazioni/quaderni/natura-e-biodiversita/ programma-re-mo-rete-nazionale-monitoraggio-biodiversita-e-degrado-dei-suoli

Table 9.1: Number of Italian arthropod families and species highlighting classes more related to soil[20]

Class	Families	Species
	no.	
Arachnida	351	4,618
Symphyla	2	19
Pauropoda	3	43
Chilopoda	11	155
Diplopoda	28	473
Protura	6	31
Diplura	5	76
Collembola	18	419
Insecta	623	36,853

In line with the Thematic Strategy for soil protection (COM (2006) 231), the final stage of the soil degradation processes is called desertification. In the collective imagination, this term is wrongly associated with the expansion process of sandy deserts (more precisely defined as desertisation), which is taking place in various parts of the world, from Africa to China.

Desertification, however, means "land degradation of in arid, semi-arid and dry sub-humid areas, resulting from various factors, including climatic variations and human activities"[21].

Desertification is the last stage of soil degradation processes.

The lack of a shared methodology, adopted at both the global and local level, makes it difficult to assess the intensity and extent of desertification and, above all, does not permit comparisons between analysis and results obtained so far.

Among the most used methodologies is the ESA (*Environmentally Sensitive Areas*) model, which defines an environmental quality index varying between 1 and 2 by combining four elements (index of soil quality, climate, vegetation and land management).

Large areas of Italy are also affected by loss of soil functionality; in this regard, the most recent assessment at national scale (Figure 9.12) estimates that 10% of the Italian territory is highly vulnerable (ESAI>1.5), 49.2% has a medium vulnerability (1.3<ESAI<1.5) and 26% has low vulnerability or is not vulnerable (ESAI<1.3).

Large areas of Italian territory are affected by loss of soil functionality.

The most vulnerable areas (ESAI >1.5) are Sicily (4.9% of the regional area), Molise (24.4%), Apulia (15.4%), Basilicata (24.2%) and Sardinia (19.1%).

Six regions (Tuscany, Umbria, Marche, Abruzzo, Campania and Calabria) have a percentage of very vulnerable territory between 5% and 15%, while in all the other regions the vulnerable areas are below 5%.

The most vulnerable areas to soil degradation processes are in Sicily, Molise, Apulia, Basilicata and Sardinia.

[20] Source: MATTM, 2006. *Check-list della Fauna d'Italia*, by F. Stoch

[21] UNCCD - *United Nations Convention to Combat Desertification, Convention text, Art. 1a (1994)*

Other investigations carried out in the regions, within the activities promoted since 2004by the Italy National Committee to Combat Desertification Desertification, confirm the national situation, providing in-depth information about the most vulnerable areas and highlighting situations of particular local importance.

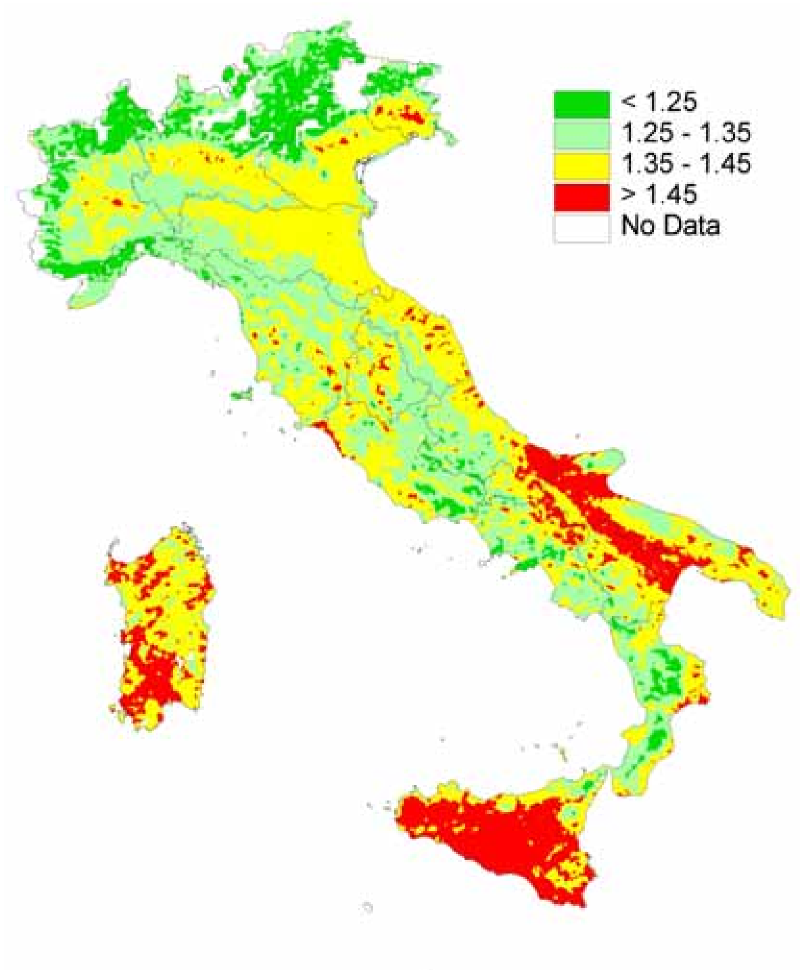


Figure 9.12 Map of the **ESA (*Environmentally Sensitive Areas*) Index (2008 on 2000 data)**[22]

In the Mediterranean area, the cartography produced by the European Environment Agency (EEA) and the ETC-LUSI (European Topic Centre Land Use and Spatial Information shows the existence of several areas with high/very high sensitivity to desertification, where might be reached a degradation level that could make them unusable for agricultural, forestry or pastoral uses (Figure 9.13).

[22] Perini L., Salvati L., Ceccarelli T., Sorrenti S. & Zitti M., 2008 – *La desertificazione in Italia. Processi, indicatori, vulnerabilità del territorio*. CRA, CNLSD, MATTM, Bonanno editore, 191 pp.

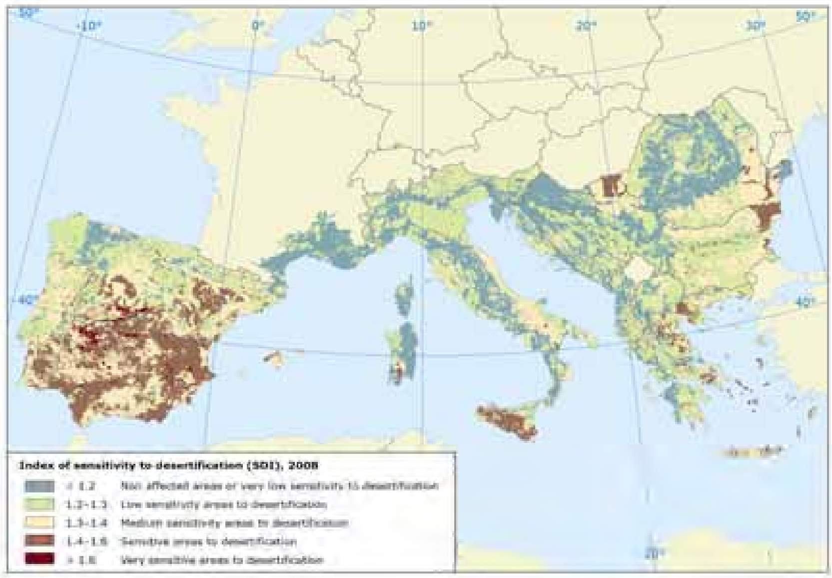


Figure 9.13: Map of Sensitivity to Desertification Index in Europe (2008)[23]

In the Mediterranean area there are several areas with high/very high sensitivity to desertification, where soil degradation could be reached such as to make them unusable for agriculture, forestry and grazing.

At the international level, the Millennium Ecosystem Assessment (MA)[24], using the concept of “ecosystem services”[25], made more operational the definition of desertification adopted by the UNCCD . The decline or improvement of various services provided by ecosystems is, in fact, the main symptom of degradation /desertification, or of the success of remediation actions, particularly in the case of services related to subsistence farming, which directly threaten the living conditions of the most vulnerable communities. In this regard, recent data show that loss of biodiversity has already started to degrade the essential processes that regulate the productivity and sustainability of Mediterranean ecosystems.

On the basis of concepts proposed by the MA, the FAO Land Degradation Assessment in Drylands (LADA) project developed the GLADIS methodology[26] to assess state and evolution of desertification and land degradation. The preliminary results are promising, although the low spatial resolution of the data makes limits the use of the available results. Six indicators were selected, relating to: biomass, biodiversity, soil health, water availability, economic and social conditions.

Global theme maps and charts on a local and national scale have been realized, using biophysical and socioeconomic parameters, with a view to giving a picture of the state of the ecosystem services and

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[23] Source: Domingues, F. and Fons-Esteve, J., 2008. *Mapping sensitivity to desertification (DISMED Project*. EEA-TC-LUSI.European Environment Agency, Copenhagen

[24] Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Desertification Synthesis*. World Resources Institute, Washington, DC

[25] Multiple benefits provided by ecosystems to humans. They can be divided into four main categories: support to life (e.g. soil formation), provisioning (e.g. food, water resources, medicines), regulating (e.g. climate regulation), cultural (e.g. cultural and religious, aesthetic and recreational, educational)

[26] LADA Technical report no. 17, *Global Land Degradation Information System (GLADIS) Version 1.0, An Information database for Land Degradation Assessment at Global Level*, September 2011

their evolutionary trend. The six indicators are calculated on the basis of satellite data, obtained from simulation models and economic and social databases. The results of the GLADIS are still being improved and verified and it is therefore not yet possible to use them on a national and sub-national scale.
The exploitation of geological resources constitutes an important socioeconomic sector.

Mining activities produce temporary impacts and permanent changes to the environment.

Minerals that are found in nature in solid (coal and minerals), liquid (oil) and gaseous (natural gas) states are extracted by underground or surface mining, or by wells[27]. Even when governed by regulations such activities are particularly invasive and produce environmental problems. In addition to temporary impacts (noise, dust, pollution, etc.), extraction can cause deep and permanent changes to the landscape, an irreparable loss of soil, possible pollution of the groundwater and a series of problems related to the intended use of abandoned areas.

2,991 mines operated during the period 1870-2010, with a peak in 1950 when 1,247 were active. Only 179 are now operating.

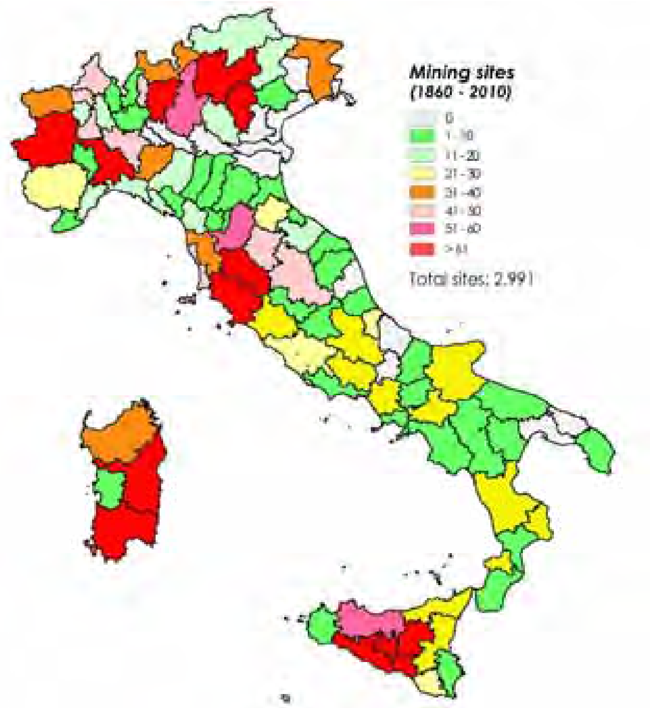


Figure 9.14: Italian mining sites (1870-2010) [28]

Mining activities has decreased considerably compared to the last century; however, the problems related to abandoned sites have not yet been solved.

Extraction of first and second category solid minerals (mines and quarries) has a particularly severe impact. In the first case, during the period 1870-2010, there were 2.991 mines in operation, each for the period of time laid down in the permit, and 88 out of 103 provinces were affected (Figure 9.14).
Mining increased until the middle of the last century and then gradually decreased to 179 mines in operation in 2010. Extraction is mainly ceramic and industrial minerals (98 mines) and marlstone (32).

[27] Classificazione delle attività economiche Ateco 2007,http://www3.istat.it/strumenti/definizioni/ateco/
[28] Source: ISPRA

In both cases Italy is a leader in European production. On the other hand, an insignificant role is played by exploitation of metal ores (11), barite and fluorite (12), halite and potassium salts (12) and other minerals (lignite, talc, steatite, graphite, bitumens etc.) (Figures 9.15 and 9.16).

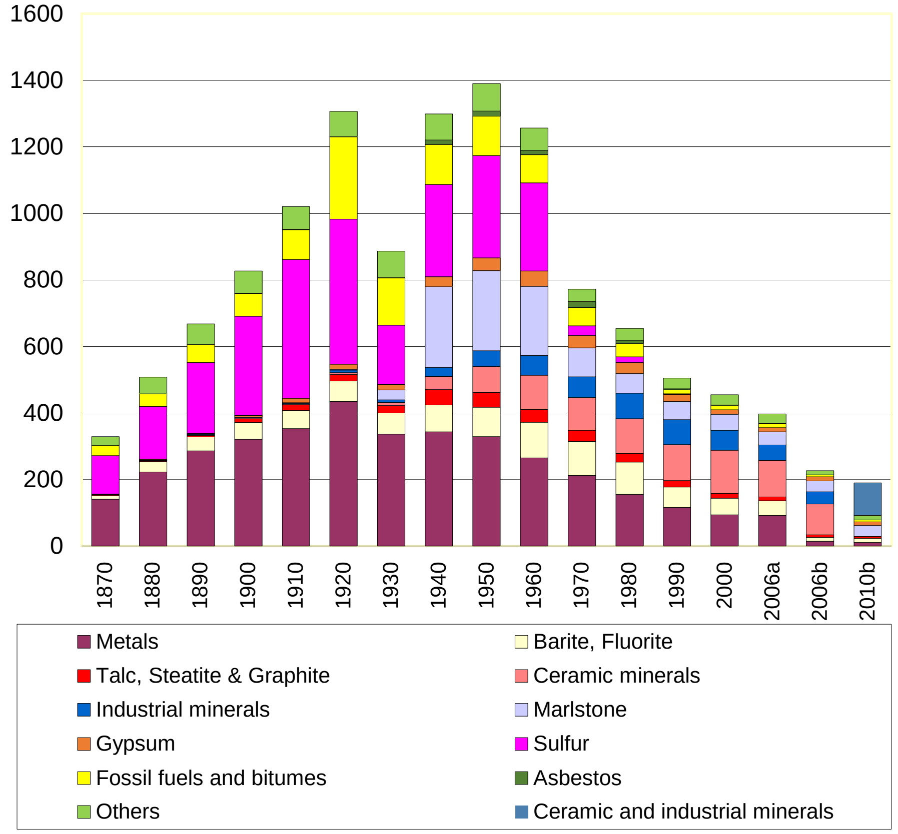


Figure 9.15: Mining sites operating between 1870 and 2010, by groups of mineral extracted[29]

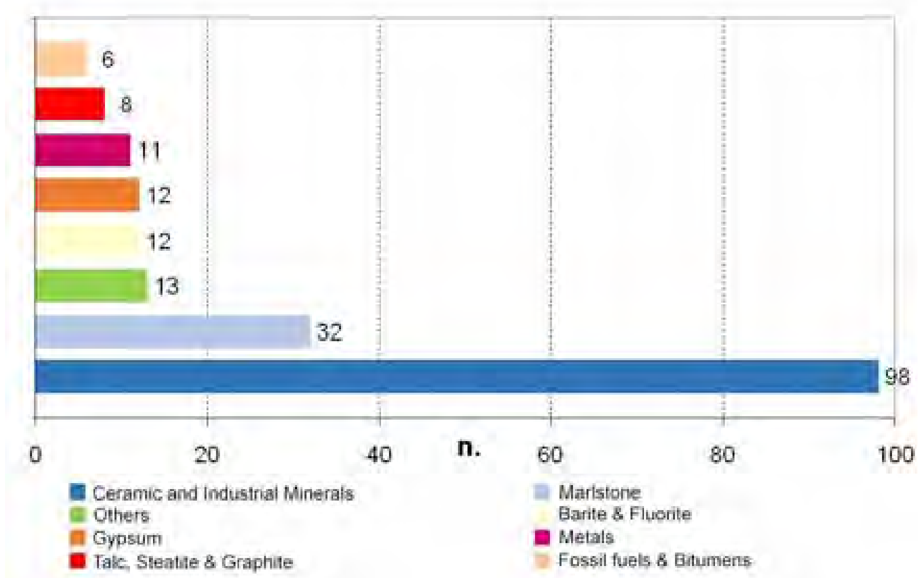


Figure 9.16: Active mines by groups of mineral extracted (2010)[30]

[29] Source: ISPRA; every site has been in operation for several years, depending on the permit granted. a) sites with an active permit b) sites actually in operation.

The drop in extraction activities, particularly mining of metal ores the waste of which contains high concentrations of pollutants, has certainly mitigated the pressure of mining on the land. Nevertheless, the ecological, health, static and structural problems relating to the hundreds of abandoned mining sites and related dumps and washing plants, which, have not yet been remedied, remain unsolved .

With regard to quarries, according to data collected at the competent regional offices about 5,500 are operating in the counry of which more than 60% extract alluvial materials and carbonate rock.

The regions with the highest number of quarries are: Lombardy, Veneto, Piedmont (where extraction of alluvial material is highly developed), Apulia (where extraction of limestone predominates), Sicily, Sardinia, and Tuscany (with the highest number of metamorphic rock quarries, due to the marble quarrying in the Apuan Alps area (Figure 9.17).

At present, it is not possible to describe the situation of the thousands of disused or illegal quarries, which can lead serious environmental problems related to their condition.

There are operational quarries in various parts of the country; it is not yet possible to outline the situation of the disused or illegal sites.

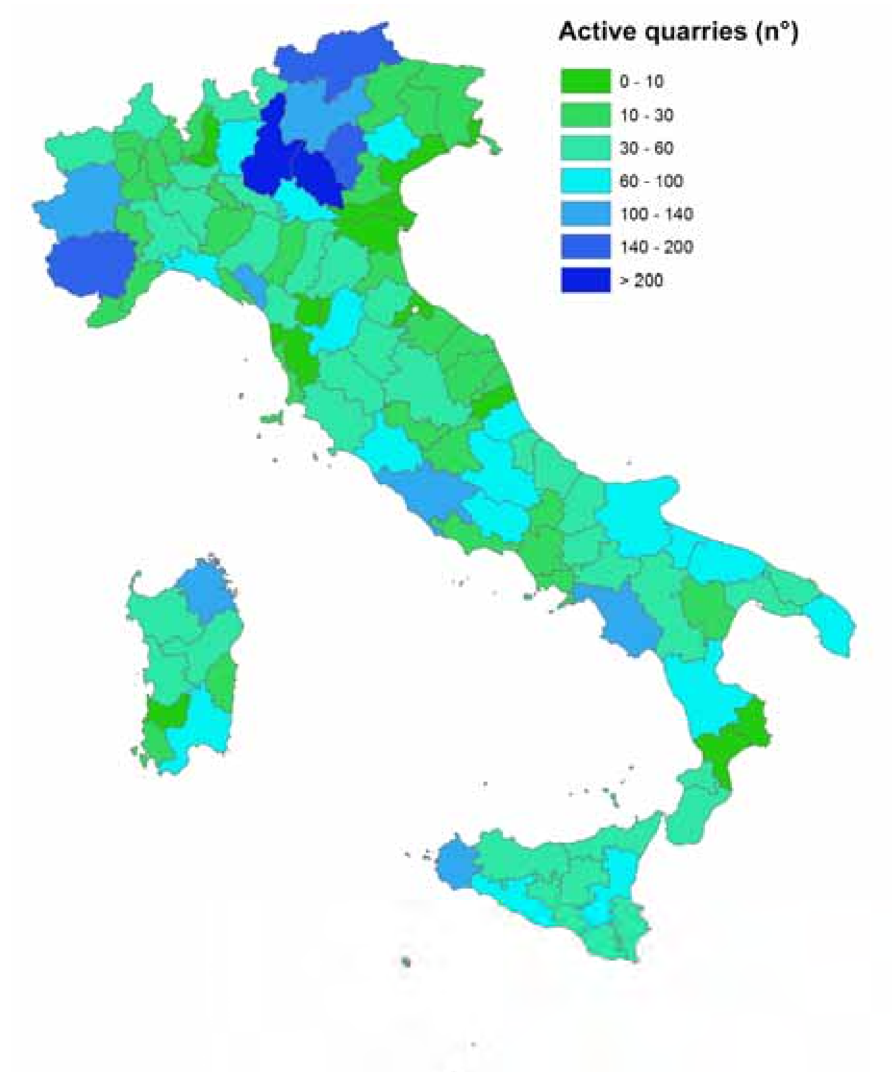


Figure 9.17: Active quarries in Italy (2012)[31]

The regions with the highest number of active quarries are Veneto, Lombardy and Piedmont in the North, Sicily and Apulia in the South. The provinces of Vicenza, Verona, Brescia, Cuneo and Bolzano have more than 150 active quarries.

[30] Source: ISPRA

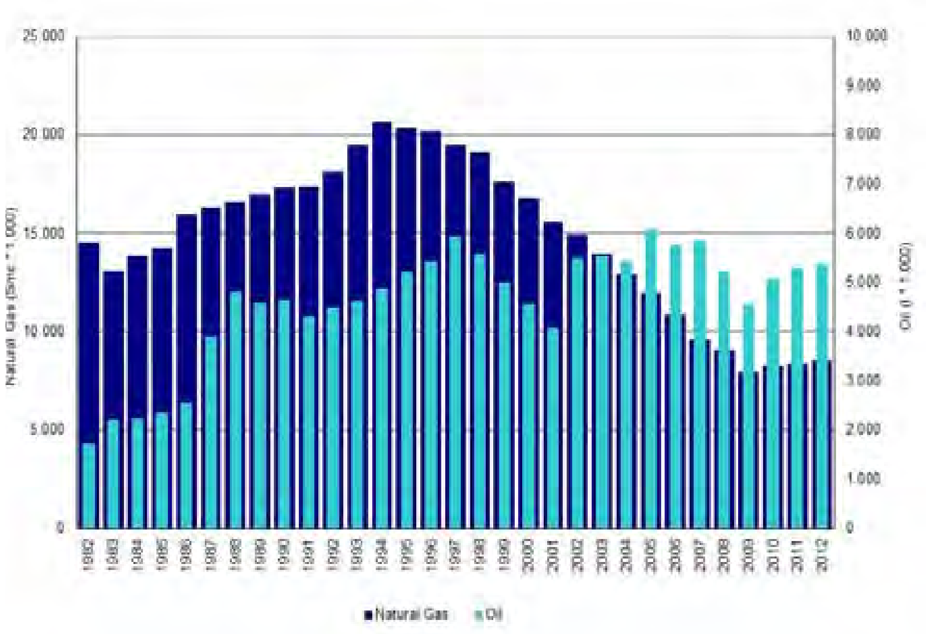
[31] Source: Ibidem

With regard to the extraction of energy resources, the most important fields are located in Basilicata (75% of the oil and 12% of the natural gas), Sicily (10% oil and 4% gas) and offshore in the Adriatic where the maximum production of natural gas is recorded (52% in zone A, 14% in B and 10% in D, corresponding to the Northern, Central and Southern Adriatic). At the end of 2011 the recoverable reserves with a probability of more than 50% were estimated at about $187*10^6$ t of oil and $123*10^9$ Sm^3 of natural gas, an important increase compared to previous estimates. Gas production was quite stable in 2012, while, in relation to the resumption of activity in the fields on land, oil production continues to increase (Figure 9.18). Attention is also drawn to the start of Ministry of Economic Development/ISPRA cooperation for the controls required by the AIA (environmental integrated permit) for offshore plants.

Oil production is highest in Basilicata, while natural gas mainly comes from the Northern Adriatic. Geothermal steam is only produced in Tuscany.

An important partial alternative to fossil fuels is exploitation of the earth's heat, which can be extracted from the subsoil (geothermics) and used to produce electricity (high and medium enthalpy resources, T>90°) or for direct use (medium and low enthalpy, T<90°).

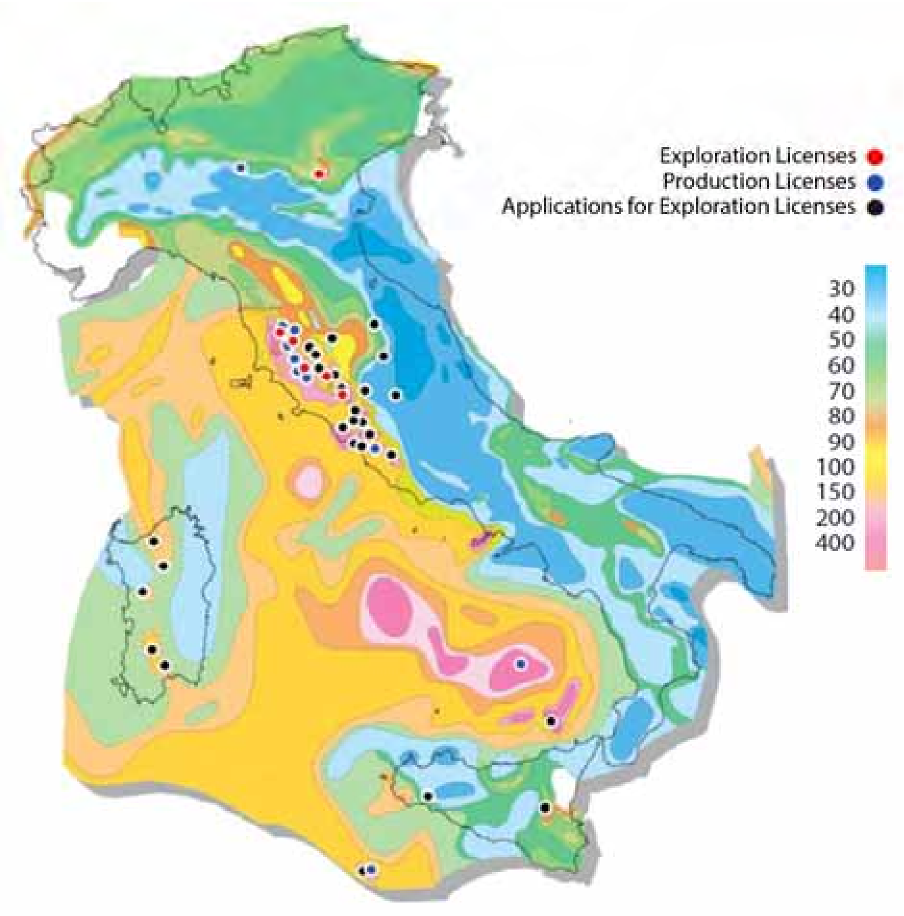
In Italy, the high enthalpy resources are mainly located in the volcanic areas of the Tyrrhenian coast and characterised by great anomalies in the heat flow, where two areas are being exploited, both located in Southern Tuscany (Larderello-Travale/Radicondoli and Monte Amiata). Interest in the production of energy from a geothermal source is growing steadily, as can be seen from the increase in the number of research concessions (Figure 9.19). Exploitation of geothermal energy also has considerable environmental impacts, although much lower than those from traditional energy sources. The environmental situation of the Tuscan fields is therefore constantly monitored by the ARPA (regional Agency for environmental protection).



Production of natural gas has been decreasing since 1994 due to the decline of the old fields, not replaced by new discoveries. There has been an increase in oil production in the last few years.

Figure 9.18: National production of oil and natural gas [32]

[32] Source: Ministry of Economic Development data processed by ISPRA



Interest in energy production from geothermal source is growing.

Figure 9.19: Heat flow map of Italy (mW/m^2) and areas where there are current mining rights[33]

Important information regarding the composition of the subsoil and about the groundwater can be found in the database on excavation, wells, drilling and geophysical surveys made for deep water searches exceeding 30 metres from ground level prepared by the ISPRA in accordance with Law 464/84.

In accordance to Law 464/84 the database has improved knowledge of the geological and hydro-geological structure of the country.

The data show a strong incidence of the use of water for irrigation purposes (about 50%) primarily in flat areas (0-20°).

There is a certain unevenness in the database related to the different degrees of compliance with the law, although, following an information campaign promoted by the ISPRA, there has been an increase in the flow of communications received and therefore better statistical relevance of the geographical breakdown of the data, during the last few years (except for 2010).

As well as performing functions that are essential for human existence (from fertility to geo-resources), the soil and subsoil are also an important cultural asset and, like all cultural assets, have been considered by lawmakers as a geological heritage.

[33] Source: MSE-CNR. VIGOR Project, Valutazione del potenziale geotermico delle regioni della Convergenza

In Italy, about 3,000 geosites have been counted and recorded.

This expression means all the sites of particular geological resources (geosites) with characteristics which allow to know, study and interpret the geological history of an area and for which there is an interest in conservation (Wimbledon, 1996).

These places are often of particular importance for their scenery cultural, educational and recreational appeal. In some cases, they offer opportunities for sustainable local development, through the promotion of geotourism for instance, whereas in other cases their scientific value takes priority.

In 2002 the ISPRA (ex APAT) started a project called *Inventario dei Geositi italiani* (Inventory of Italian geosites) aimed at knowledge about the country's geological heritage.

The target of the work is to create a national centre for collecting data and metadata on sites of geological interest, an information and coordination centre for knowledge about, improvement and protection of the geological heritage and for providing the Public Administration with a tool for regional planning.

The information in the inventory related to the Italian geosites is available on the "*Geositi*" geodatabase, freely consultable on the ISPRA website[34].

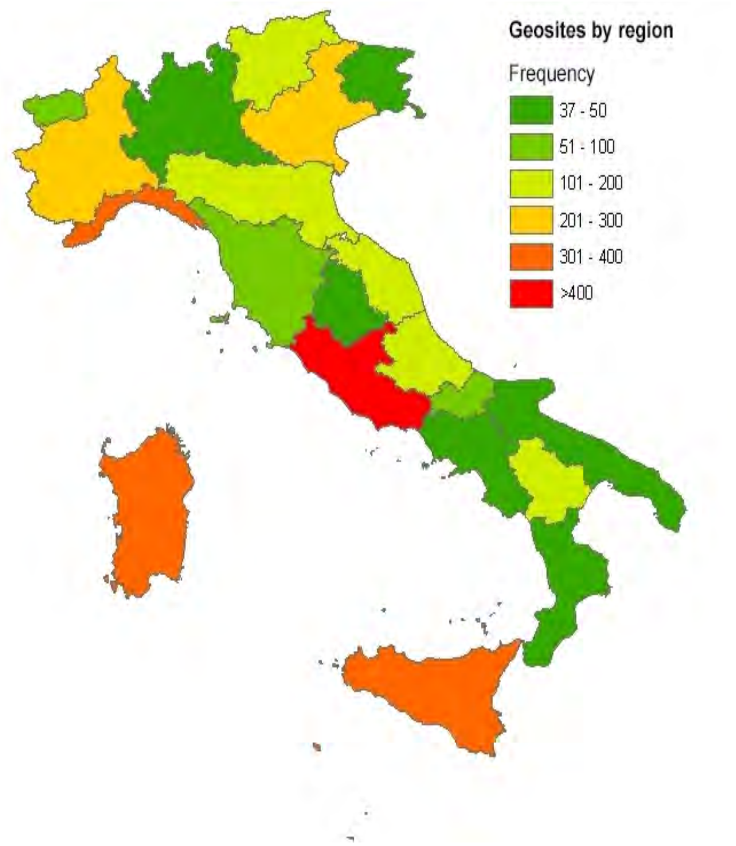
Text-based and geographic searches can be made and the latter make it possible to identify the geosites on a map of Italy with access to each descriptive file.

The geodatabase contains data related to about 3000 geosites, but the quality of the data varies from Region to Region and the content is constantly being revised.

In fact, during the initial phase of the project data was collected on a bibliographic basis and following reports sent by Research Bodies, Universities, independent professionals and students. However, many reports need to be verified in the field.

At present the data collection work is being done by the ISPRA in collaboration with Regions and local administrations and the technical form can be downloaded from the ISPRA website. When the forms are received by the ISPRA they are checked for form and substance and completion is requested where necessary; if approved, they are entered in the *Geositi* geodatabase.

[34] http://sgi2.isprambiente.it/geositiweb/



The registered geosites differ among regions , also in relation to the progress of the inventory

Figure 9.20: Regional distribution of the geosites inventoried by ISPRA (2012)[35]

Main causes of soil degradation

The various problems related to the physical and biological degradation processes that certainly affecting the soils in most anthropized areas (e.g. erosion, compaction, loss of organic matter, etc.), are mainly due to the great transformations that took place in Italy during the last century.

The irregular expansion of urban areas, the industrial development, the proliferation of infrastructures, the extraction of raw materials and the modernisation of agriculture (focused on maximum productivity) have all exercised a huge, and sometimes inevitable, pressure on the soil.

A large part of the land was then sacrificed, often inconsiderately, to society's development needs, but present knowledge about on the effects of land use and soil exploitation make the adoption of sustainable management policies no longer undelayable.

A common problem shared by for all the industrialised countries is represented by local or diffuse pollution of soil and groundwater.

Local contamination is due to the existence of: oil refining, chemical and steel industries, and some waste disposal activities (including asbestos).

Contamination from local sources is caused by anthropic activities (industrial plants, mines, landfills etc.) that can determine local contamination of soil, due to spills, leaks from plants/tanks, incorrect waste management etc.

In Italy, local contamination is mainly due to oil refining, chemical and steel industries, waste disposal activities and the presence of asbestos structures, particularly those in a bad state of preservation.

[35] Source: ISPRA

On the other hand, diffuse contamination can be linked with to atmospheric depositions and intensive farming, or to anthropic activities on the land that are so widespread and/or continue for such a long time that it is difficult to identify one specific source (Figure 9.21).

Diffuse contamination originates from industrial, civil and agricultural sources. When soil loses its protective function, pollutants also contaminate rivers and groundwater and enter the food web.

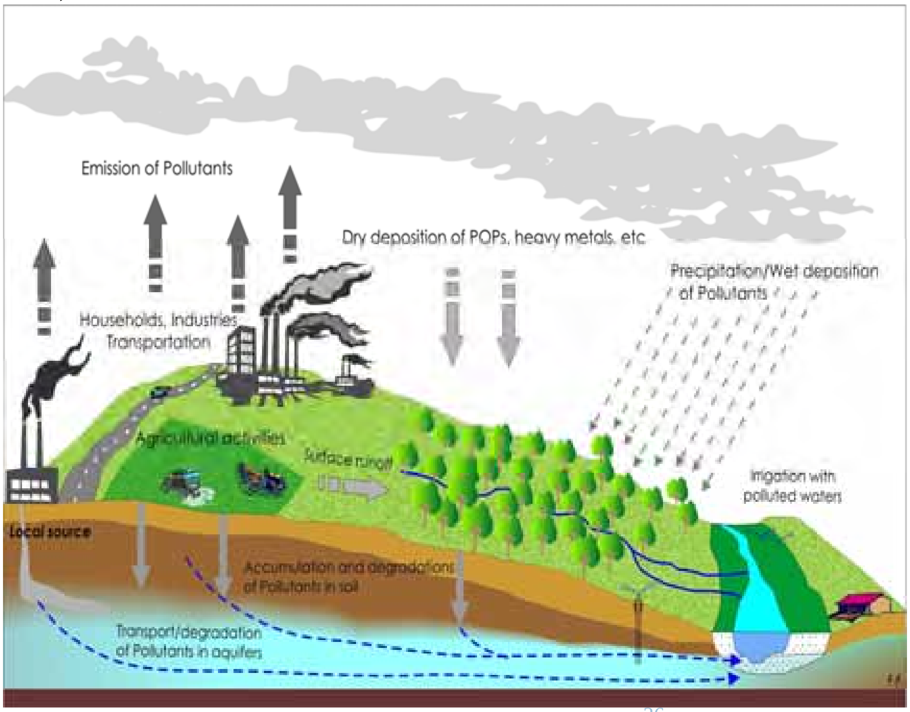


Figure 9.21: Diagram of diffuse contamination [36]

Industrial and vehicle emissions in the atmosphere cause release into the soil of acidifying contaminants (SO_x, NO_x, NH_3), heavy metals (Pb, Hg, Cd, As, Cr, Cu, Ni, Se, Zn) and organic compounds (aliphatic and aromatic hydrocarbons, dioxins, furans etc.). Intensive farming that make abundant use of plant protection products, chemical fertilizers, livestock manure and sewage sludge can cause a surplus of nutrients (N, P, K), an accumulation of heavy metals and the spread of biocides. In particular, nitrates are very water-soluble are barely sorbed by soil and then can cause serious pollution of groundwater and eutrophication of water ecosystems.

Industrial and civil activities release acidifying substances, heavy metals and organic compounds into the atmosphere. Farming methods lead to an excess of nutrients, accumulation of heavy metals and the spread of biocides.

Notwithstanding the European trend of nitrates concentration in waters is showing a decrease related to the actions undertaken in compliance with the regulations in force, there are still some critical situations in Europe and these include large areas of Northern Italy[37].

Within the framework of the National Rural Network Programme, the MiPAAF will finance the ISPRA for implementing a programme that, on an over-regional scale, will enhance the knowledge on nitrate sources in surface and groundwater, in agreement with European Union aims for the protection of waters against pollution caused by nitrates from agricultural sources (Directive 91/676/EEC). This project, coordinated by the ISPRA and carried out in collaboration

Nitrates are decreasing all over Europe but there are still critical situations.

[36] Source: ISPRA

[37] *Report from the Commission to the Council and the European Parliament on implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2004-2007.* SEC(2010)118

with the agencies for environmental protection (ARPA) of the Piedmont, Lombardy, Emilia-Romagna, Veneto and Friuli-Venezia Giulia regions, will focus on the application of isotopic investigations to support the identification and evaluation of contributions that can lead to high values of nitrates in surface and underground waters.

As part of the project, an index is being worked out that can be used as a fast method for qualitative apportionment of the contributions arising from the different sources of nitrates (agricultural and civil) in water.

Spreading sewage sludge should be accompanied by a careful study of soil features.

The use of sewage sludge, which, along with nutrients and organic carbon, can contain significant amounts of hazardous substances for humans, can also cause concern if it is not properly managed and controlled. In particular, spreading of sludge must always be accompanied by a careful study of the pedological characteristics of the areas concerned so as to be able to determine the amounts of sludge that can be introduced into the soil without causing environmental problems.

Some soils naturally contain high quantities of contaminants.

In certain geological contexts it is also possible to identify a naturally high value of certain contaminants (base or pedo-geochemical value) not attributable to any specific, past or present, source and/or activity in the area concerned[38].

In order to calculate the presence of heavy metals in the soils, the discrimination between the natural content (base value) and the one induced by anthropic activities is fundamental.

A high concentration of heavy metals can be due to the chemical composition of the rock from which the soils originated and their background must therefore be correctly defined before any anthropic contamination can be identified. For example, a recent study made by the Emilia-Romagna Region[39] points out that the high values of Ni and Cr found in the Emilia-Romagna plain, much higher than the legal limits for uncontaminated land, are related to the erosion of the ophiolitic rocks existing in the basin and not to anthropic contamination. The excesses of Zn, Ni, Cr, As, Sn found in the Venetian Prealps can also be attributed to parent material[40].

Zn, Cu, Pb and Cd enrichment in the topsoil (0-30 cm)is probably due to an anthropic origin, whether industrial and civil (Pb and Cd) or agricultural (Cu, Zn).

On the other hand, Ni, Cr and As concentrations found in deeper horizons of soils are probably related to natural origin due to the geological composition of the parent material.

Excessive concentrations of pollutants also have negative effects on soil organisms, both directly, causing the emigration or death of organisms and species, or indirectly, for the development of resistant and scarcely specialised organisms.

For this reason, edaphic biodiversity is increasingly used in monitoring programmes of soils and contaminated sites, as useful biological indicator capable of integrating the chemical and physical data obtained from conventional pedological analyses. However, the

[38] APAT-ISS, Protocollo operativo per la determinazione dei valori di fondo di metalli/metalloidi nei suoli dei siti di interesse nazionale. June 2006

[39] Emilia-Romagna Region, Servizio Geologico Sismico e dei Suoli, 2011 - Carta Pedo geochimica della pianura emiliano-romagnola http://ambiente.regione.emilia-romagna.it/geologia/temi/metalli-pesanti/la-carta-pedogeochimica-di-cr-ni-zn-pb-cu-della-pianura-emiliano-romagnola-a-scala-1-250.000-2011

[40] ARPAV (2011) – Metalli e metalloidi nei suoli del Veneto. Determinazione dei valori di fondo

reasons for the loss of soil biodiversity are not limited to the problem of the presence and persistence of pollutants; a strongly negative impact is also linked to intensive farming (deep and frequent tilling) which often, with the formation of compacted surfaces, reduces the favourable habitat for edaphic organisms.

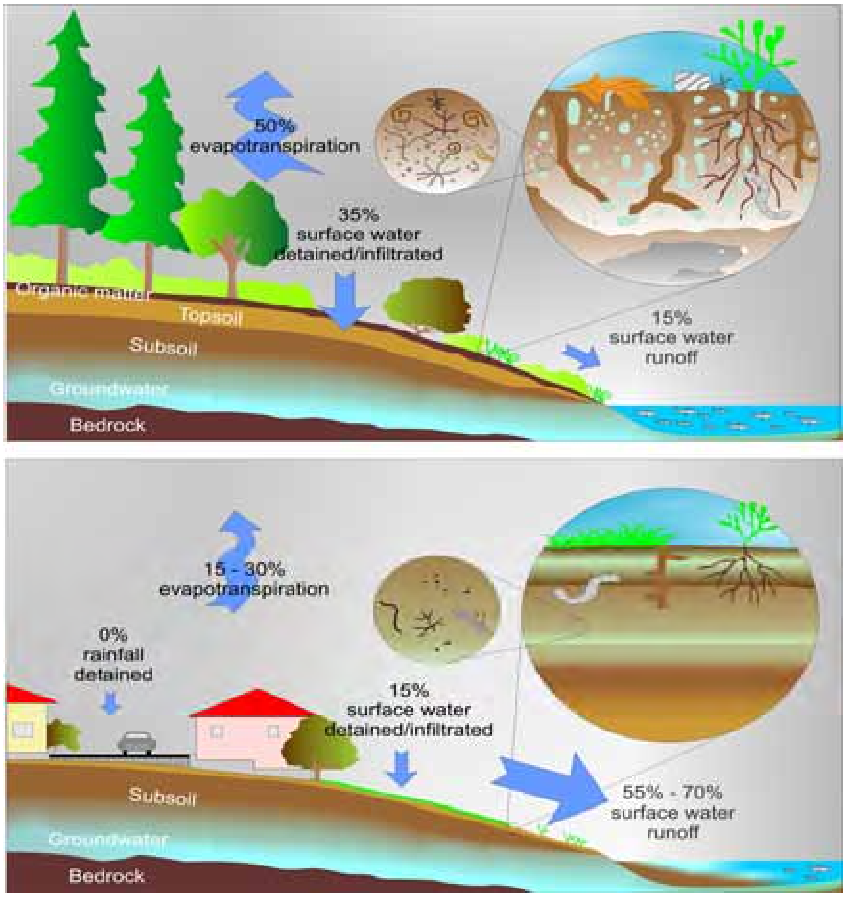
The reduction of porosity in the so-called "plough sole" limits the amount of oxygen spreading, thus causing alterations in the food web and, in particular, in the type and distribution of organisms.

The consequence of pollution, intensive farming, erosion, compaction, salinization, organic matter decline and sealing is the loss of soil biodiversity and, therefore, the reduction of its vital functions.

Other factors limiting the presence of organisms are linked to the increase of salts or soil acidity changes, that can modify the structure of communities of micro-organisms.

Moreover, a serious loss of biodiversity occurs in all the transformations of land use that involve soil-sealing , due to the failed supply of organic matter, its removal by erosion or after fires or, in the worst case, the total removal of the topsoil horizons, richer in organic matter.

Finally, the accidental or deliberate introduction of allochthonous species often determines invasive population explosions, to the detriment of the autochthonous ones, which are more in balance with the environment.



Soil under natural conditions, on the basis of its porosity, permeability and humidity, is able to hold a big amount of atmospheric rainwater, thus contributing to regulating the surface flow. On the other hand, in an anthropized environment, the presence of soil sealing, the reduction of vegetation, the removal of the topsoil layer rich in organic substances and increasing compaction entail a serious decline of soil functionality. The reduction of evapotranspiration and of the soil absorption capacity of waters determine an increase of surface runoff with increased erosion and transportation of large amounts of sediment in the natural channels.

Note:
The values shown in the picture are given by way of example only. They can vary, also considerably, according to several parameters (physical-chemical characteristics of soil, topography, geology, duration and intensity of rainfall, etc.)

Figure 9.22: Indicative sketch of the functionality of a natural soil and an anthropised one [41]

[41] Source: APAT (2008) – *Il suolo, la radice della vita*. Roma, 120pp

Organic matter (OM) decline is one of the most serious processes affecting soils. The phenomenon is linked, on the one hand, to the large-scale changes in land use, carried out by humans activities, at different times (massive deforestation, conversion of forests or permanent pastures into arable land etc.), on the other, although to a lesser extent, to the development of intensive farming. In fact, a serious anomaly of farming systems in the last century was the interruption of the organic matter cycle, in which agricultural biomasses represent an important step. In particular, the traditional practices of restoring the losses of OM due to tilling, mainly with manure, were given up a long time ago. Thus the input of organic carbon for ploughed land is mainly by a more or less careful management of crop residues and supply of other non-livestock organic matter.

Organic matter decline is linked to land use changes and intensive farming.

Moreover, organic matter mineralization processes depend on climate and the type of soil and, therefore, in the Mediterranean region the average concentration of OM in the soils is lower than the mean levels for the rest of Europe. Therefore, in the Italian situation particular attention must be given to OM conservation, to avoid alert values that could involve a significant loss of fertility.

With regard to the capacity of soils to stock carbon and thus combating climate change and, in particular, the organic carbon dynamics of tilled soils, recent Italian studies[42] show that the OC (Organic Carbon) sink is approaching a balance, maintaining an average annual loss of between 0.2 and 0.5 t/ha. This loss can be attributed to the intensification of farming methods on soils that have been tilled for thousands of years and it could be reduced by using various mitigation options, such as reduced cultivation, better soil management or using fertilisers of livestock origin. In order to increase the amount of OC sink, a long-term national policy thatpromotes the adoption of low-impact agricultural practices is necessary, perhaps with the help of the implementation of measures in the agriculture and forestry sectors in order to meet the targets fixed by the Kyoto Protocol. The agricultural practices for supporting specialised and intensive farming have changed the agricultural scene drastically; moreover, they have not succeeded in keeping a balance between needs and the environment.

The abandonment of agrarian irrigation and drainage networks, terracing, land levelling cultivation on steep slopes, excessive breaking up of clods and the use of heavy equipment increase soil erosion and the consequent loss of surface layer rich in organic matter, favouring, particularly during a heavy rainstorm, the formation of landslides. The use of heavy machinery on wet soil causes a greater soil compaction than dry soil..

Farming methods focussed only on productivity are one of the reasons of the occurrence of serious soil erosion and compaction.

Excessive grazing has a similar effect, while ploughing repeated to the same depth every year causes the formation of a compacted layer in the soil (plough sole).

Impacts on the soil caused by agriculture can be mitigated by the use of innovative agronomic techniques for reducing the impact on the telluric ecosystem and encouraging maintenance of production capacity and soil fertility.

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[42] Chiti et al. 2011

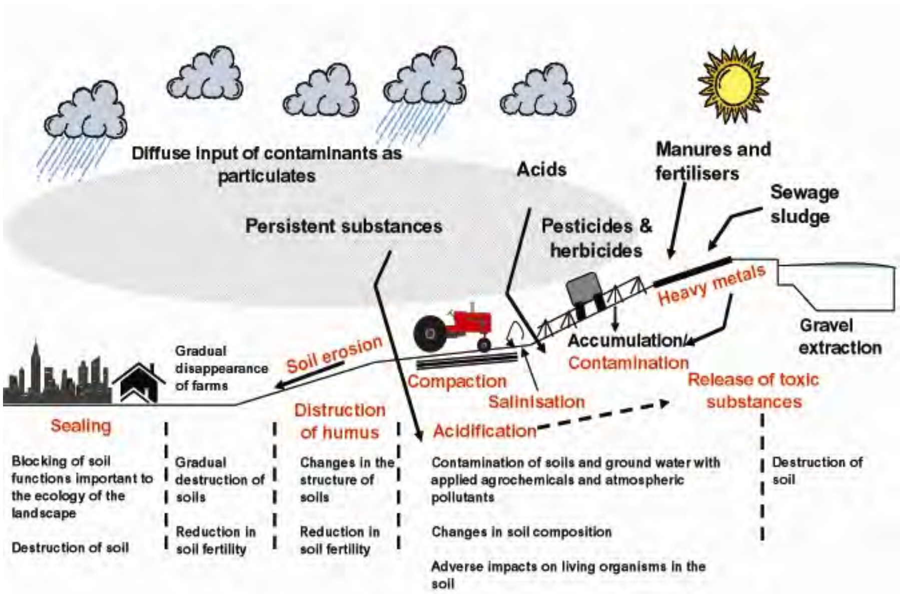
Like other countries in Mediterranean Europe, Italy is particularly prone to soil salinisation, linked both to natural factors related to parent material (primary salinization) and caused by humans activities (secondary salinization), or the result of a combination of both effects. In particular, secondary soil salinisation due to irrigation is a problem that is destined to increase, not just because of the strong competition for the use of water between towns, industries and rural areas, the exploitation of groundwater and the use of low quality water in agriculture (saline water, civil and industrial wastewater), but also because of the effects of climate change which, by increasing aridity, will cause reduced leaching and consequently an increase in salinization. The areas characterized by a hot-dry climate are particularly exposed particularly in coastal areas where excessive drainage for agricultural, civil or industrial use induce the reduction of groundwater level and the possible infiltration of saline water.

Italian coastal areas are particularly prone to salinization caused bydrainage and the use of increasingly saline waters.

Land degradation is therefore linked to various pressure factors of natural and anthropic origin (Figure 9.22); desertification is the result of this complex system of interactions, when degradation can seriously compromises the sustainable production capacity of agricultural and forestry ecosystems.

Desertification is the last stage of soil degradation.

The climatic factors that mostly characterise this process are aridity, drought, and rainfall erosivity while the main anthropic causes are linked to socioeconomic activities: agriculture, zootechnics, water resources management, forest fires, industry, urbanisation, tourism, landfills, and extraction activities (Figure 9.23).



The degradation process of an area is linked to pressure factors of natural and anthropic origin.

Figure 9.23: Diagram of the threats that can compromise soil functions. The last phase of degradation is desertification.[43]

[43] Source: JRC - IES

Figure 9.24: Diagram of the natural and anthropic dynamics related to desertification [44]

SPECIFIC REGIONAL CHARACTERISTICS

ARPA Friuli-Venezia Giulia

The "soil consumption (sealing)" indicator gives a picture of soil consumption caused by the presence and temporal evolution of artificial (sealed) areas in the Friuli-Venezia Giulia Region. Since this indicator is obtained from data of the CLC project and developed using internationally recognised methods and the same criteria for the whole of the EU, it also enables comparisons to be made with other Italian regions and with neighbouring areas.
A comparison of soil consumption with the other regions shows that, in 2006, in Friuli-Venezia Giulia artificial or sealed areas were a fairly high percentage (about 7%), exceeded only by Lombardy and Veneto, and that it is the Italian Region with most urbanised soil *per capita*.

Actions aimed at soil protection

The growing awareness in Europe of the environmental relevance of soils and of the need to prevent their progressive degradation and loss of function, the need to combat desertification processes, to mitigate hydrogeological risk and to reduce human impact on the environment has led to a review of the regulatory framework. The Sixth and Seventh Environment Action Programmes, the new Common Agricultural Policy (CAP; EU Regulations 1782/03, 1783/03 and 1698/05) and the proposal for a soil protection directive (COM (2006) 232) recognise the environmental function of soils and lay the foundations for the protection and conservation of this resource. A large part of not-urbanised areas in Italy and the rest of Europe is managed and maintained by agroforestry operators, who are mostly involved in soil conservation policies.

[44] Source: APAT (2008) – *Il suolo, la radice della vita*. Roma, 120pp

In consequence of the problems caused by application of the old CAP relating to surplus production, to the enormous growth of Community investments, as well as to the appearance of considerable environmental damage and a gradual decline in yields, the new agricultural policy "Agenda 2000" adopted an environmental sustainability approach.

The Common Agricultural Policy is a fundamental principle for sustainable farming.

Based on the principles of Agenda 2000, the following mid-term review of the CAP (Fischler review) has been a turning point towards agriculture as much in balance with the environment as possible and able to guarantee productivity in the future. Of particular relevance for soil protection is the principle of "conditionality', according to the full granting of the decoupled payment will be conditional on the respect of sustainable agricultural land management (even if no crops are grown) namely: the statutory environmental, animal welfare and food safety standards, as well as occupational safety requirements for farmers.

"Conditionality" limits Community support to the obligation to ensure proper soil management.

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Support to farms is therefore subject to compliance with the Statutory Management Requirements (SMRs) and to maintaining the land in Good Agricultural and Environment Condition (GAEC). Each year the Ministry of Agricultural, Food and Forestry Policies (MiPAAF) issues a decree providing for the complete list of SMRs and GAECs to be met the following year and each Region is allowed to issue the implementing measures best suited to its area.

In particular, the SMRs are legal provisions already in force and resulting from relevant Community regulations (e.g. Directive 278/86/EEC "Sludge Directive" and Directive 91/676/EEC "Nitrates Directive"), while the GAECs (Standards) are established at national and regional levels to ensure the implementation of the four issue set by the European Union:

- protecting the soil from erosion;
- maintaining the levels of organic matter in the soil;
- protecting the soil structure;
- ensuring a minimum ecosystem level and conserving habitats.

The rules for maintaining land in good agricultural and environmental condition include: regulation of surface water runoff ; stubble management of, crop rotation and residue management; maintaining an efficient network for surface runoff; protecting permanent pastures; minimum managing land ; maintenance of olive groves; maintenance of landscape. Thanks to EU funds new challenges and measures were introduced for the period 2007–2013.

The National Strategic Plan for Rural Development (NSP), elaborated by MiPAAF, develops guidelines for the regional plan (RDP) and in Axis 2 (Improving the environment and the countryside) provides four priorities to achieve the conditionality conditions:

The National Strategic Plan for Rural Development provides the guidelines for the corresponding Regional Programmes (RDP).

- conservation of biodiversity, protection and preservation of agroforestry systems characterized by an high natural value;
- protection of all surface and groundwater resources quality and quantity;
- reduction of greenhouse gases;
- soil protection.

The fourth objective should be achieved through a series of measures aimed at mitigating water erosion, salinisation, compaction, contamination, organic matter decline and biodiversity, soil consumption and soil sealing.

Every Region/Autonomous Province has developed its own RDP in accordance to the NSP, suitably adapted to the local environments. Many of the measures planned within Axis 2 of the RDP have a direct positive impact in relation to some of the threats highlighted by the Thematic Strategy for soil protection, since they aimat reducing the nutrient loading to the level needed by crops, at maintaining or increasing organic matter in the soil, at mitigating the intensity of soil tillage, at decreasing the use of plant protection products, at increasing the degree of soil cover in order to combat erosion and the release of nutrients, at promoting crop rotation and the protection of natural areas or buffer-strips .. In particular, in measure 214 “Agro-environmental payments” many Regions are providing support for sustainable farming practices with a strong focus on the conservation of soil properties, such as, for example, organic farming or integrated farming system, or the creation and maintenance of hedgerows.

Even measures not strictly dealing with organic matter contain some obligations for farms relating to the spreading of manure on the land with a certain periodicity. The reform of the 2014-2020 CAP (the fifth in twenty years) is still under discussion; among the principal novelties will be the introduction of green payments, in line with the greening process to support agriculture. The regulation proposal defines greening as a payment for farmers who follow a number of practices beneficial to the environment and climate

Farmers will be entitled to it on condition that they receive the base payment and that they use three farming practices considered beneficial for the climate and the environment on their eligible hectares:

- crops diversification;
- maintenance of permanent grassland;
- presence of 7% of areas of ecological interest.

The European Commission’s SoCo (Sustainable Agriculture and Soil Conservation) project[45] analysed the effects of the adoption of conservative farming practices suited for maintaining the soil’s production capacity and fertility. The results revealed important positive effects following the introduction of these alternative farming methods, from the economic and social, but above all environmental, points of view.

Farming practices such as “no tillage”, “reduced tillage”, suitably combined with cover crops or crop rotation, can reduce soil degradation.

Agricultural practices like “no tillage” and “reduced tillage”, suitably combined with cover crops or appropriate crops rotation, can reduce soil degradation processes with unquestionable advances such as, for example:

- the reduction of water erosion and the consequent increased of the water infiltration capacity in the soil;
- the increase of organic matter and nitrogen in topsoil, which

[45] (http://soco.jrc.ec.europa.eu/)

permits, at the same time, a reduction in the use of pesticides and herbicides, groundwater protection from possible pollutants and, last but not least, storage of harmful greenhouse gases;
- the increase of soil biomasses (a larger biological activity contributes to the formation of essentially vertical macropores increasing water infiltration and soil resistance to compaction).

Nevertheless, the implementation of similar farming systems must inevitably take into account the considerable investments that farms need to make to purchase specific equipment and adequately train the farmers, and the waiting times needed by a conservative agriculture system for reaching a balance (usually between 5 and 7 years). In this regard, some Regions introduced a new agro-environmental measure in the Rural Development Plan, providing for a contribution to cover the costs for farms that commit to sod seeding, minimum tillage or intercropping for a period of at least 5 years.

The results of the SoCo project showed that no single solution exists for reducing, or even eliminating, the effects of soil degradation due to inappropriate farming practices. Conservative farming can be a solution but even then its applicability has to be assessed in relation to the soils, the farm and the related productions. Modern agriculture, also aimed at conservation of natural resources, cannot ignore the knowledge about the resources and the "territorialisation" of agricultural management systems.

The European Commission has launched a Thematic Strategy leading to the adoption of a proposal for a Framework Directive for Soil Protection (COM (2006) 232), presently blocked due to the opposition of some Member States.

In September 2006, the European Commission proposed the *Soil Thematic Strategy (COM(2006) 231)*, the *Proposal for a Soil Framework Directive (COM(2006) 232)* and the *Impact Assessment (SEC(2006)1165)* with the aim of protecting European soils allowing their sustainable use by prevention of further degradation, protection of soil functions and remediation of degraded soils. These documents confirm the environmental role of soil and define the threats that can compromise its functions. They also acknowledge the strong interrelationship between soils and the other environmental factors, and the need, due to their extreme spatial variability, to incorporate a strong local factor in protection policies.

With regard to threats to agriculture, Member States need to identify the areas at risk on the basis of common elements, set reduction targets for the areas in question and adopt programmes containing the measures needed to reach them.

With regard to contamination, recognised as one of the "priority threats" to soil functions, the main elements contained in the Thematic Strategy are:

- the common risk-based (i.e. based on risk assessment) definition of "contaminated site" and "remediation
- the systematic procedure for identifying contaminated sites and the setting up of national registers of contaminated sites
- the introduction of the "report on soil status" as a useful tool in the purchase and sale of sites affected by potentially polluting activities
- the need for Member States to establish a "National Remediation Strategy" including targets (number of sites to be remediated),

action priorities and a timetable for their implementation.

The proposal was adopted at first reading by the European Parliament in November 2007 but the procedure was blocked by a minority of Member States at the Environment Council in March 2010 for reasons related to subsidiarity, costs considered too high and the administrative burden[46].

The blocking of the procedure thus resulted in the continuation of a legislative lack, reasserted also in the Communication of the European Commission COM (2011) 531[47], which stresses that "*on balance the 6th EAP helped to provide environment policy with an overarching framework for a decade during which environmental legislation was consolidated and completed to cover almost all areas related to environment, with the exception of soil*".

In spite of the complex process of the directive proposal, its drafting had the great merit of drawing attention to the environmental, economic and social role of soil and therefore influenced the work in progress.

The European legislative lack is reflected at the national level also, where current legislation on soil protection focuses more on protecting land from hydro-geological instability.

The European regulatory gap is reflected at the national level also, where current legislation on soil protection focuses more on protecting land from hydro-geological instability than on resource conservation[48].

The protection of soil and water from pollution is an exception: there are various rules that, among other things, provide the involvement of different institutional sectors. The remediation of contaminated sites is regulated in Italy by Legislative Decree 152/06 (Part IV, Title V) and its amendment decrees.

Leg.Dec. 152/06 regulates the remediation process for contaminated sites and introduces the concept of risk analysis.

Legislative Decree 152/06 defines a "potentially contaminated site" as: "*a site where the concentrations of one or more chemicals in the environmental media (soil, sub-soil and groundwater) exceed 'Contamination Threshold Concentrations' (CTCs, i.e. screening values for residential and industrial commercial land uses) and needs a detailed site investigation followed by a site-specific risk assessment to evaluate the contamination level and the 'Risk Threshold Concentrations' (RTCs, i.e. site specific target values)*". On the other hand it defines a "contaminated site" as: "*a site where 'Risk Threshold Concentrations', derived by a site-specific risk assessment carried out on the basis of a detailed site investigation, are exceeded*".

Within the decision-making process for the identification and management of contaminated sites, the difference between the *Contamination Threshold Concentrations (CTCs)* and the *Risk Threshold Concentrations (RTCs)* is relevant. While exceeding the former requires characterisation and risk assessment , exceeding the latter determines the status of "contaminated site" and requires safety measures or remediation.

[46] European Commission (2012) - *Implementation of the Thematic Strategy for Soil Protection and ongoing activities*. COM (2012) 46 final

[47] European Commission (2011) - *Sixth Community Environment Action Programme. Final Assessment*. COM (2011) 531

[48] See the introduction to this chapter

It should be noted that, among all the effects that could be harmful to human health or the quality of the environment, cause deterioration of material assets, or impair or interfere with the recreational values of the environment or other legitimate uses of it, the rule only deals with direct effects on health. In fact, the definition of a contaminated site depends only on the *"effects on human health resulting from prolonged exposure to the action of chemicals present in contaminated environmental media"*.

The percentage of released and/or remediated areas is still low for the SNI.

With regard to the Sites of National Interest (SNI), more than ten years since the first rule was issued the percentage of areas released and/or remediated is still low and the progress of remediation activities in Italy is rather uneven. Generally speaking, most of the remediated and/or released areas are in less complex SNI and, in particular, it is noted that procedures move faster in areas where settlements with high economic value (improvement for urban-residential purposes, installation of new manufacturing facilities) are planned.

The introduction, with Legislative Decree No. 04/08, of Art. 252-bis (Sites of overriding public interest for industrial conversion), which, through the involvement of the Ministry of Economic Development, provides public finance schemes and several elements to speed up the procedures for the reuse of polluted areas by private parties, might lead to greater development of remediation activities and to the reclamation of contaminated sites for industrial purposes. Programme Agreements are another effective tool for ensuring coordination of actions by the various parties involved in the remediation work and the streamlining of administrative procedures

At the regional level contaminated sites must be entered in "Regional Registers of sites to be remediated".

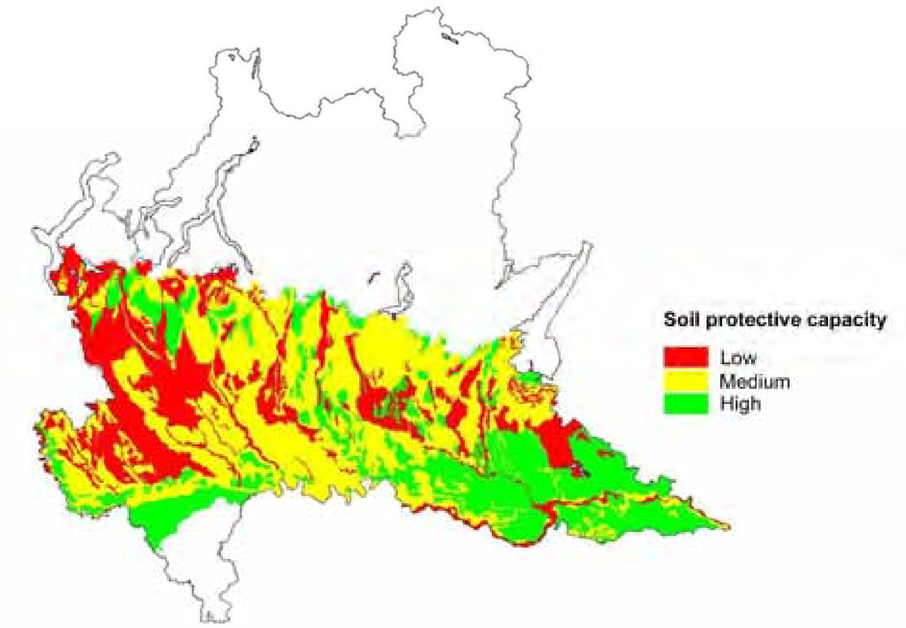
Legislative Decree 152/06 requires the Regions to establish a system for collecting and updating data on polluted sites by the creation of *"Regional registers of sites to be remediated"* and to adopt the related remediation plans. However, the systems established are somewhat inconsistent because of the different criteria used for identifying contaminated sites. More generally speaking, the criteria for inclusion of contaminated sites in the Regional Registers often suffer from the lack of nationwide systematic and uniform procedures for the identification of potentially contaminated areas, in other words, areas that host or have hosted potentially polluting activities, to be investigated.

With regard to brownfields, work is under way to revitalise disused areas and make them an active part of urban areas.

Many areas have already been reclaimed and are generally used for residential areas, public parks, shopping centres and public common spaces, while work on the conversion of "megasites", particularly those in the southern regions, is still very much below potential.

In the case of generalised contamination the most effective response is to take action aimed at mitigating the pressures.

In the case of diffuse contamination the most effective response is to take preventive action aimed at mitigating pressures by: improving monitoring of emissions into air and water; limiting the use and marketing of potentially contaminating substances; defining quality criteria for products used in agriculture and limiting the quantities of fertilisers used on the basis of their composition. The quality of sewage sludge, in relation to its possible use in agriculture and of the soils as its receptors, is defined by Directive 86/278/EEC, assimilated by Legislative Decree 27 January 1992, no.99. That decree is aimed at regulating the use of sludge in agriculture so as to avoid harmful effects on soil, vegetation, animals and humans and, at the same time, encourage its proper use. The Regions have been empowered to issue permits for the collection, transport, storage, preparation and use of sludge. They also fix further limitations and conditions for the use of sludge and rules for spreading it. They also draw up plans for agricultural use of sludge. MiPAAF Ministry Decree 19/04/99 "Code of Good Agricultural Practice" gives guidelines for the proper use of fertilisers in order to avoid excess of nutrients, while Legislative Decree 152/06, part three "Rules on soil protection and combating desertification, protecting water from pollution and management of water resources", gives instructions on the mitigation of water pollution by nitrates, making the Regions responsible for identifying Nitrate Vulnerable Zones (NVZ), and by plant protection products. Definition of the NVZ is a complex process resulting from the intersection of the protective capacity of the soils and their hydro-geological characteristics with loads of agricultural origin and data on water quality (see examples in Figures 9.25 and 9.26). These zones have been identified, at different times, all over the country except for the Aosta Valley, Trent and Bolzano, which do not have this problem. Directive 2000/60/EC also gives an estimate, on a river-basin scale, of pressures on water bodies, including local and diffuse contamination.



The map shows the potential capacity of the soil to retain crop protection products within the thickness of the layer affected by the roots system of plants and for a time sufficient to allow degradation.

Figure 9.25: Soil protective capacity map in the Lombardy Po Plain (2005)[49]

[49] Source: ERSAF (Ente Regionale per i Servizi all'Agricoltura e alle Foreste) Lombardy Region

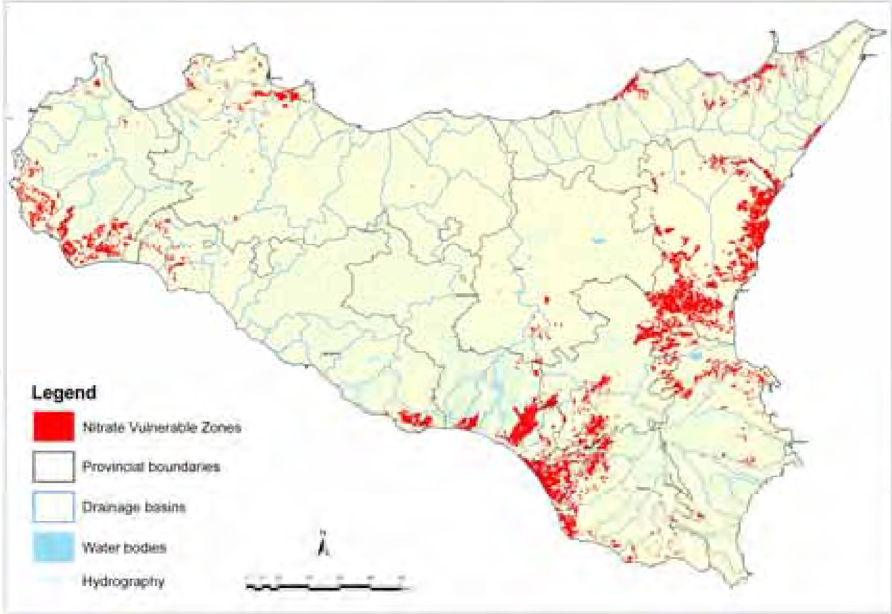


Figure 9.26: Regional map of Nitrate Vulnerable Zones (NVZ) of agricultural origin (2005)[50]

In vulnerable zones a series of rules must be applied related to the management of fertilisers and other farming practices, as well as compulsory measures described in the Code of Good Agricultural Practice.

With regard to action for mitigation of desertification risk, in 1994 Italy signed the United Nations Convention to Combat Drought and Desertification, becoming a member country of the UNCCD with the dual role of "donor" and "affected" country listed in Annex IV of the Convention, which includes the countries of the Northern Mediterranean.

The United Nations Convention on the fight against drought and/or desertification is an international legal instrument that commits all the signatory countries to cooperating in the fight against desertification.

The "UNCCD Ten-Year Strategy" for the period 2008-2018 establishes four long-term "Strategic Objectives" (to improve the living conditions of affected populations and the ecosystems in affected areas, to generate global profits through effective implementation of the UNCCD, and to mobilise resources to support implementation of the Convention) and five medium and short-term "Operational Objectives" (awareness raising and education of the population to the problems of *land degradation*; a policy framework concerning the adoption of national action plans; science, technology and knowledge for an adequate land degradation monitoring system; capacity building; financing, and technology transfer). A new system was developed for monitoring and data collection to verify the progress of each country, based on impact and performance indicators, to be evaluated every two years.

Two "obligatory" indicators were chosen among the impact indicators for the first reporting cycle, completed at the end of 2012:

- poverty rate in the affected areas;
- land cover status.

[50] Source: Sicily Region

In processing the first indicator, considering the lack of specific studies and a definition of "poverty line" in Italy, the ISTAT censuses (2001, 2011) and the recent vulnerability maps to desertification were taken into account ; the population living in rural municipalities[51] (particularly subject to the risks of loss of ecosystem services) and "very vulnerable" to desertification (municipality areas characterized by an ESA index > 1.4 and greater than 30%). The results show that, the municipal areas meeting the two requirements were found to be equal to 40,524 km^2, about 30.8% of the national country and mainly located in Sicily, Sardinia, Apulia, Basilicata and Molise. The second indicator was compiled using the first Corine Land Cover level (artificial surfaces, agricultural areas, forests and semi-natural areas, wetlands and water bodies), comparing the changes in the period 2000-2006.

Considering the limitations related to the spatial resolution of the CLC database, no significant changes at the national level were recorded for this indicator. Last year, the MATTM, in agreement with the other involved Ministries, started work on the preparation of a National Strategy for Adaptation to Climate Change, which will be completed at the end of 2013, after the public consultations. The Strategy identifies desertification, land degradation,drought, and hydro-geological hazards (floods and landslides), among the sectors that need to be taken into account for establishing policies, programmes and plans for adaptation.

At the same time, the MATTM has submitted to the inter-ministerial committee for economic planning (CIPE) the strategy for the adaptation plan to climate change, sustainable management and land protection, accompanied by suitable financing facilities.

With regard to mining activities, the national regulation refers, as well as to Royal Decree no. 1443 of 29/07/1927 and DPR.128/59 to Law 388 of 23/12/2000 (a special plan for remediation and environmental reclamation including former mining areas), to Law no. 179 of 31/07/2002 (establishing an inventoryof abandoned mine sites) and to Leg.Dec.117/2008 implementing Directive 2006/21/EC (management of waste from extractive industries). Leg.Dec. 117/08 sets out the measures, procedures and actions needed to prevent, or reduce as much as possible, any adverse effects for the environments as well as any risks for human health, resulting from the management of waste produced by extractive industries (mines and quarries). It requires the manager of the extractive site to draw up a waste management plan, which must be approved by the Competent Authority. It also requires the creation of a national inventory of mining waste from abandoned sites, which must be updated annually by ISPRA. The decree also concerns with the management of waste from quarries, which, are regulated by regional laws following DPR 616 of 24/7/1977.

Waste from extraction activities (quarries and mines) are regulated byDeree. 117/2008, implementing Directive 2006/21/EC.

Extractive activities is carried out through Regional (or Provincial) quarry management plans (PRAE or PPAE) which contain

Planning of quarrying is

[51] According to the OECD definition, "rural" areas are ones with a population density < 150 inhabitants/Km^2

information about active or abandoned quarries, identification and delimitation of quarried areas, methods of exploitation, activities planningand reclamation plans. However, the situation in Italy is deeply different: plans approved at different times and Regions that have not yet implemented any planning .

delegated to the Regions through Regional and/or Provincial Plans.

Following the inclusion of the geological heritage in landscape planning activities (Leg.Dec. 42/2004), some Regions and Provinces have carried out projects to identify the geosites existing in their areas sometimes including them in regional and provincial Landscape Plans; this is a first step towards their protection.

Several regions have started projects for the identification of geosites.

In Italy, only Emilia-Romagna, Liguria and Apulia approved a regional legislation on the protection of the geological heritage

A careful and suitable environmental and territorial policy, also aimed at the prevention of disasters, cannot do without careful identification and a thorough understanding of the phenomena on a national scale. An essential basis is the geological knowledge of the area through official geological and geothematic mapping (including the associated database) to a suitable scale able to investigate geological risk, making it an effective tool for land management policy. At present the country is covered by the official Geological Map at a scale of 1:100.000, completed in 1970. The new geological maps at a scale of 1:50.000, more suited for application studies, is carried out by the ISPRA'S Geological Survey of Italy, in collaboration with the Regions and the Autonomous Provinces, Institutes and University Departments, and the National Research Council (CARG Project - Geologic CARtography). The collaboration with research institutes ensures the scientific support also through the elaboration of new methodologies. The project characterized bynational technical standards specially developed by the Geological Service of Italy in collaboration with expert consultants and by improving a geological database has produced many data useful for land management and planning and for producing detailed maps for numerous applications.

Geological mapping at appropriate scale is an important requirement for proper land planning.

ISPRA – Geological Survey of Italy is the State cartographer's office.

The legal and financial framework from 1988 to 2004 ensured the necessary resources for the production of 277 geological maps, 14 thematic maps, 6 maps of the geology of the Adriatic continental shelf at a scale of 1:250.000, 1 morphobathymetric map of the Tyrrhenian basin, part of the CROP (CROsta Profonda - deep crust) project and an update of the catalogue of geological formations. Of the 277 geological maps at a scale of 1:50.000, 270 have been completed, of which 132 have been printed, 54 are being printed, 55 are in preparation for printing and the surveys have been completed for 29 (Figure 9.27).

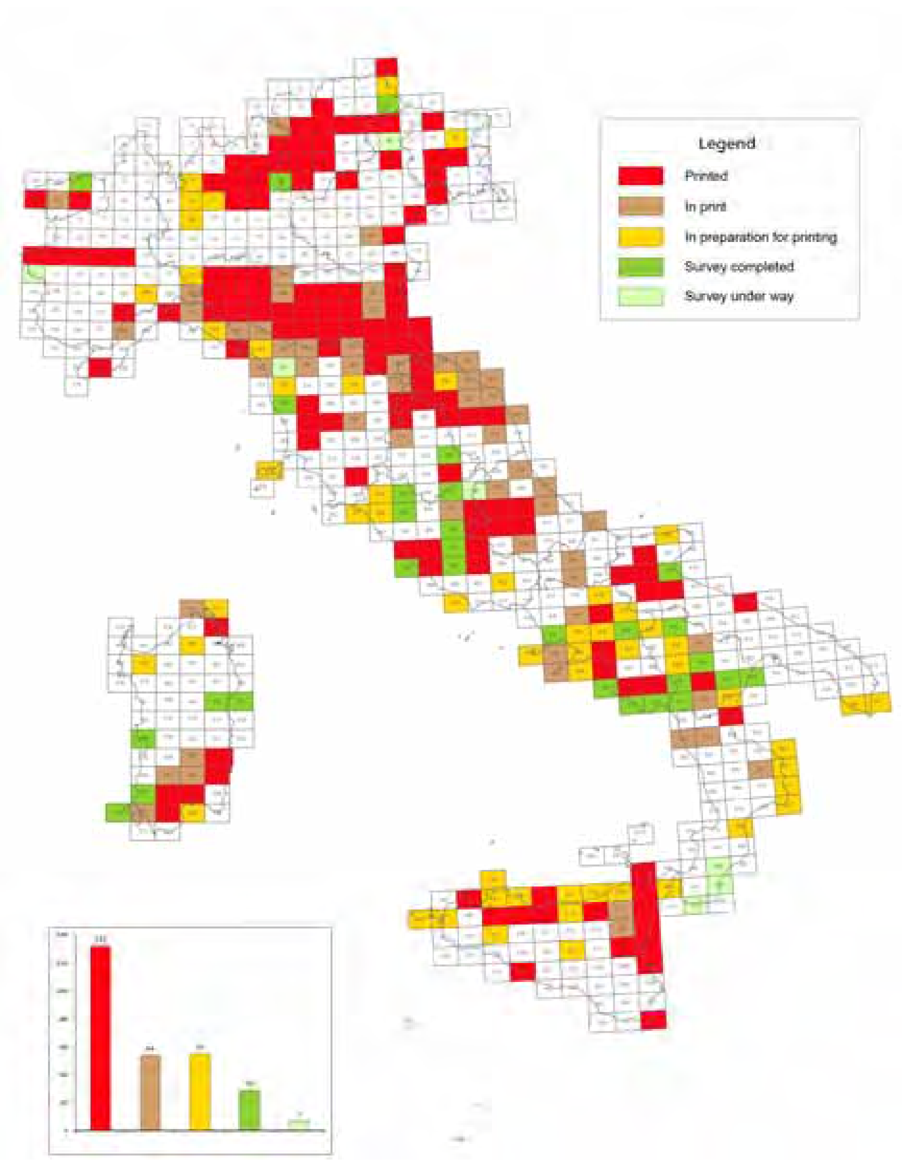


Figure 9.27: Status of CARG project - Geological Map of Italy at a scale of 1:50.000 (March 2013)[52]

The resources assigned to the CARG project have not been constant with only two large allocations, in 1989 and 1999. Since 1999 no resources have been allocated to continue the Project. In the future there is a need for new regulations and the necessary funds to start a second phase of the Project to produce the remaining maps. It would also be necessary to follow up the production of geothematic maps providing further information on morphology, hydrogeology, gravimetry and slope stability, which are essential to study the natural risk and land vulnerability. It should follow the production of geological map on the same scale, which is the basic tool.

[52] Source: ISPRA

SPECIAL FOCUS BOX

Land consumption

Causes and consequences of land take

Land take means the growing set of areas covered by buildings, sheds, roads, railways, extractive areas, landfills, work sites, yards, squares and other paved or packed-earth areas, greenhouses or other permanent roofed structures, airports and ports, sealed sports areas and fields, photovoltaic panels and all the other sealed, but not necessarily urban, areas.

Land take also extends to rural and natural environments, as well as to the traditional settlement area where, on the other hand, natural or semi-natural areas where the soil keeps some of its essential ecosystem functions may continue to exist. The phenomenon is therefore linked to the use for settlement purposes of extra-urban land assigned for agricultural or natural use.

This process involves the loss, through concrete covering and soil sealing, of a common asset, the land, the availability of which becomes more and more limited.

The gradual expansion of built up areas and the growing dynamics of urban sprawl means that agro-forest soils are being used up more quickly.

Construction of buildings, roads or other uses of land generally involve the removal of soil or soil sealing due to its compaction or permanent cover with waterproof materials like concrete, metal, glass tar and plastic.

In these cases the change in the nature of the soil is such that these forms of processing can be considered virtually irreversible.

Productive functions are inevitably impaired, as is the possibility of absorbing CO_2 or providing support and sustenance for the biotic components of the ecosystem, and of guaranteeing biodiversity or social use.

Fragmentation of habitats increase, with a risk of interruption of migratory corridors for wildlife.

The climate in urban areas becomes hotter and dryer due to diminished plant transpiration and the evaporation of larger areas with a high heat refraction coefficient.

Moreover, soil affected by the expansion of artificial and sealed surfaces is no longer able to retain much rainwater and help to regulate surface runoff.

Leaching of soils due to surface runoff also causes an increase in the solid load, in many cases with a high content of pollutants, causing a strong impact on the quality of surface water and aquatic life.

The situation in Europe and Italy

In the absence of effective policies for land planning and natural resources management, the expansion of urban areas in Italy and Europe has often led to the loss of agricultural areas of high environmental and cultural value.

A uniform picture of the situation at the European level is available on the Corine Land Cover (CLC) database but the resolution is not sufficient for making an accurate estimate of land use due to urbanisation. In fact, it does not take into account individual changes in land cover of less than five hectares or changes due to linear infrastructures, such as roads and railways, thus leading to considerable underestimation of soil consumption.

Analyses of the CLC data made by the European Environment Agency (EEA) and contained in the report "European environment - state and outlook 2010" show that changes in soil cover between 2000 and 2006 accounted for 1.3% of the surface area of the 36 countries studied (68,353 km^2 out of 5.42 million km^2).

The annual rate of change has decreased compared to the period 1990-2000 but there are marked differences between the various countries. Artificial land cover increased by 3.4% between 2000 and 2006.

Even though urban areas cover only 4% of land in the European Union (5% in Italy), their sprawl means that at least one quarter of the land is directly affected by "urban" use. What is more, between 2000 and 2006 low-density peri-urban areas increased four times faster than high-density compact urban areas, showing a growing tendency towards urban sprawl in Europe.

Based on data supplied by the European Environment Agency, a report published by the European Commission in 2011 (The Soil Sealing Report) estimates that the rate of increase in occupied land in the EU between 1990 and 2000 was about 1.000 km^2 per year; between 2000 and 2006 the increase in the share of land occupied went down to 920 km^2 per year but it is not yet known whether this trend will continue in the future.

The result is that in 2006 every EU citizen had a land occupation footprint of about 390 m^2, that is to say 15 m^2 more than in 1990. Out of these 390 m^2, about 200 m^2 are actually sealed, in other words covered by cement or asphalt, giving a total figure of 100 000 km^2, in other words 2.3% of the EU territory. As far as Italy is concerned the EEA data estimate the percentage of cement-covered land as 2.8% and therefore above the European average.

In Italy, the CLC data, even though they only take major changes into account and ignore much of the constant sprawl of infrastructures and settlements, show an increase in artificial surfaces of about 80,000 hectares during the period 1990-2000 (overall growth of more than 6%) and about 50,000 hectares during the period 2000-2006 (more than 3%). The increase in artificial areas is unevenly distributed among the various Regions. More than 60% of the changes between 1990 and 2006 were concentrated in six Regions (Piedmont, Lombardy, Veneto, Emilia-Romagna, Tuscany and Sardinia).

Even though annual national growth rate remained almost unchanged, at about 8,000 hectares a year, during this period, there were Regions, such as Lombardy, that rose from a rate of 500 hectares a year between 1990 and 2000 to 1,000 hectares a year between 2000 and 2006.

Veneto had a similar trend (from 600 to 1,300 hectares a year), whereas the annual urbanisation rate in Sardinia went down from 1,200 hectares a year between 1990 and 2000 to less than 300 (2000-2006).

In order to ensure an accurate estimate of land take in Italy, with a uniform picture at the national level, without the accuracy limitations of the Corine data, ISPRA, in cooperation with the Environmental Agency network, developed a punctual monitoring system that presently represents the most significant collection of data at the national level and reconstructs land take trend from the second post-war period to 2010.

The survey methodology developed, the only one specifically dedicated to land take, is able to combine various data sources with local data and European earth observation data, also within the framework of the Copernicus programme (formerly known as GMES - Global Monitoring for Environment and Security), using cartographic and aero-photogrammetric analyses. This methodology consists of three main phases: photointerpretation, integration of local data with European observation data, and indicator processing.

During the photointerpretation phase 120,000 points of a stratified network covering the whole of Italy were monitored. This punctual type monitoring made it possible to overcome the limitations of the minimum mapping unit typical of thematic maps like the Corine Land Cover.

ISPRA data show that, at the national level, land take went from 2.8% in the fifties to 6.9% in 2010, an increase of more than 4 percentage points. That means that, on an average, more than 7 square metres a second were occupied during more than 50 years. The period of fastest land take was the nineties, when it was close to 10 square metres a second, but the most recent period also has a rather fast rate of land take (more than 8 square metres a second). In fact, an area equal to that of the municipality of Naples is being cemented every 5 months and an area equal to the sum of the municipalities of Milan and Florence every year.

In absolute values it is estimated that, from about 8,000 km^2 of soil consumed during the second post-war period, the figure went up to more than 20,500 km^2 in 2010. This increase cannot be explained by demographic growth alone: if 170 m^2 for every Italian were lost during the fifties, in 2010 the value of surface area consumed *per capita* had increased to more than 340 m^2 per inhabitant. The phenomenon is more common in Northern Italy. Lombardy is by far the Region with the greatest area consumed, more than 10% of the regional territory, followed by Veneto, Emilia-Romagna, Apulia and Latium.

But if the North is the area with the highest percentage of area consumed, the South has the highest increases recorded during the last 60 years. The phenomenon takes on alarming proportions in the big plain areas, where in addition to urbanisation there are also the effects of intensive farming (soil compaction).

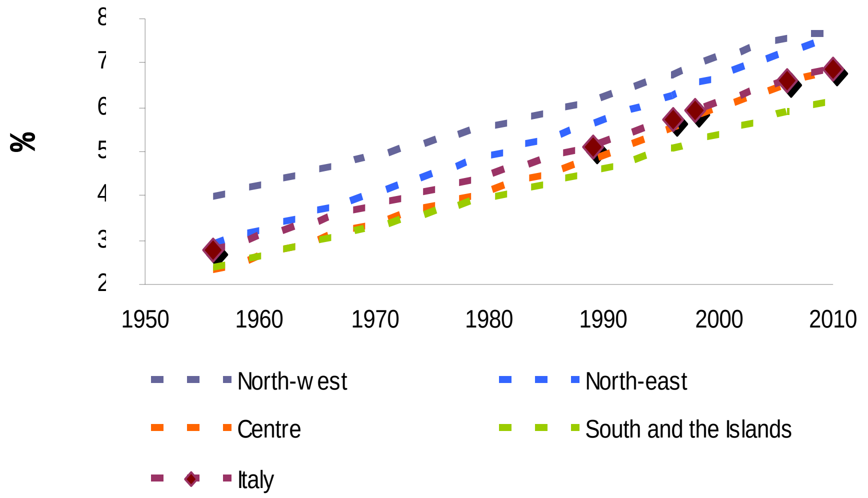


Figure 1: Evolution of land take in Italy due to expansion of artificial cover [53]

In the major urban areas land take has, in some cases, affected as much as more than half the municipal territory (over 60% in the municipalities of Milan and Naples) and the trend is growing: in the municipality of Rome alone there has been an increase in sealed surfaces of more than three hundred hectares a year in recent years.

[53] Source: ISPRA (The 1946-1960 data were taken from topographic maps by the Military Geographical Institute)

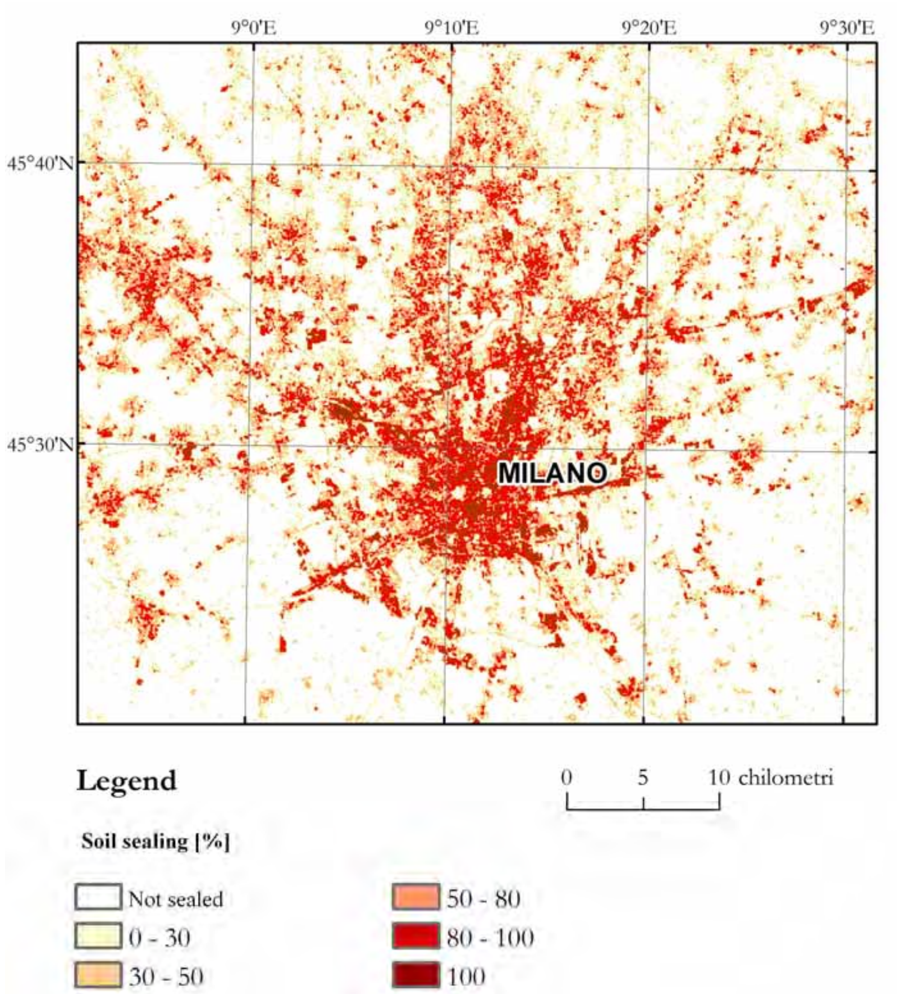


Figure 2: Soil sealing in the Milan area in 2009[54]

<u>Sustainable land management policies</u>

The primary goal should be to reduce the rate of conversion from agricultural and natural land to artificial land with a loss of areas of high environmental and cultural value. According to what has already been done in other European countries, it would seem necessary, in Italy also, using the appropriate tools and governance levels, to take effective measures to limit and contain land take and soil sealing. Regional planning instruments should ensure a three-tiered approach, as laid down by the European Commission's Directorate General for the Environment: limitation, mitigation and compensation. Above all, the reuse of already urbanised areas should be guaranteed and promoted, preventing the expansion and sprawl of towns with new housing, office, commercial and industrial developments, and the resulting consumption and sealing of agricultural or natural land. When soil sealing and land take are expected and inevitable, adequate mitigation measures need to be identified, defined and implemented with a view to maintaining soil functions and reducing negative effects on the environment. Lastly, only in cases where the measures for mitigating inevitable actions are deemed to be insufficient, consideration could be given to offering compensation for the reclamation and remediation of neighbouring degraded areas.

[54] Source: EEA - *Degree of soil sealing* 2009

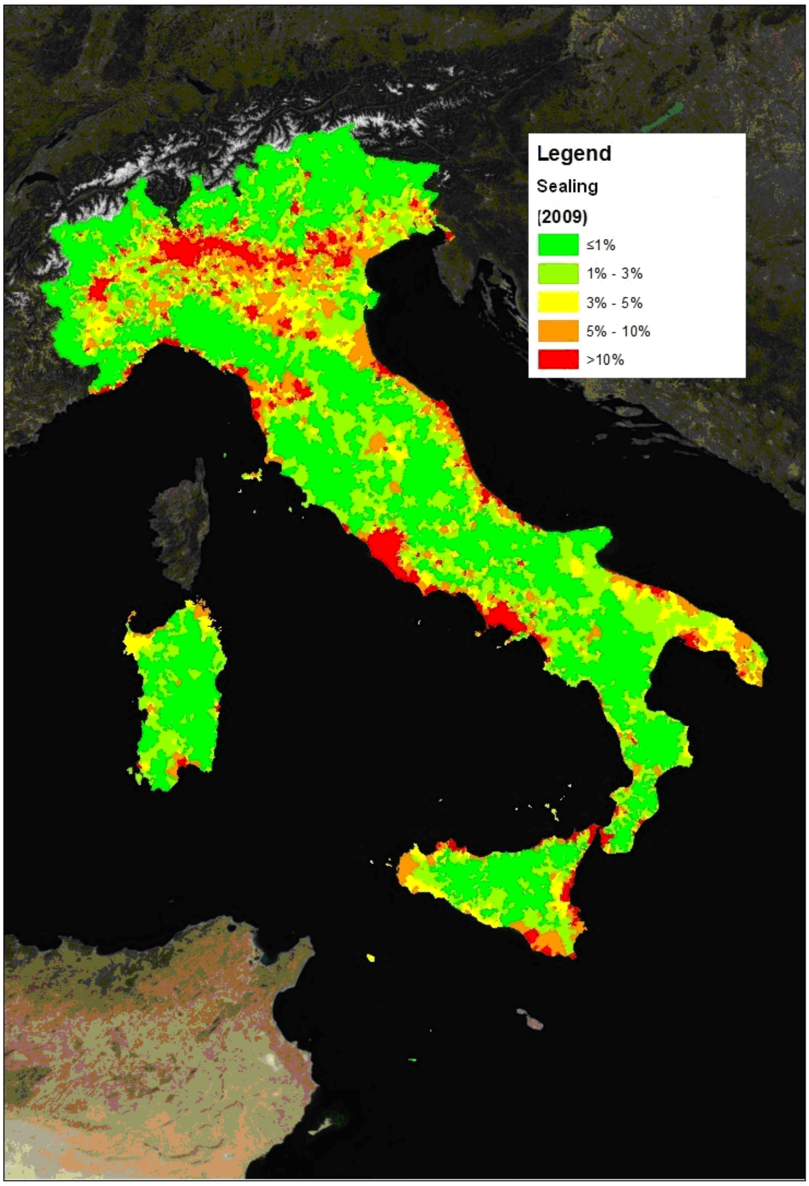


Figure 3: National map of soil sealing (2006)[55]

GLOSSARY

Brownfields:

are abandoned or underused industrial or commercial facilities and sites, located in inner city or suburban areas, which already feature infrastructures (water, electricity, gas supply, sewerage, etc..), with nearby transport services, the regeneration and development of which, however, is hampered by environmental pollution

Desertification:

land degradation in arid, semi-arid, sub-humid, dry and other areas subject to chemical pollution, salinization and depletion of the water table, as well as the inefficient management of the soils, resulting from various factors including climate change and human activities

[55] Source: Copernicus 2009 data (Geoland 2 project), processed by ISPRA

Desertisation:
Expansion of sandy deserts

Horizon:
in a vertical section of the soil, from the surface to the pedogenic substrate, it is normally possible to recognize a series of layers running parallel to the surface, which take the name of horizons and feature specific characteristics depending on pedogenic processes. They are therefore also called genetic horizons and their designation is based on a qualitative assessment of the origin of the analyzed soil. The vertical succession of horizons constitutes the soil profile

Pedogenesis:
process of soil formation from mostly mineral debris originating from the disintegration of rocks (pedogenic substrate). It is achieved through processes of transformation, accumulation, loss and movement due to a set of pedogenic factors: climate, rock, morphology, living organisms and time

Organic matter:
all the materials of organic – mostly vegetable – origin, from the 470 flora or by fertilization and accumulated mainly in the upper horizons of soil. The further transformation of these materials produces humus

Territory:
an area of land considered with regard to its biology and geology and as shaped by past and present human activities. It also takes on a political and administrative meaning, with respect to the formulation of land use and regional/urban planning and development activities

Surface Runoff:
excess rainwater running off the topsoil due to insufficient penetration into the soil as a result of its saturation or excess rainfall. It is a fundamental part of the hydrological cycle and the main agent of soil erosion

Nutrients:
any materials absorbed by plants and essential for their development. The main nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, ulphur, iron, manganese, copper, boron and zinc from the soil, and carbon, hydrogen and oxygen from air and water.

CHAPTER 10

THE WASTE CYCLE

Problems and regulations

All the European Union's strategic and regulatory acts, starting from the Sixth Environment Action Programme, have as their priority objective the sustainable use of resources, correlating it with the sustainable management of waste.

All the European union's strategic and regulatory acts have as their priority objective the sustainable use of resources, correlating it with the sustainable management of waste.

The objective is to guarantee that the consumption of renewable and non-renewable resources, and the impact this consumption entails, does not exceed the environment's carrying capacity, and to be able to decouple use of resources from economic growth by significantly improving the efficiency of their use through the "dematerialization" of the economy and the prevention of generation waste.

To prevent waste generation, interventions are carried out above all "at the source"; this approach involves, on the one hand, seeking solutions to expand product lifetimes, making less use of resources, and transition to cleaner production processes, and on the other the ability to influence consumer choices and demand towards favouring products and services that generate less waste.

The thematic Strategy for the prevention and recycling of waste, one of the seven thematic strategies implementing the Sixth Environment Action Programme, also indicates a set of measures to be carried out in order to improve waste management, strengthening the approach according to which waste is no longer seen as a source of pollution, but as an important resource to be appropriately managed and utilized.

The aims of the waste management policy, adopted by the Strategy, remain preventing waste and promoting preparing for reuse, recycling, and recovery. But the new objective is to bring the European Union closer to being *"a recycling society that seeks to avoid waste and uses waste as a resource."*

Lastly, Directive 2008/98/EC of 19 November 2008 introduces significant new elements aimed at reinforcing the principles of precaution and prevention in waste management, maximizing recycling/recovery, and ensuring that all management operations, starting from collection, take place in compliance with rigorous environmental standards. Moreover, the directive asks Member States to ensure complete traceability of hazardous waste from generation to final destination.

Knowledge of the waste system makes it possible to take decisions and then to monitor them, and to provide information accessible to economic operators and the public on the environmental situation and its trends.

It is therefore essential, also to be able to fulfil EC requirements, to have an effective, continuous, and accurate information base capable of adjusting to the actual situation and its changes, and able to take into account institutional responses and the effects produced by choices and by the corrective actions determined by these choices.

In the waste sector, also to fulfil EC requirements, it is essential to have an effective,

Even more important is to ensure, for the citizen and for all the organizations and structures operating in the social fabric, proper information on the waste cycle.
The individual, in fact, plays a fundamental role in applying waste prevention and recycling policies. Directing consumption towards products that pollute less during all the phases in their life cycle (design, development, distribution, consumption, and post-consumption) and that are, moreover, more easily reused and recycled, can truly promote prevention and recycling, guaranteeing a more sustainable use of resources. Mention must then be made of the fundamental role played by the citizen in systems of separate waste collection, the success of which is linked above all to proper information and active involvement.
Recently, the European Commission took action to stress priorities in waste management with two Communications to the European Parliament, to the Council, to the European Economic and Social Committee, and to the Committee of the Regions: the first on 26 January 2011, titled "*A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy*," and the second on 20 September 2011, titled "*Roadmap to a Resource Efficient Europe*." In the consumption society, the problem of waste management has grown in size over time, at times becoming an emergency and requiring drastic interventions. These communications place the sustainable use of waste within the scope of a broader strategy of strategic use of resources; this approach starts from modifying the current growth and consumption models to define a consistent framework of action that embraces different areas and sectors and has the objective of providing a stable outlook for transforming the economy.
The Commission's Communication *"Roadmap to a Resource Efficient Europe"* identifies in detail the actions and times needed to concretely achieve an efficient use of resources. It starts from an analysis of the overall framework of the current situation, which appears truly alarming: today in the EU, each person consumes 16 tonnes of materials annually, of which 6 tonnes are wasted, with half going to landfill. It is now clear that the era of cheap and plentiful resources is over. Businesses are facing rising costs for essential raw materials and minerals; their scarcity and price volatility are having a damaging effect on the economy.
Our economic system still encourages the inefficient use of resources by pricing some below true costs. In this setting, it appears essential to transform waste into a resource. A few numbers should be sufficient to grasp the need for quick, concrete actions of use for changing the current system: In 2010,in the European Union we threw away 2.5 billion tonnes of waste, 102 million tonnes of which is hazardous. On average only 40% of our municipal waste is recycled or composted, the rest going to landfill or incineration. Of concern is the increase in certain waste streams, such as construction and demolition waste, sewage sludge and marine litter; Waste electrical and electronic equipment is expected to increase by roughly 11% between 2008 and 2014.

continuous, and accurate information base capable of adjusting to the actual situation and its changes, and able to take into account institutional responses and the effects produced by choices and by the corrective actions determined by these choices.

The European Union places the sustainable use of waste within the scope of the broader strategy of strategic use of resources; this approach starts from modifying the current growth and consumption models to define a consistent framework of action that embraces different areas and sectors.

Some Member States have an efficient management system, in fact recycling more than 80% of waste and indicating how waste can be used as a resource. Others on the other hand still send up to 90% of generated waste to landfill.

Improving waste management makes better use of resources and can open up new markets and jobs, as well as encourage less dependence on imports of raw materials and lower impacts on the environment.

Unfortunately, the current management models, like the control systems that often use insufficient procedures, have not always been adequate. This has also fostered the development of traffic connected with organized crime, which has built an enormous business around waste.

Directive 2008/98/EC was transposed into Italian law with Legislative Decree no. 205 of 03 December 2010, which deeply modified and, in some parts, totally rewrote the fourth part of Legislative Decree no. 152/2006.

In particular, the amended article 179 of Legislative Decree no. 152/2006, implementing the provisions of art. 4 of Directive 2008/98/EC, establishes the order of priority of regulations and policy in the matter of waste management and prevention. Prevention remains the absolute priority, followed by preparation for reuse, recycling, recovery of other kinds (energy recovery, for example) and, lastly, disposal. To guarantee the implementation of prevention policies considered to be priorities in the management hierarchy, it was ordered that by 31 December 2012, the Ministry of the Environment and Protection of Land and Sea would adopt a national waste prevention Programme and work out recommendations for this programme to be integrated into the regional waste management plans. The prevention programmes have the objective of decoupling economic growth from the environmental impacts connected with waste generation.

Prevention remains the absolute priority, followed by preparation for reuse, recycling, recovery of other kinds (energy recovery, for example) and, lastly, disposal.

In line with the provisions of Directive 2008/98/EC, both the national Programme and the regional Programmes, developed based on the national one, will have to set prevention objectives. The Ministry of the Environment and Protection of Land and Sea is required to describe the existing prevention measures, assess the usefulness of the sample measures indicated in annex L of Legislative Decree no. 205/2010 or of other appropriate measures, and ensure the availability of information on the best practices in the matter of waste prevention and, where applicable, develop guidelines to assist the regions in preparing the regional programmes.

Other measures to promote prevention are identified in article 180-bis of Legislative Decree no. 152/2006, which establishes that public administrations promote specific initiatives aimed at fostering the reuse of products and the preparation for reuse of waste, such as, for example, the adoption of economic instruments, of educational measures, and of programme agreements.

This area also includes the requirement for public administrations to adopt assessment criteria for awarding public contracts, based on environmental characteristics and on containing energy consumption; towards this end (within six months of the entry into force of the legislative decree), the Ministry of the Environment will have to

establish the objectives of environmental sustainability in purchases by public administration.
In order to foster the development of an authentic waste management industry and to promote and develop the "recycling society," Legislative Decree no. 205/2010 introduces new definitions, specifies the notions of recovery and disposal, sets recycling and recovery objectives, and identifies specific measures for achieving them. It thus introduces a different approach, more attentive to reducing waste upstream and to increasing separate waste collection with a view to possible recovery and recycling, in such a way that waste management does not pursue quantitative goals alone, but becomes a full-fledged sector of the recovery and recycling industry capable of offering economic and business opportunities. The most important measures to help Italy move closer to being a "recycling society" seeking to avoid waste generation and to use waste as resources, are indicated in article 181 of Legislative Decree no.152/2006.

The municipalities, based on the criteria laid down by the Ministry of the Environment and Protection of Land and Sea and by the regions, will have to achieve, by the end of 2015, separate waste collection at least for paper, metal, plastic, glass, and - where possible - wood.

The municipalities, based on the criteria laid down by the Ministry of the Environment and Protection of Land and Sea and by the regions, will have to achieve, by the end of 2015, separate waste collection at least for paper, metal, plastic, glass, and – where possible – wood.
Separate waste collection is thus accorded the role as essential instrument for guaranteeing quality recycling of the various categories contained in municipal waste.
Separate waste collection, implemented in compliance with the provisions of article 205 of Legislative Decree no.152/2006, and additional measures adopted by the municipalities, are functional to the achievement of specific preparation objectives for reuse and recycling, to be attained by 2020.
The targets involve both the waste categories originating from households (at least paper, metal, plastic, and glass) or of other origin, to the extent that these waste streams are similar to household ones, and non-hazardous construction and demolition waste, excluding the material in natural state identified by code 17 05 04 in the European Waste List.
Specifically, the former waste has to be prepared for reuse or recycled for at least 50% by weight, and construction and demolition waste for at least 70%. Again with the same objective of making waste disposal residual to the benefit of all forms of prevention, recycling, and recovery, the principle of producer responsibility has been introduced in compliance with Directive 2008/98/CE.
The producer's individual responsibility is a considerable spur to modifying products' design features to promote their recyclability or reduce waste generation. Moreover, by requiring producers to bear the products' recycling cost at the end of the life cycle, their specific role in the producer-consumer-waste manager chain is leveraged to finance recycling and incorporate its management costs into the product's price. In this way, the aim is also to incentivize producers to reduce the cost of reusing and recycling their products, for example by choosing design solutions or materials designed for recycling.
The implementation of the regulatory provisions described thus far should guide our country towards sustainable waste management.

Generation and management of municipal waste

The information on municipal waste generation and management shows a system, in certain settings, that is highly evolved and comparable with the best experiences in other countries in the European Union.

The situation at any rate appears extremely diversified, and many efforts will still have to be made to attain the objectives that the new Framework Directive 2008/98/EC on waste imposes, especially as regards the prevention and recovery of municipal waste.

In 2010, the generation of municipal waste came to somewhat less than 32.5 million tonnes, recording a percentage increase equal to 1.1% over 2009.

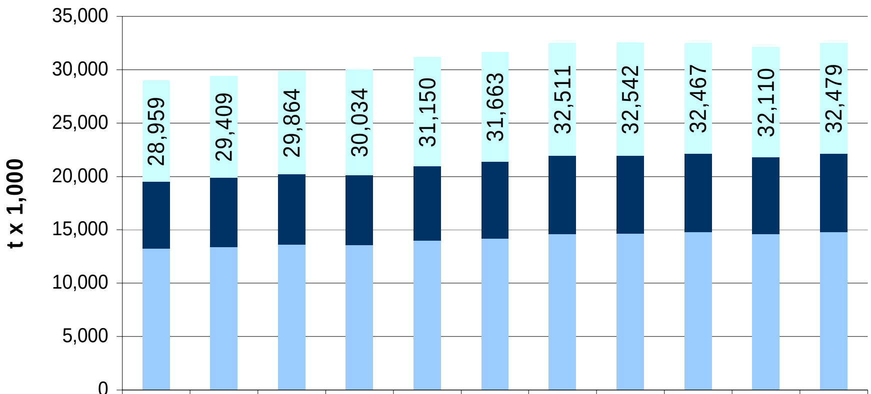
The 2010 generation of municipal waste was somewhat shy of 32.5 million tonnes

After the declines in generation recorded between 2007 and 2008 (-0.2%) and between 2008 and 2009 (-1.1%), last year's increase results in a generation level similar to that in 2008.

In general, the trend in the generation of municipal waste appears to be in line with that of socioeconomic indicators, such as domestic product and household spending, although, in comparison with what was observed for the latter, the growth in waste generation was, between 2003 and 2007, more sustained, and the subsequent decline, between 2007 and 2009, less evident.

As regards per capita generation, the 2010 level was 536 kg/inhabitant per year, as against about 532 kg/inhabitant in 2009 (Figures 10.1 and 10.2).

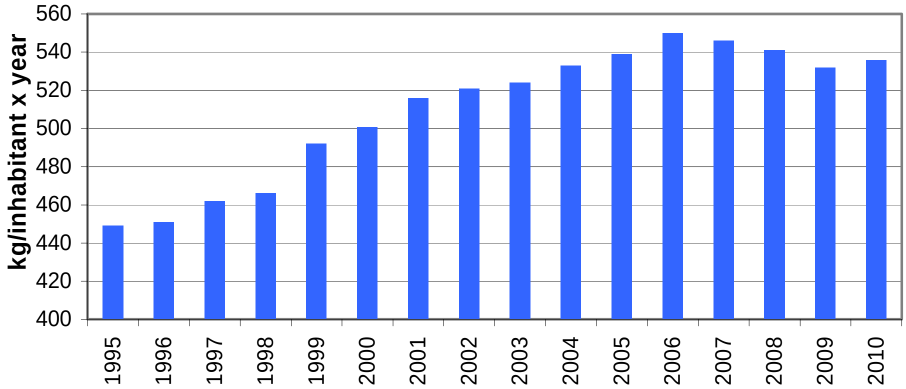
Between 2009 and 2010, 1.1% growth in municipal waste generation was observed.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South	9,469	9,506	9,637	9,872	10,181	10,258	10,555	10,575	10,340	10,303	10,348
Centre	6,214	6,501	6,594	6,586	6,941	7,230	7,352	7,350	7,302	7,186	7,323
North	13,276	13,402	13,632	13,576	14,028	14,175	14,604	14,617	14,825	14,621	14,808

Figure 10.1: Municipal waste generation[1]

[1] Source: ISPRA

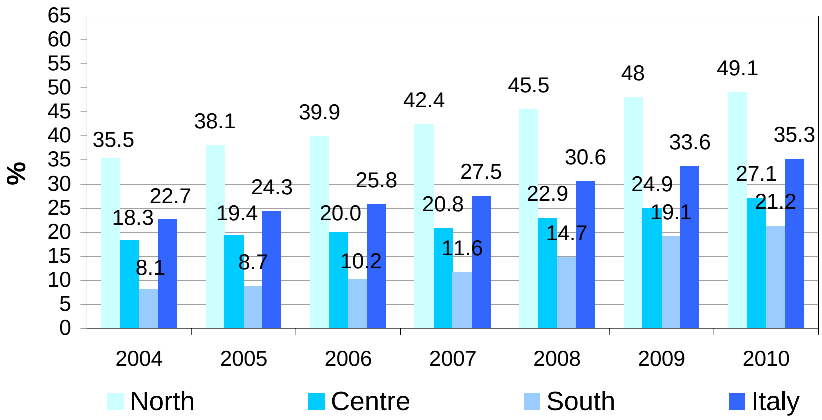


Per capita generation in 2010 was 536 kg/inhabitant per year.

Figure 10.2: Per capita municipal waste generation[2]

In 2010, separate waste collection reached a percentage equal to about 35.3% of the national generation of municipal waste, for more than 11.4 million tonnes. (Figure 10.3).
The separate waste collection situation appears considerably diversified at the level of geographical macro-area.
In fact, the north's percentage equals 49.1%, while the centre and south show figures equalto 27.1% and 21.2% respectively.

In 2010, separate collection reached 35.3% of total municipal waste generation.



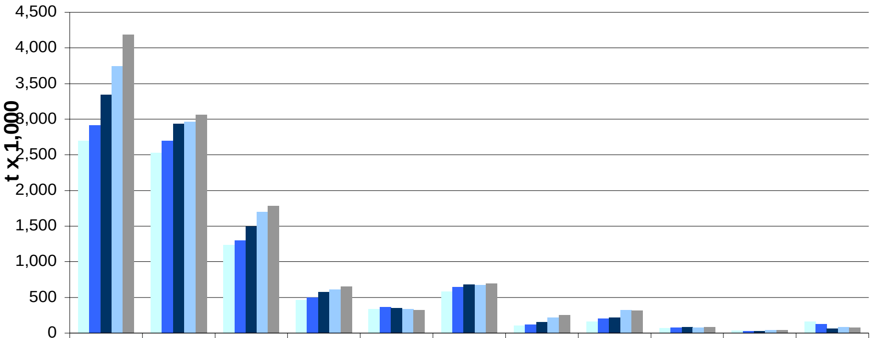
The separate waste collection situation appears considerably diversified at the level of geographical macro-area. In fact, the north's percentage equals 49.1%, while the centre and south show figures equal to 27.1% and 21.2% respectively.

Figure 10.3: Percentage of municipal waste that is collected separately[3]

In 2010, organic waste (kitchen scraps and greenery from yard and park maintenance) was confirmed as the most collected category, representing 36,6% of the separate waste collection total (34.7% in 2009, Figure 10.6). Between 2009 and 2010, an increase of more than 440,000 tonnes (about +11.8%) of organic-category separate waste collection (wet waste + greenery), was recorded, following the growths of 433,000 tonnes and of more than 400,000 tonnes recorded respectively between 2007 and 2008 and between 2008 and 2009. The past four years have thus seen an increase in organic separate waste collection, alongside more contained increases recorded over the previous 2004-2007 period (on average, about 230,000 tonnes of growth per year).

The organic category accounts for 36.6% of the separate waste collection total.

[2] Source: ISPRA
[3] Source: Ibidem

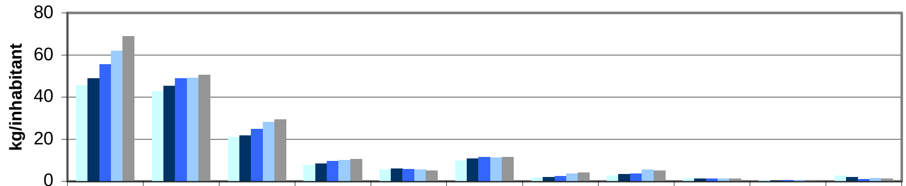


	Organic fraction	Paper	Glass	Plastic	Metal	Wood	WEEE	Other bulk	Fabrics	Selective	Other
2006	2,701	2,529	1,240	459	337	581	106	158	70	32	163
2007	2,910	2,698	1,297	500	362	643	116	201	73	31	129
2008	3,340	2,934	1,496	577	354	681	157	221	80	32	60
2009	3,744	2,962	1,703	613	340	676	217	329	71	37	86
2010	4,187	3,063	1,779	649	318	692	254	316	80	38	79

Between 2009 and 2010, an increase of more than 440,000 tonnes (about +11.8%) of organic-category separate waste collection was recorded.

Note: the percentages for the glass, plastic, metal, and wood categories are provided by the sum of the amounts of packaging and of other waste types consisting of these collected materials.

Figure 10.4: Separate waste collection broken down by category[4]

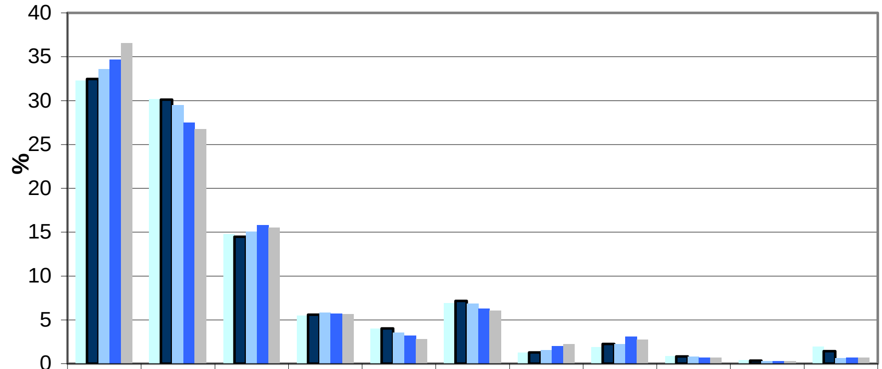


	Wet waste - greenery	Paper	Glass	Plastic	Metal	Wood	WEEE	Other bulk	Fabrics	Selective	Other
2006	45.7	42.8	21.0	7.8	5.7	9.8	1.8	2.7	1.2	0.5	2.8
2007	48.8	45.3	21.8	8.4	6.1	10.8	1.9	3.4	1.2	0.5	2.2
2008	55.6	48.9	24.9	9.6	5.9	11.3	2.6	3.7	1.3	0.5	1.0
2009	62.0	49.1	28.2	10.2	5.6	11.2	3.6	5.4	1.2	0.6	1.5
2010	69.1	50.5	29.3	10.7	5.2	11.4	4.2	5.2	1.3	0.6	1.3

Figure 10.5: Per capita separate waste collection by category[5]

On the national level, per capita separate waste collection of the organic category equalled, in 2010, 69 kg/inhabitant per year, against 62 kg/inhabitant per year for 2009.

[4] Source: ISPRA
[5] Source: Ibidem



	Wet waste - greenery	Paper	Glass	Plastica	Metal	Wood	WEEE	Other bulk	Fabrics	Selective	Other
2006	32.2	30.2	14.8	5.5	4.0	6.9	1.3	1.9	0.8	0.4	1.9
2007	32.5	30.1	14.5	5.6	4.0	7.2	1.3	2.2	0.8	0.3	1.4
2008	33.6	29.5	15.1	5.8	3.6	6.9	1.6	2.2	0.8	0.3	0.6
2009	34.7	27.5	15.8	5.7	3.2	6.3	2.0	3.1	0.7	0.3	0.7
2010	36.6	26.7	15.5	5.7	2.8	6.0	2.2	2.8	0.7	0.3	0.7

The cellulose and organic categories, taken together, represent more than 63% of total separate waste collection. Moreover, along with the textile and wood categories, they constitute what is referred to as biodegradable waste.

Note: the percentages for the glass, plastic, metal, and wood categories are provided by the sum of the amounts of packaging and of other waste types consisting of these collected materials

Figure 10.6: Percentage breakdown of separate waste collection[6]

In the south, collection of the organic category grew by more than 160,000 tonnes over 2009 and 370,000 tonnes over 2008.

At the level of geographical macro-areas, total collection of the organic category exceeded 2.7 million tonnes in the north in 2010, for an almost 160,000 tonne increase over 2009; levels equalled almost 640,000 tonnes in the centre, and exceeded 820,000 tonnes in the south. In this latter geographical macro-area, collection of the organic category showed, in comparison with 2009, a growth of more than 160,000 tonnes, and of more than 370,000 tonnes against 2008.

In terms of per capita values, collection of the organic category equalled 98 kg/inhabitant per year in the north, 53 kg/inhabitant per year in the centre, and 39 kg/inhabitant per year in the south. Although showing an increase in all geographical macro-areas, these data underscore the considerable gap that exists between the northern and the central-southern regions. Nationally, the per capita value of collection of the organic category came to about 69 kg/inhabitant per year in 2010 (62 kg/inhabitant in 2009).

Separate waste collection in the cellulose category over the last year was recorded at somewhat less than 3.1 million tonnes, showing approximately 3.4% growth over 2009.

Almost 60% of the total is collected in the regions of northern Italy (more than 1.8 million tonnes), while amounts equalling 700,000 tonnes and 550,000 tonnes come respectively from the regions in the centre and south. These amounts translate to per capita collection values exceeding 65 kg per inhabitant per year in the north, nearing 59 kg per inhabitant per year in the centre, and equalling 26 kg per inhabitant per year in the south (a level equalling that of 2009).

Nationally, per capita collection of the cellulose category exceeded 50 kg per inhabitant per year in 2010.

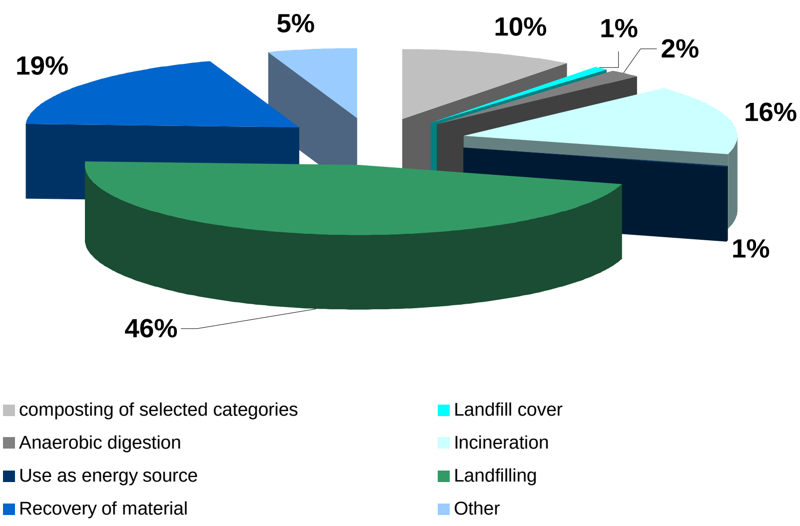
The cellulose and organic categories, taken together, represent about 63.3% of total separate waste collection. Moreover, along with the

[6] Source: ISPRA

textile and wood categories, they constitute what is referred to as biodegradable waste, for which Legislative Decree no. 36/2003 introduced specific objectives to reduce dumping in landfill. The amount of biodegradable waste collected separately exceeded 8 million tonnes in 2010, showing an approximate 7.6% growth over 2009. In the last year of reference, this category holds a share equal to approximately 70% of the total waste collected separately, with an average value, recorded in 2006-2010, equal to about 70%. Separate collection of glass came to somewhat less than 1.8 million tonnes in 2010, with a growth of approximately 4.5% over the year before, while plastic neared 650,000 tonnes, showing a percentage increase equal to 5.7% over 2009. Also on the rise over the same period was the separate collection of wood (approximately +2.4%), which, over the last year, exceeded 690,000 tonnes, and that regarding e-waste (+17%), which exceeded 250,000 tonnes. Analysis of management data shows that, in 2010, about 46% of the municipal waste generated was sent to landfill.

Separate collection of biodegradable waste (organic, paper, wood, and textile categories) exceeded 8 million tonnes in 2010, showing an approximate 7.6% growth over 2009.

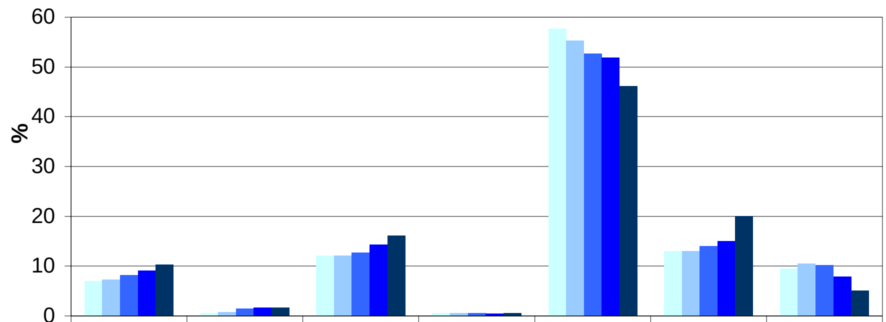
Landfill is therefore the most widespread form of management, even if it is no longer prevalent; in fact, on the whole, the other types of recovery, treatment, and disposal represent more than one half of the waste generated yearly (54%). In particular, 19% is subjected to material recovery operations (excluding composting), 16% is incinerated with energy recovery, 12% goes to aerobic or anaerobic biological treatment processes (10% to composting, 2% to anaerobic digestion), l.1% goes to production plants, such as cement factories, to be used as fuel to produce energy, and the same amount, after pre-treatment, is used to cover the landfills.



In parallel with the growth of separate waste collection, an industrial system is being developed for recycling the materials collected separately, now involving 31% of the total municipal waste that is managed (compost from selected categories, anaerobic digestion, and other forms of recovery of material).

Figure 10.7: Percentage distribution of municipal waste management, 2010[7]

[7] Source: ISPRA



	Composting of selected categories	Anaerobic digestion	Incineration	Use as energy source	Landfilling	Recovery of material	Other
2006	7	1	12	1	58	13	9
2007	7	1	12	1	55	13	11
2008	8	1	13	1	53	14	10
2009	9	2	14	0.4	52	15	8
2010	10	2	16	1	46	20	5

In 2010, even if disposal in landfill is still the most widespread form of management, an additional decline in its percentage weight has been recorded.

Figure 10.8: Trend in the percentage distribution of municipal waste management[8]

Disposal in landfill has declined from 2009 by more than 520,000 tonnes (-3.4%). On the other hand, the amount of waste sent for mechanical biological treatment has increased by about 1.7 million tonnes (+23%), and that of incinerated waste by more than 630,000 tonnes (+13%).

The total waste sent to the various forms of recovery of material (composting, anaerobic digestion, recycling of packaging and other materials) has increased by 6%.

The forms of recovery of material of the various categories of separate collection, such as paper, plastic, glass, metal, and wood, involve about 6.5 million tonnes. Composting of the organic category, with a total amount of treated municipal waste equalling about 3.3 million tonnes, has recorded a 14% increase (equal to 402,000 tonnes), showing further growth in the sector.

The waste sent to anaerobic digestion plants, which also consists essentially of the organic category from separate collection, rose from about 546,000 tonnes in 2009 to approximately 564,000 in 2010.

Disposal in landfill has declined from 2009 by more than 520,000 tonnes (-3.4%; the amount of waste sent for mechanical biological treatment has increased by about 1.7 million tonnes (+23%). The amounts of incinerated waste (+13%) and of waste sent for recovery of material (+6% total) have also increased.

Generation and management of special waste

Special waste generation was quantified starting from the information contained in the MUD (*Modello Unico di Dichiarazione ambientale* – single environmental declaration) database for the yearly declarations..

The illustrated data refer to 2010, and were therefore drawn from the declarations submitted in 2011.

In order to partially fill the information gap derived from the exemptions from the MUD provided for by Legislative Decree no. 152/2006, ISPRA has supplemented the MUD data using specific estimation methodologies. These methodologies were applied only to certain productive sectors (in certain cases to departments within

[8] Source: ISPRA

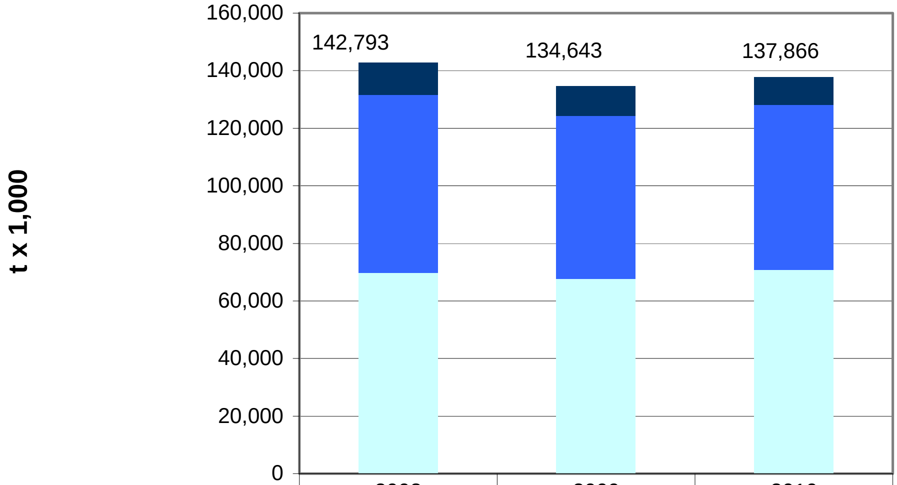
productive sectors), for which information has always been found to be lacking; for this reason, even the supplemented data set may turn out to be partially underestimated.

The year 2010 saw an overall generation of special waste amounting to 137.9 million tonnes, a 2.4% rise from 2009 (134.6 million tonnes). This increase is closely correlated with the limited recovery of the market and industry after the economic and financial crisis of 2008-2009.

In detail, the increase is due only to non-hazardous special waste that, against 2009, shows a 3.1% increase (more than 3.9 million tonnes), returning to 2008 levels. Hazardous waste generation shows, on the other hand, a percentage decline of 6.4%, equal to 651,000 tonnes.

Non-hazardous waste generation equals 128.2 million tonnes, including the quantities originating from construction and demolition activities. On the other hand, the amount of hazardous special waste generated in 2010 amounts to about 9.6 million tonnes.

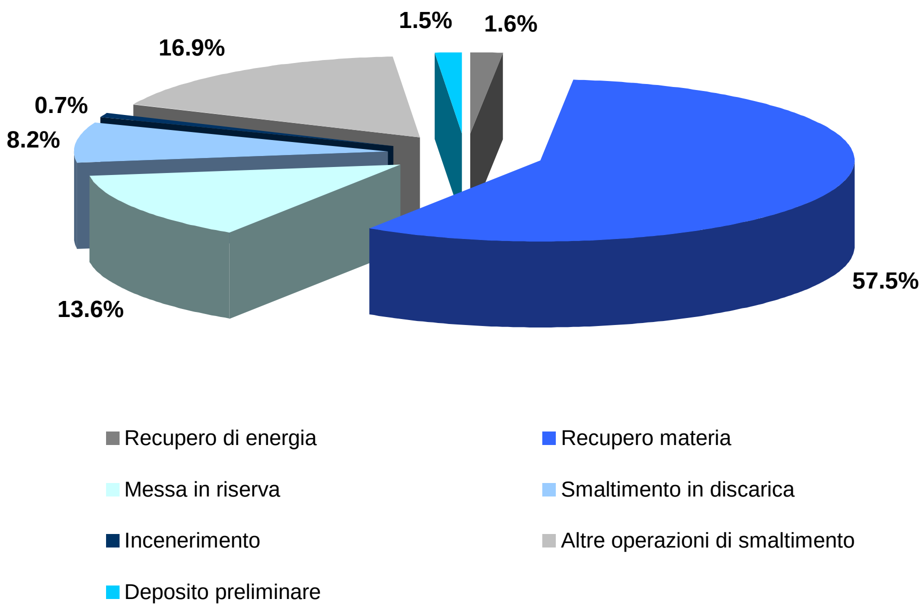
Between 2009 and 2010, there has been a 1.3% increase for non-hazardous special waste from C&D, and an approximately 4.8% increase for non-hazardous special waste originating from other productive activities. Non-hazardous special waste comes above all from the construction and demolition sector and from manufacturing activities, with percentages respectively equalling 46.2% and 26.4% of the total, while waste treatment activities account for 20.2% of total generation, for almost 26 million tonnes. Analyzing hazardous waste alone, it may be noted that the manufacturing sector generated about one half of the total – 47.8% to be exact, equalling 4.6 million tonnes. On the other hand, 24.4% may be attributed to the "services, trade, and transport" sector, which takes in an amount equal to about 1.7 million tonnes of end-of-life vehicles removed from circulation for demolition, and 18.4% comes from waste treatment activities. 63.8% (2,9 million tonnes) of the amount of hazardous waste generated overall by the manufacturing sector derives from the industry of chemical fabrication and refining, rubber items, and plastic items. The estimated share represents more than one half of the total set of data for special waste, due especially to the contribution of waste generated by construction and demolition activities.



	2008	2009	2010
waste list code not available	7	3	4
H SW	11,291	10,315	9,660
NH SW from C&D	61,720	56,681	57,421
NH SW excluding C&D	69,775	67,644	70,781

In 2010, total special waste generation equalled approximately 137.9 million tonnes, a 2.4% increase over 2009.

Figure 10.9: National special waste generation[9]



The prevailing form of management is recovery of material, with 57.5%, (83.3 million tonnes), followed by other disposal operations (approximately 25 million tonnes, equal to 17.2%); landfill accounts for approximately 12 million tonnes (8.2%).

Figure 10.10: Special waste management (2010)[10]

[9] Source: ISPRA
[10] Source: Ibidem

The data for non-hazardous waste alone show that 81.4 million tonnes were sent to recovery of material, while 6.5 million tonnes were spread on the soil to benefit farming and the ecology. The operation of storage prior to recovery operations involved more than 19 million tonnes of non-hazardous waste, while more than 30 million tonnes were disposed of, 11 million of which were disposed of in landfill. For hazardous waste, the total amount recovered exceeded 2.3 million tonnes.

The most widespread recovery operation is metal recycling/recovery, with 714,000 tonnes (30.5% of the total), followed by the recycling/recovery of inorganic substances, with 339,000 tonnes (14.5% of the total) and by "recycling/recovery of other organic substances" with 257,000 tonnes (7.8% of the total recovered hazardous waste). Energy recovery involves 131,000 tonnes.

Disposal operations, on the other hand, involved 9.5 million tonnes of hazardous waste – approximately 80% of the managed total. The form most used was physical chemical treatment, with approximately 7.3 million tonnes, 76.3% of the total hazardous waste disposed of, while 8.2% of the waste was disposed of in landfill (about 777,000 tonnes). As to disposal in landfill, the number of installations declined by 30 units from 2009; a total of 475 landfills were counted: of these, 47% are landfills for inert waste (221), 51% are landfills for non-hazardous waste (244), and only 2% are landfills for hazardous waste (10). In 2010, approximately 12 million tonnes of special waste were disposed of in landfill, an almost 7% decline from 2009. The decline is particularly considerable in central Italy (-12%), followed by the north with a 7.7% decline; countering the trend is southern Italy, which shows a 3.8% increase. In 2010, 103 incineration plants treated special waste, and most were located in the north (63), with 24 in the south and 16 in central Italy.

In total, almost 979,000 tonnes of special waste were brought to incineration (397,000 tonnes of hazardous waste and 582,000 tonnes of non-hazardous waste); medical waste exceeded 133,000 tonnes (14% of the total). Compared with 2009, a 4% increase was recorded. As regards energy recovery, 500 industrial plants in operation used special waste as an energy source. Of these, 365 use an amount of waste exceeding 100 t/year, while the remaining 135 use small quantities of waste exclusively for the recovery of thermal energy functional to their own productive cycle. The total of special waste recovered in the form of energy amounts to about 2.3 million tonnes, for a 9% increase over 2009. Hazardous waste exceeds 131,000 tonnes (6% of the total). The regional picture shows that most special waste, equal to 81%, is treated in only seven regions: Lombardy with more than 612,000 tonnes (27%), Emilia Romagna with 425,000 tonnes (19%), Piedmont with almost 223,000 tonnes (10%), Friuli-Venezia Giulia with almost 192,000 tonnes (8%), Veneto with 169,000 tonnes (7%), Apulia with 145,000 tonnes (6%), and lastly Umbria with more than 80,000 tonnes (4%). To complete the waste management analysis, it is also necessary to calculate the amounts imported and exported. In 2010, the amount of exported special

waste came to 3.8 million tonnes, approximately 2.5 million tonnes of which was non-hazardous waste (65%) and more than 1.3 million tonnes hazardous waste (35%). The greatest quantities of exported waste are destined for plants located in Germany (1.5 million tonnes) and China (399,000 tonnes). Germany on the other hand receives more than a million tonnes of hazardous waste that it sends for disposal in the salt mines.
The waste exported to China is only non-hazardous. The quantity of imported waste is greater, exceeding 4.9 million tonnes, and consisting mainly of non-hazardous waste. In fact, hazardous waste exceeds 32,000 tonnes. Again in 2010, Germany was the country from which Italy imported the greatest quantity of special waste, exceeding 1.2 million tonnes, and consisting almost entirely of non-hazardous waste; 92% of the latter consisted of metal scraps.

Specific Regional Characteristics

ARPA Calabria

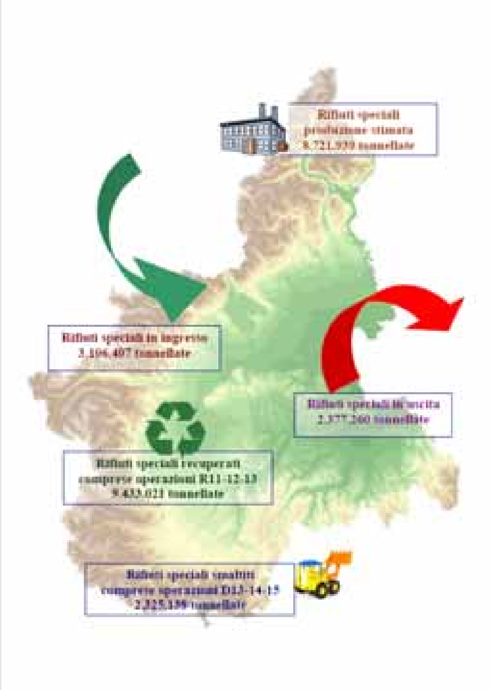
The management of treatment systems is to be brought in compliance in accordance with the principles of exploiting municipal waste materials, in order to confirm the line of maximum recycling. The possibility being brought forward is to rely on intensive models of Separate Waste Collection (including the collection of wet waste).
Analysis of the data (2011) for Calabria, regarding the output of mechanical biological treatment facilities, shows that nearly all the biostabilized portion and the dry category are brought to landfill. In consideration of this, pending fully operational separate collection and to best handle the “waste emergency,” a management of non-separated waste that involves energy recovery and reducing disposal in landfill may be opted for. In particular, the sectoral literature (Adani, 2003) underscores that for municipal waste treated with biodrying processes, it is possible to obtain products with a high biological stability, that may in turn be further processed (sifting, etc.) to produce fuels derived from waste (eg. SRF) of various characteristics, depending on the final uses (e.g. concrete plants, thermal power plants, etc.).

ARPA Campania

The increase in separate collection and the activation of the Acerra incinerator have halved the regional landfill requirement, which fell from 90% in 2003-2008 to 48.6% in 2010. The historic trend and the planning in progress raise hopes for bringing Campanian waste management into alignment with European standards in the years to come.

ARPA Piedmont

The amounts of special waste treated in Piedmont depend not only on the facilities’ location and their treatment capacity, but also on market conditions. To make a calculation of the regional balance of special waste flows in Piedmont, it is necessary to consider all the contributions, while seeking also to estimate the portion of inert waste that is actually generated, which is greater than that derived from the MUD, since producers of CER 17 non-hazardous waste are not required to make a declaration. Taking the quantities managed at the regional level, to which those generated in Piedmont and sent outside the region are to be added, as a basis, and after subtracting those managed in Piedmont but generated elsewhere, an inert waste generation estimate equalling approximately 3,777,345 tonnes is obtained. The flow of incoming and outgoing special waste from the Region towards other Italian Regions is estimated at approximately 5 million tonnes a year, about 2 million of which outgoing and 3 million incoming, far more important than the flow of waste imported from and exported to other countries, equal to approximately 400,000 t/year.



The amount of waste theoretically present on regional territory is less than that actually managed, with a difference equal to approximately 550,000 tonnes of waste. This difference may probably be attributed to the underestimate obtained from processing the data that can be extracted from the MUD database, and may, besides the inert waste, depend on other factors (businesses not subject to MUD, warehousing, waste subjected to a number of consecutive treatments, etc.).

ARPA Apulia

In 2010, the generation of municipal waste in Apulia declined slightly (-0.02%) from 2009, going against the trend both nationally and in the individual macro-areas. As regards the management of municipal waste, a 19% increase in composting of the organic category from separate collection has emerged, with a consequent growth in generation yields. Also noteworthy is the 320% increase for the potential authorized for mechanical biological treatment, with the facilities showing a similar trend in input and output.

In 2012 ARPA, Umbria developed "*portale discariche*" – its landfill website available on the agency's site. There, all environmental information regarding the six municipal waste landfills present in Umbrian regional territory may be consulted. Each landfill is provided with a general section, one on environmental checks, and a map. The general section provides the main information, which is to say the authorization details, the authorized capacity, and for each year the remaining volume, the incoming waste (subdivided by origin, municipal and special), the leachate that is generated and treated on site, the biogas captured, and the energy produced. The section on environmental checks provides, on a yearly basis, the results of the monitoring operations performed by ARPA and by the operator on the water, air, soil, sediment, flora, and noise matrices. With the map, the location of the monitoring points and the outcome of the checks for each point can be displayed. The purpose of this site – the only one of its kind in Italy – is to make the environmental status of Umbria's landfills accessible to citizens, and has brought good results for site visits.	**ARPA Umbria**

The recent events connected with waste management policies in Aosta Valley are of considerable interest. The Region has approved the choice of thermal treatment of waste by means of pyrolysis and gasification. The project has met with strong public opposition, which led to a signature drive to organize a proposition referendum (provided for by the regional law system) to approve a law to ban thermal treatment of waste on regional territory. Held on 18	**ARPA Aosta Valley**

November 2012, the referendum reached the required quorum (45% of the total number of those entitled to vote) with a clear victory (94%) in favour of the proposed law: regional law no. 33 of 23 November 2012 was published in the region's bulletin no. 49 of 2012.

GLOSSARY

Waste:
Any substance or object which the holder discards or intends or is required to discard.

Organic waste (Bio-waste):
Biodegradable garden and park waste, food and kitchen waste generated by households, restaurants, caterers and retail premises and comparable waste from food processing plants.

Self-composting:
Composting of organic scraps of municipal waste, performed by household users, for the purpose of using the generated material on site.

Waste management:
The collection, transport, recovery, and disposal of waste, including the supervision of such operations, and the after-care of disposal sites, and including actions taken as a dealer or broker.

Separate waste collection:
Collection where a waste streamis kept separately by type and nature so as to facilitate a specific treatment.

Reuse:
Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.

Preparation for reuse:
Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing.

Recovery:
Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfila particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy .

Recycling:
Any recovery operation by which waste materials are reprocessed into products, materials, or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Disposal:
Any operation which is not recovery, even where the operation has as a secondary consequence the reclamation of substances or energy.

CHAPTER 11

USE OF RESOURCES AND MATERIAL FLOWS

Introduction

Everything that surrounds us consists of or derives from natural resources. In the mountains, at the seaside or in a city park, nature is there, either unchanged or transformed to some degree, but in any case it is a connected set of natural resources. The products of human activities are nothing else than the result of the transformation of material resources taken from nature.

Everything that surrounds us consists of or derives from natural resources.

The products and infrastructures that we use every day come at a cost to nature. This cost cannot of course be represented in terms of money, but solely in physical terms, as only the latter have a relevance for nature and its balances. This cost is represented – regardless of considerations about the natural functions of specific resources taken – by the material resources that man extracts from the environment to obtain something that he believes to be useful, or rather more useful than the natural resources themselves, if be left in their natural state. Even services, which we may consider to be intangible, indirectly require the extraction of large amounts of natural resources[1].

The products and infrastructures that we use every day come at a cost to nature.

Socio-economic systems are omnivorous: materials of all types – biomass, metal ores, non-metallic minerals and fossil energy resources – are "devoured", and after being used expelled via a metabolism quite similar to that of an animal.

In such a setting a bioeconomic approach is useful, as one that clearly shows the existence of biophysical limits to economic growth set by the material nature of the socioeconomic metabolism, i.e. by the need to transform matter and energy in order to perform the functions of the anthropic system. This metabolism should be studied using a conceptual system that is internally coherent and has statistical tools able to correctly represent phenomena at various levels of aggregation[2].

The system used to analyse material flows that we refer to in this text is the satellite account *Economy-wide Material Flow Accounts* developed by Eurostat[3].

[1] E.g. the fuel input necessary to produce a transport service.

[2] See on this point A. H. Sorman, M. Giampietro: *Generating better energy indicators: addressing the existence of multiple scales and multiple dimensions* in Ecological Modelling 223 (2011) 41–53, in which the authors show that the use of aggregate indicators without considering their composition brings up the risk of misleading information being given out (this argument is developed in relation to the measure normally used for a country's energy performance, but is easily applied to our case).

[3] See also EU Regulation no. 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts.

This system, in keeping with the concepts and criteria of the European accounts system (ESA95) and with guidelines adopted by international organisations for the development of an integrated environmental and economic accounting system[4], describes the global use made of natural resources by the economy in terms of the physical mass of handled materials.

In short, the approach is:

- multi-scale, being possible to conduct both *macro* (whole economy) and *meso* (economic activity) analyses;
- multi-dimensional, bringing together the economic and environmental dimensions.

Table 11.1 shows the trends of some socio-economic and environmental variables whose figures refer to the whole of the Italian economy: Direct Material Input (DMI), all material resources (measured by weight) other than air or water at the disposal of the economic system for its annual production, consumption and accumulation cycles; Gross Domestic Product (GDP), the aggregate that gives an idea of the dimension of the economic system in terms of the economic value of new goods and services made available to final users; employment, expressed in units of full-time equivalents (FTE)[5]; CO_2 emissions, from industry and from households, one of the main outputs towards the natural environment deriving from the socio-economic metabolism.

Table 11.1: Trends of some socio-economic and environmental variables, Italy, 1992-2010 (Indices, 1992=100)[6]

This table shows the trends of some socio-economic and environmental variables ,referred to the whole of the Italian economy.

Socio-economic and environmental variables	1992	1995	2000	2005	2010
	Index 1992=100				
Direct Material Input	100	94.1	113.1	107.3	87.2
Gross Domestic Product (GDP)[a]	100	104.2	114.5	120.3	118.8
Employment (FTE)	100	95.8	99.7	104.0	102.1
CO_2 emissions from industries[b]	100	101.9	105.4	110.4	94.1
CO_2 emissions from households[b]	100	105.5	112.6	119.8	109.5

Notes

a: GDP at market prices, chain-linked volumes, reference year 2005

b: Air emissions accounts

[4] European Commission, Food and Agriculture Organization, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank (2012): *System of Environmental-Economic Accounting (SEEA). Central Framework.* Just as for economic data, the SEEA offers an international standard on criteria, definitions and classifications for the generation of statistics on the interaction between the economy and the environment.

[5] Full-time equivalents (FTE): Unit for measuring the volume of work performed, calculated by transforming the unit values of part-time working positions into full-time equivalents. The survey on employment comprises the following job levels: executives, white collar, blue collar, clerks, apprentices and domestic workers, but does not include top managers. (Source: Istat)

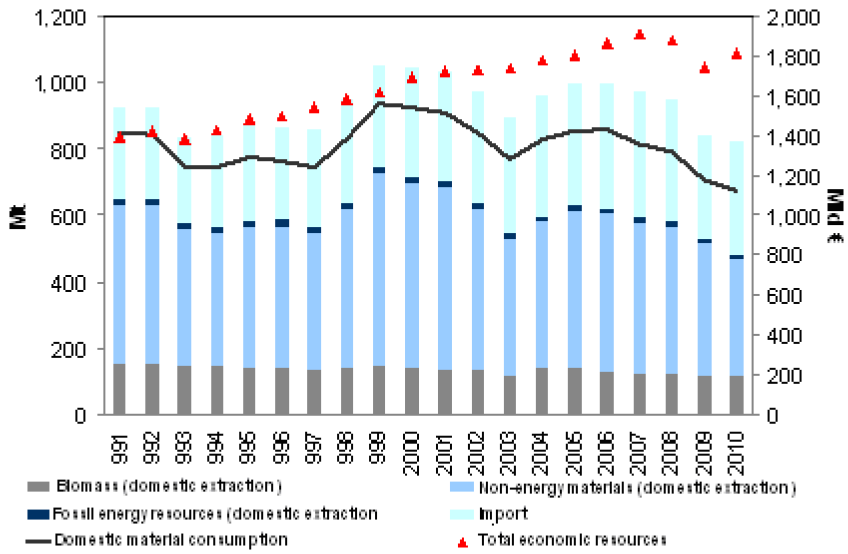
[6] Source: ISTAT

Material flows of the Italian economy

Direct Material Input (DMI) records materials used of domestic origin (domestic extraction) and imported products , regardless of whether the final destination of the materials they are made from is domestic (emission of residues and accumulation of residues and durables) or for overseas (exports).

The indicator is formally similar to the monetary aggregate for the economic value of all available resources, i.e. GDP plus imports. Figure 11.1 includes this variable too, to offer a comparison with the trends and dimensions of the economy more correct in relation to the usual one with GDP only.

Figure 11.1 also shows the aggregate Domestic Material Consumption (DMC), which differs from DMI by the mass of materials exported[7].



DMI totalled 823.8 million tons in 2010, an 11.1% fall compared with 1991.

Figure 11.1: Direct material input, Domestic Material Consumption and total economic resources (chain-linked volumes, reference year 2005) in Italy[8]

DMI totalled 823.8 million tons in 2010, an 11.1% fall compared with 1991.

It is interesting to look at material flow trends considering separately the domestic component and imports. The latter have been growing considerably (23.2% in the period under review), while domestic extraction has fallen by 26%. As a result of the different trends of the two components, the composition of DMI has gradually changed in favour of foreign flows, which went from 30.2% of DMI in 1991 to 41.9% in 2010.

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[7] DMC is normally used as a reference (e.g. in European indicators for the monitoring of development sustainability) for policies on sustainable production and consumption, and in particular for the question of resource scarcity. Use of the DMC indicator for this purpose does not appear to be optimal, since for construction this does not include material resources incorporated in traded products. Therefore we have preferred to highlight all material resources used in the national socio-economic system, expressed by DMI, and to analyse its composition

[8] Source: ISTAT

The main materials extracted in Italy are non-energy minerals – non-metallic minerals in particular – and biomass, while Italy's economic system is dependent on foreign markets for energy and metal ore resources.
Figure 11.2 shows this dependence pattern in detail, showing imports and exports and their composition by material type. Exports also grew considerably in the period under study: the Direct flows of exported materials almost doubled.
In the period 1991-2010 the Physical Trade Balance (PTB) was down by about 4% due to a lower rise in imports compared with exports.

In the period 1991-2010 the Physical Trade Balance was down by about 4% due to a lower rise in imports compared with exports.

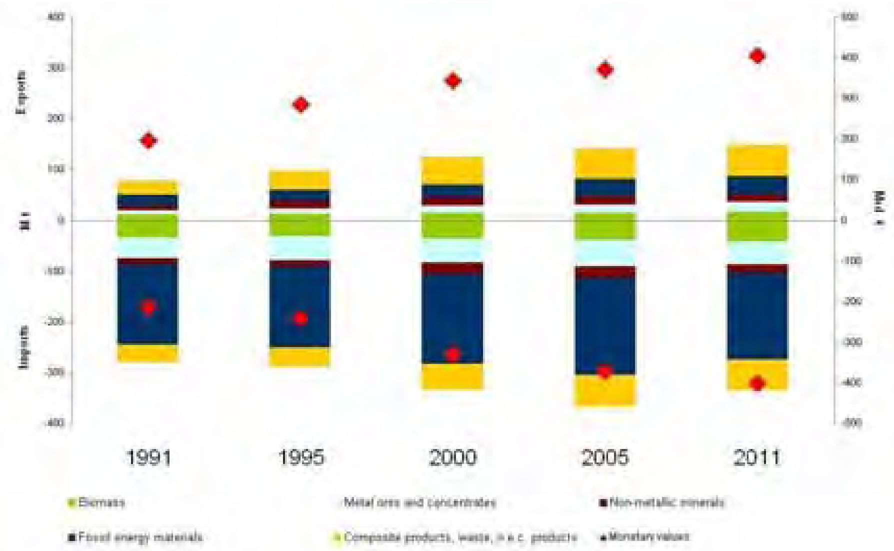


Figure 11.2: Imports and Exports in physical terms by category of material; total imports and exports in monetary terms in Italy (chain-linked volumes, reference year 2005)[9]

Unlike what happens with monetary values, for which the trade balance is close to zero, foreign trade in physical terms is very much out of equilibrium, with imports 2.3 times greater than exports in 2011 (in 1991 the ratio was 3.6).
Italy's dependence on raw materials, very much like most other European nations, makes it a net importer of material resources.
Table 11.2 shows the dependence on imports for the four macro-categories of raw materials and for some particularly significant resources (in some macro-categories).

[9] Source: ISTAT

Table 11.2: The physical external constraint of the Italian economy (share of Imports on Direct Material Input)[10]

The Italian economy is basically self-sufficient only for materials used mainly in the construction industry i.e. non-metallic minerals.

Materials	**1991**	**2010**
	%	
Crops	17.0	30.8
Cereals	*31.1*	*45.9*
Other biomass	40.3	55.4
Timber(industrial round-wood)	*80.1*	*85.3*
Metal ores	99.7	98.2
Non-metallic minerals	2.4	4.8
Fossil energy resources	89.4	93.3
Coal and other solid energy resources	*92.7*	*91.8*
Crude oil and natural gas liquids	*96.1*	*95.3*
Natural gas	*68.9*	*89.9*
Ratio of total imports to DMI	30.2	42.6

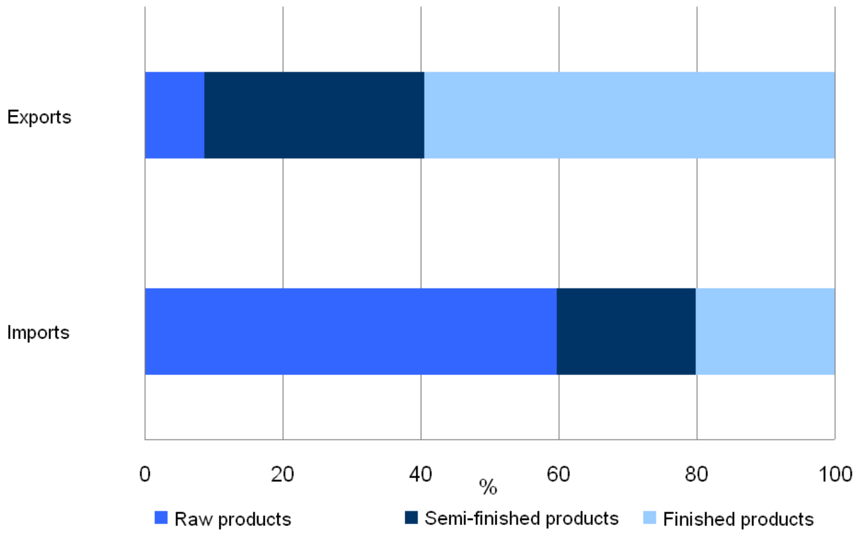
It is seen that the Italian economy is basically self-sufficient only for materials used mainly in the construction industry, i.e. non-metallic minerals. With regard to biomass, less use is made of imports of crop products compared with other categories of biomass, including industrial timber, which reached 85% of imports in 2010. There is a lower but growing dependence on crop products, in particular cereals, whose share reached 46% in the period under review. Italy also imports almost all its metal and fuel needs. The share of imports out of all fossil energy resources available for Italy's economic system remained steady during the period reviewed, at around 90%. This share is high for all energy products; for natural gas too, it went from just below 70% up to 1998 to about 90% in 2006, since national resources were insufficient to meet the growth in demand.

The composition of exported products is of course very different to that for imported products.

The composition of exported products is of course very different to that for imported products. In terms of weight, products exported in 2011 derived from biomass (10.8%), metal ores (13.1%), non-metallic minerals (10%), fossil fuels (23.5%), while the remaining 42.6% were composite products, and waste. The latter is the only category of goods whose share of the total is clearly rising (36% in 1991), while products deriving from fossil fuels are falling (27.5% in 1991).

In 2011 imports consisted mainly of raw products (60%), while the remainder was even shared between semi-finished and finished products (Figure 11.3). In the period 1991-2011 these shares varied significantly only for semi-finished and finished products, by -3.2% for the former and +4.9% for the latter. The breakdown of exported products by level of manufacture shows that exports were almost exclusively semi-finished and finished products (32% and 60% respectively in 2011). Compared with 1991, in 2011 the share of exported semi-finished products was down, while that of finished products was up. The share of raw products remained steady in the period 1991-2011.

[10] Source: ISTAT



In 2011 imports consisted mainly of raw materials (60%), while the remainder were even shares of semi-finished products and finished products.

Figure 11.3: Imports and Exports by stage of manufacturing in Italy (2012)[11]

Material footprint

The figures on foreign trade do not however give a complete picture of the demand for material resources of Italy's socio-economic system. They cannot be straightforwardly interpreted in terms of the scarcity of resources or potential pressure on the global environment, and they are not consistent with data on the domestic extraction of materials, since they do not consider raw materials extracted and used to produce imported and exported goods and services. These are indirect flows, and represent a part of the so-called *ecological rucksack* that is transformed into waste or emissions.

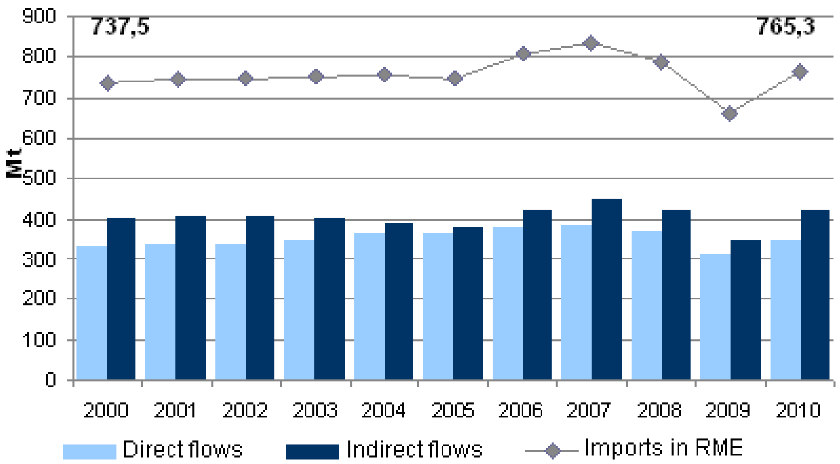
A more exhaustive picture can be gained by expressing imports and exports in Raw Material Equivalents (RME).

A more exhaustive picture can be gained by expressing imports and exports in Raw Material Equivalents (RME)[12]. The RME of a given quantity of cereals traded overseas consists not only of cereals but also of what had to be extracted to produce all the products (goods and services) used as input (intermediate consumption) in the farming activity, such as oil used to produce the fuels used by farm machinery and the raw materials used for soil fertilisers. It should be noted that the part of RME not physically contained in imported goods and services becomes, overseas, a residue returned to the natural environment or waste accumulated in a landfill. This part makes up the indirect flow of imports. The same holds true for exports. If in addition to "direct flows" with overseas we consider indirect flows, i.e. extracted resources used to produce goods and services traded with overseas, imports and exports in RME are obtained.

[11] Source: ISTAT

[12] Actually, the expression Raw Material Equivalents is not totally correct, with "raw materials" referring to products deriving from the first-stage processing of material natural resources. Often it is in these processing phases that the most waste is produced per unit of useful product, and it is this discarded material that makes the difference between resources and products, which is a significant one in the bioeconomic approach to the analysis of material flows.

The "upstream" needs can be calculated by different methodologies, e.g. by the inventory input of the *Life Cycle Analysis*, or by a more complete but much less detailed *Input-Output* model used in the economic analysis. Hybrids of the two methods are often used, such as the model based on *Input-Output*, developed by Eurostat, to estimate direct and indirect material flows relating to foreign trade for the EU27 only[13]. Based on this model, suitably adapted to the case of Italy, and on the supply and use tables of the Italian economy[14], the imports, exports and final domestic uses in RME were calculated for the period 2000-2010. The approach adopted to calculate RME reconstructs the chain of material resources needed to obtain the products actually imported, used in the country and exported, and gives a clear idea of the Italian *material footprint* and its composition.
The strong, growing dependence of the Italian economy on imports, already commented on, places emphasis on the analysis of total flows, both direct and indirect, associated with imports, and thus on the calculation of imports in RME.
In 2010 imports in RME totalled 765.3 million tons (cf. Figure 11.4), having a value 2.2 times more than direct imports[15]. This factor remains fairly constant for the whole period reviewed. So, just as for the quantity of products actually imported, for RME too there was a growth up to 2007 (+14.7% since the year 2000). After a sharp fall in 2009, at the end of the period this quantity returned at a level a little higher than that recorded in the year 2000.



In 2010 imports in RME totalled 765.3 million tons, having a value 2.2 times more than direct imports, i.e. actually imported products.

Figure 11.4: Imports in RME, actual imports and their indirect flows of materials used in Italy[16]

[13] For more information: http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/RME_project_-_Introduction_v%204.pdf

[14] The *supply and use tables* are in the form of matrices that record how supplies of different products originate from domestic industries and imports and how those supplies are allocated between intermediate or final uses, including exports.

[15] It should be noted that the quantities considered here, pertaining only to raw materials and not to all material resources taken from the natural environment, do not include unused materials, unlike estimates for indirect flows made previously by Istat. These estimates for the years up to 2007 show a ratio between total extractions associated with actual imports and imports in excess of 4.

[16] Source: Eurostat and Istat data processed by Ispra-Istat

The results of this application are quite detailed, both by product type (166 types for imports, 59 for final domestic uses and exports) and by type of resource requested (52 types, broken down by origin, domestic or foreign, resources for final domestic uses and exports). Some of these results are presented below, with reference only to the type of resources required, broken down into 4 macro-categories[17]. Figures 11.5 and 11.6 compare for 2010 actual imports with their equivalents in raw materials[18]. Indirect flows, included in RME results, substantially alter the composition by type of material and the level of such flows. The clearest difference in this comparison is for non-energy minerals. Upstream of the imports for this category of products are refining processes that generate large flows of waste materials – belonging to the same category – that do not enter into products actually imported: more than four fifths of the RME of imports of metal ores consisted of indirect flows.

Indirect flows, included in RME results, substantially alter the composition by type of material and level of such flows. The clearest difference in this comparison is for non-energy-producing minerals.

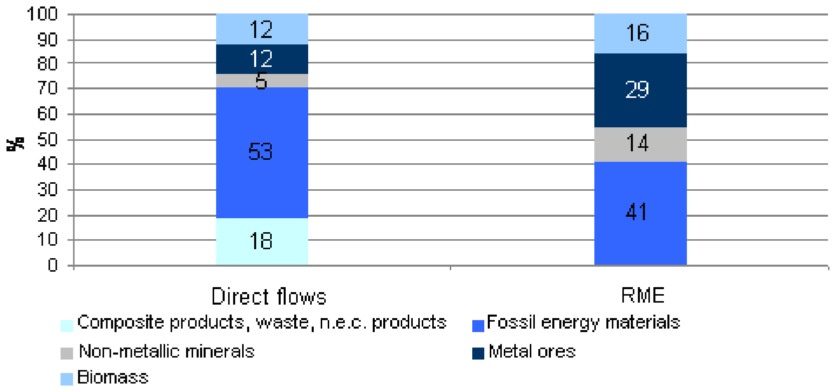


Figure 11.5: Percentage distribution of actual imports and of Imports expressed in RME: composition by category of material taken from the natural environment, Italy, 2010 (Million tons)[19]

Despite the small quantity of direct imports, 17.5 million tons (5% of total), non-metallic minerals recorded a relevant flow of indirect imports (5 indirect tons for every direct ton), which brings their share of the total amount of imports (when expressed in RME) to 14%.

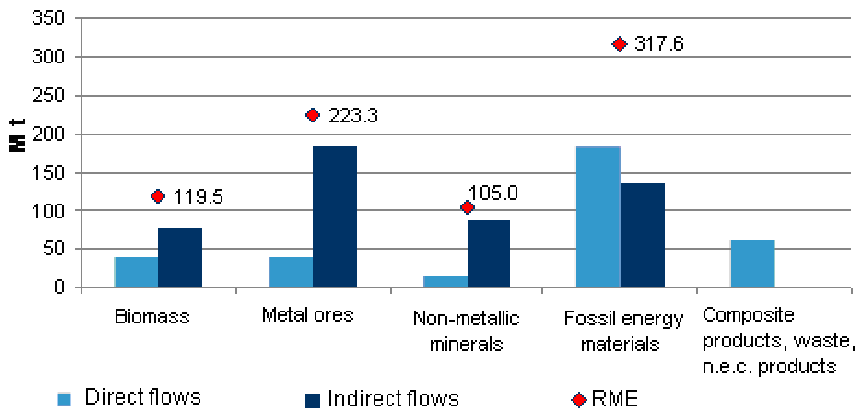


Figure 11.6: Imports in RME, actual Imports and their indirect flows of used materials, Italy, 2010 (Million tons)[20]

[17] Analysis of the results at the most detailed level should bear in mind the uncertainties incorporated into base data and the method of calculation

[18] The percentage composition by categories of materials did not change significantly in the period 2000-2010

[19] Source: Eurostat and Istat data processed by Ispra-Istat

[20] Ibidem

Despite the small quantity of direct imports, 17.5 million tons (5% of total), non-metallic minerals recorded a relevant flow of indirect imports (5 indirect tons for every direct ton), which brings their share of the total amount of imports (when expressed in RME) to 14%. In the same way, 4.5 indirect tons of metal ores are needed for every direct ton.

Fossil fuels, which make up more than 50% of products actually imported, make up a little more than 40% of all RME of imports, due to their lower indirect flows (less than 30% of all indirect flows in 2010). While fossil fuels are a fundamental input for all production processes, the indirect flows of these materials are not so high as those of metal resources since their mining and refining do not entail relevant indirect flows.

Imported biomasses expressed in RME make up 16% of the total. For this category almost 2 indirect tons are needed for every direct ton.

The category "Composite products, waste, other products n.e.c.", disappears altogether, and needs to be considered only for actual imports (and exports). By the definition of RME this category is not applied to total flows since all imported products are "reduced" to the raw materials required to produce them as they are found in nature.

In the period 2000-2010 actual Italian exports grew in terms of weight by 22.1%, despite the 2009 crisis (Figure 11.7). In the same period there was a smaller rise in exports expressed in RME (6.3%), due to the changing composition of exports, leading to a reduction in the global ratio of indirect to direct flows. Exports in RME totalled 491 million tons in 2010, 3.3 times higher than direct exports (vis-à-vis 3.7 in the year 2000).

In the period 2000-2010 actual Italian exports grew in terms of weight by 22.1%, despite the 2009 crisis.

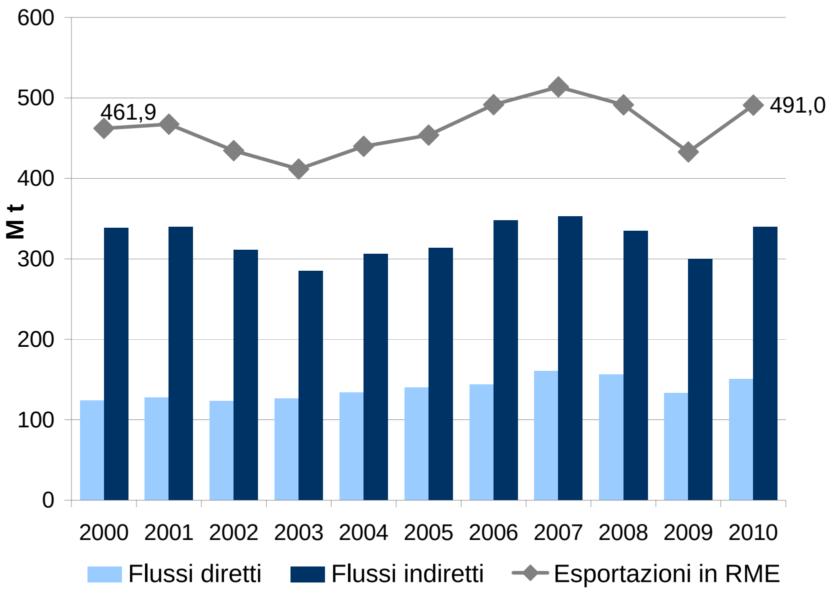


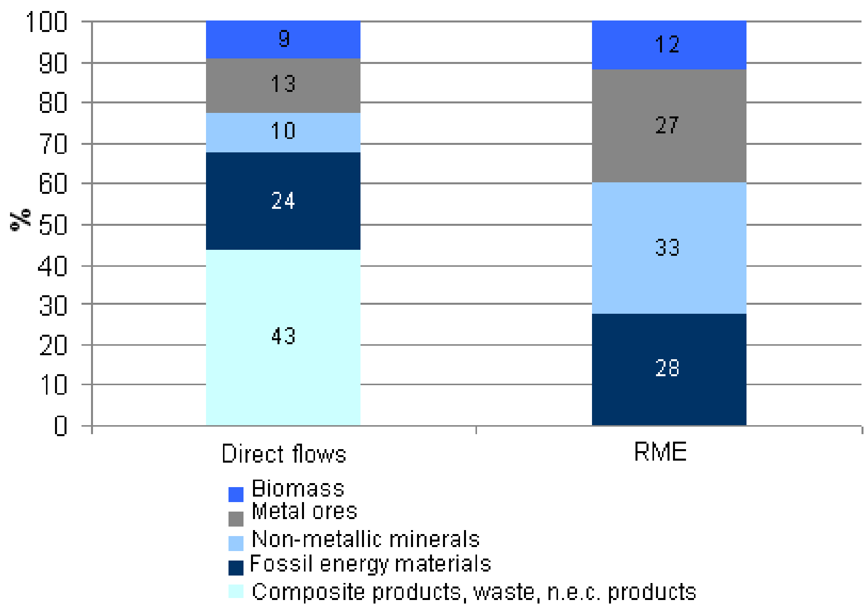
Figure 11.7: Exports in RME, actual Exports and their indirect flows of used materials, Italy, 2000-2010 (Million tons)[21]

[21] Source: Eurostat and Istat data processed by Ispra-Istat

The comparison of aggregate variables in units of weight, relating to actual foreign trade and in RME, appears to show that exports are concealing a greater *ecological rucksack*, in relative terms, than that of imports. In other terms, every kg of product imported by Italy requires, on average in the period under review, the taking from nature of 2.1 kg of resources used, while for every kg of exported product, an average of 3.4 kg of useful resources were extracted. This is due to the different composition of the goods and services imported and exported, and more precisely to the predominance of raw products among imports and of semi-finished and finished products among exports. Indeed, for a finished product the production chain and thus the flow of materials required is longer than for a product with a lower level of manufacture.

Every kg of product imported by Italy requires, on average in the period under review, the taking from nature of 2.1 kg of resources used, while for every kg of exported product, an average of 3.4 kg of useful resources were extracted.

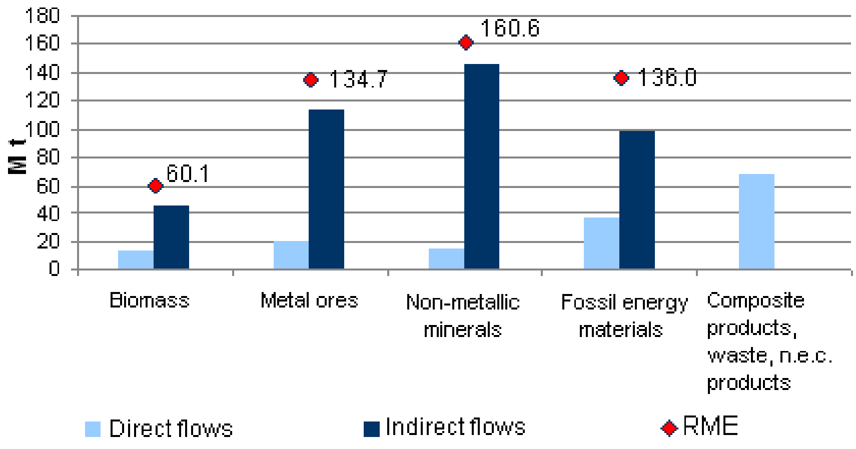
Figures 11.8 and 11.9 compare for 2008 actual exports with their RME[22]. Almost 40% of exported products consist of fossil fuels (24%) or metal ores (13%). When exports are expressed in RME the same categories cover 55% of the total. Non-metallic minerals have the highest indirect flows among the various categories: 9.4 indirect tons are needed for every direct ton.



Almost 40% of exported products consist of fossil fuels (24%) and metal ores (13%). These categories have the same percentage of exports expressed in RME, or 55% of the total.

Figure 11.8: Actual Exports and Exports expressed in RME: composition by category of material taken from the natural environment, Italy, 2008 (Million tons)[23]

[22] Disaggregation by categories of materials is available for exports only for estimates up to the year 2008 due to the unavailability of *supply and use* tables for the Italian economy, an important input for the calculation.
[23] Source: Eurostat and Istat data processed by Ispra-Istat



Non-metallic minerals have the highest indirect flows among the various categories: 9.4 indirect tons are needed for every direct ton.

Figure 11.9: Exports in RME, actual Exports and their indirect flows of used materials, Italy, 2008 (Million tons)[24]

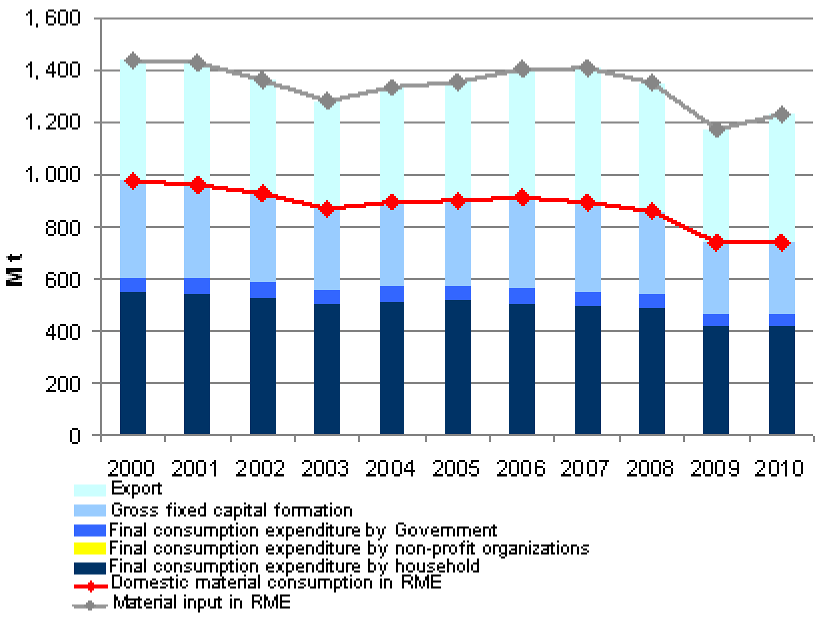
The model adopted to calculate direct and indirect flows of foreign trade also gives the RME of final uses by category (domestic uses, i.e. final consumption expenditure and gross capital formation, and exports), by type of final product acquired (59 types) and by type of raw materials required (52 types). In other words, it is possible to know the amount of natural resources (minerals, biomass, etc.) that on average need to be extracted from the national and global environment to satisfy one euro of final demand for products from the Italian economy, depending on the economic activity of which the required products are typical.

The total of resource requirements expressed in RME, relating to the total for domestic final uses only, makes up the indicator Domestic material consumption expressed in RME (DMC in RME).

In the period 2000-2010, as Figure 11.10 shows, the DMC in RME fell by 24%, from almost one billion (975 million) tons to about 738 million tons. Half of the fall recorded happened in the period 2008-2009. The reduction related in particular to final household consumption (about 130 Mt of fewer materials at a global level) and gross capital formation (approximately -100 Mt). There was a slight drop in the RME of final consumption of Government and non-profit organizations serving households, categories of final uses activating a much lower amount of materials and whose RME was growing until 2008.

Figure 11.10 also shows the Material input expressed in RME (RMI). The difference between this indicator and DMC in RME is given by Exports in RME. The DMI expressed in RME was down by 14.5% in the period 2000-2010. This reduction is less than that of DMC in RME because of the parallel increase in RME for Exports.

[24] Source: Eurostat and Istat data processed by Ispra-Istat



In the period 2000-2010, DMC in RME fell by 24%, from almost one billion (975 million) tons to about 738 million tons. The reduction related in particular to RME for final household consumption (about 130 Mt of fewer materials at a global level) and gross capital formation (approximately -100 Mt).

Figure 11.10: Material input and domestic material consumption expressed in RME, Italy, 2000-2010 (Million tons)[25]

Table 11.3 shows disaggregate DMC in RME for 2008 by category of material and group of products activated by total domestic final uses.
The products of manufacturing activities and services activated by domestic demand are those that use, both directly and indirectly, a more significant amount of resources, for all materials as for single categories. Of particular interest is the result for services, which in 2008 activated 30.8% of materials required to meet final domestic demand. In this case there are no significant differences between the different kinds of natural resources, but the value is higher for biomass and fossil energy resources (32.9% and 32.8%) and lower for metal ores.
With regard to the products of construction activities, non-metallic minerals are the main resource incorporated, but half of the total for these minerals is extracted to meet the needs of other production sectors: services, as already seen, and to a lesser extent (21.4%) manufacturing industries. Compared with the year 2000, the most important variation is the lesser use made of metal ores and fossil energy resources to produce goods in manufacturing industries, which still remain the main users of these two categories, as of biomass materials. On the other hand, to produce services larger quantities of the same resources are required, mainly due to the relative growth of services and the structural changes to the Italian economy in favour of services and to the detriment mainly of manufacturing industries.

[25] Source: Eurostat and Istat data processed by Ispra-Istat

Table 11.3: RME incorporated in products activated by domestic final uses. Italy, 2008 (Million tons)[26]

Groups of products (CPA classification 2002)		Total extracted material	Biomass	Metal ores	Non-metallic minerals	Fossil energy resources
		%				
A-B	Agriculture and fishery products	3.9	17.4	0.3	0.4	0.9
C	Products from mining activities	1.1	0.0	-0.4	-2.8	9.8
D	Products from manufacturing activities	35.0	46.4	55.8	21.4	38.7
E	Electricity, gas	2.8	0.3	1.1	1.6	7.8
F	Construction	26.3	3.1	16.4	49.6	10.0
G-P	Services	30.8	32.9	26.8	29.9	32.8
	Total	100	100	100	100	100
	Total in Mt RME	***858.5***	***171.9***	***108.5***	***367.0***	***211.0***

Notes
Negative values are due to the decumulation of stocks, which is a form of negative final demand for investments.

The products of manufacturing activities and services activated by domestic demand are those that use, both directly and indirectly, a more significant amount of resources, for all materials as for single categories. Of particular interest is the result for services, which in 2008 activated 30.8% of materials required to meet final domestic demand.

GLOSSARY

Domestic Extraction:
It includes all quantities of materials taken from the natural environment of a country in order to be incorporated in products.

Unused materials:
Materials deliberately extracted from the natural environment but not to be used. These are materials not incorporated in products, but are necessary for taking useful materials or in any case performing anthropic activities (typically in the construction industry). These materials are not included in the Domestic Extraction (DE) indicator.

Direct and indirect flows of materials:
The making of imported and exported products (direct flows) requires the extraction and use of materials that are not physically contained in them (indirect flows). Total flow (direct and indirect) considers from a *life cycle* point of view the whole flow of materials that have had to be extracted and used to produce foreign trade products. This total flow is obtained by expressing imports and exports in RME.

Raw material equivalents (**RME**):
This indicates the amount of materials used that have had to be extracted in order to make imported and exported goods and services available.

[26] Source: Eurostat and Istat data processed by Ispra-Istat

Direct Material Input (DMI):
This is the set of materials actually entering the country's economy and being used in it. It is the sum of the domestic used material extraction (DE) and and imported products.

Material input expressed in RME:
This comprises domestic extraction and imports expressed in RME.

Domestic Material Consumption:
Domestic material consumption consists of Direct Material Input minus exported products.

Domestic Material Consumption expressed in RME (DMC in RME):
Comprises material input expressed in RME minus exports expressed in RME.

Physical trade balance:
The difference between the total weight of imported products and total weight of exported products**.**

CHAPTER 12

TOOLS FOR ENVIRONMENTAL KNOWLEDGE AND AWARENESS AND MARKET INTERFACE

Introduction

Why spread knowledge and promote environmental awareness?

Environmental science, knowledge and innovation play increasingly crucial roles in the future of our society. To effectively safeguard and upgrade the environmental heritage, promote knowledge and engage in projects of sustainability, the general public must perceive and understand how strategically important environmental and scientific knowledge and skills are to social and economic development. Instead the environment is all too often scattered and removed from mainstream awareness, being viewed as a complex set of problems and limitations rather than a source of opportunities for growth and development for the whole Country. Major surveys in the sector point a large gap between available environmental knowledge, methods and tools and the public's awareness of their importance to society and to mechanisms of development. An example is the 2007 Eurobarometer, in which the percentage of the Italian public environmentally informed had fallen from 48% in 2004 to 42% in 2007.

Citizens and political decision-makers still lack adequate tools of environmental scientific knowledge for sustainable management of social change.

At the same time, 98% of those who consider themselves well informed hold environmental considerations to be as important as economic and social factors and feel that the general public should participate and be directly involved in environmental protection.

The 2010 Eurobarometer found that 30% of Italians did not know the meaning of the concept of "loss of biodiversity", as compared to an average figure of 19% for Europe as a whole, while 81% of the respondents declared themselves to be scarcely or poorly informed on environmental issues, the worst result for any EU country (Germany, for example, recorded 41%) and a further 1% below the outcome from the 2007 survey. The results for the younger generations are similar, as demonstrated by a major international survey of the OECD: the *Programme of International Students Assessment* (PISA), held every three years on a sample group of fifteen year-olds from approximately 50 countries, compares levels of awareness of students, especially with regard to the environmental and geo-sciences. In the 2010 edition of the survey, only 14% of the sample population reached the maximum performance level, whereas the OECD average was 19%. In contrast, roughly 45% of Italian students scored at the minimum level, or even lower than the minimum, as compared to an average of approximately 24% throughout the OECD.

The noteworthy gap between scientific environmental knowledge and public awareness of its importance is confirmed by surveys such as the Eurobarometer and the PISA.

An analysis of the data indicated above show that, to reduce the gap between scientific knowledge and society's perception and awareness of that knowledge, the dissemination of environmental information and the promotion of the related culture need to be further reinforced.

To arrive at an effective dissemination of environmental knowledge, procedures must be identified, refined and constantly updated and adequate tools must be found to encourage both the general public

There is a growing need for European governance of the processes through which scientific knowledge is distributed, plus increased expectations on and political decision-makers to achieve a full understanding and awareness not only of environmental problems but also of the social opportunities (in terms of growth, safety, quality of life etc.) that can result from sustainable behaviours, decisions and lifestyles. An example is the question of energy consumption, which has a noteworthy impact on family budgets and - though with less public awareness of the fact - on the environment. Significant benefits could be obtained from appropriate spreading of new knowledge and existing technology that heighten the production of energy from renewable sources, as well as good practices for improving energy efficiency of homes, plus pro-environmental attitudes and behaviour that lead to consumer and production decisions which prove advantageous both for the environment and in terms of savings etc..

the part of the general public that government authorities will be able to provide suitable responses to the main environmental issues.

In evaluating the general public's interest in environmental topics, it is important to stress that the natural heritage, in the broadest sense of the term, is also an indicator of the wellbeing of society. As stated in Chapter 10 of the recent BES Report on equitable sustainable wellbeing put out by ISTAT and the CNEL - *The Natural Heritage, our Future*: "The availability and use of natural goods and services by Mankind depends on recognition of the key role of the natural heritage. For that matter, optimisation of the approach to natural resources provides everyone with the possibility of benefiting from the tangible and intangible goods that Nature offers while also contributing to a reduction in the instances of inequality in today's society". Seeing that trends in lifestyles and production/consumption do not point to a full understanding of the crucial role of Nature in our individual existences, there is no question that increasing the general public's awareness of the central importance of the environment would be worthwhile, given that it constitutes a proven source of psycho-physical wellbeing, prevention of illness and treatment of health (as witnessed by the current popularity, especially in the United States, of "Place Based Education", whose focus on bringing children back into contact with natural sites and spontaneous movements is designed to prevent and treat conditions that are widespread among young people, such as obesity and "type 2" diabetes). In terms of regulatory measures, the need to increase the awareness of the public with regard to environmental issues, informing and involving citizens in decision-making procedures designed to protect and defend the environment, was addressed as early as the 1998 Aarhus Convention, which was transposed into Italian legislation as Law 108/2001. This act was followed by Directive 2003/4/EC, which became Italian Legislative Decree no. 195 of 19 August 2005 on public access to environmental information, plus Legislative Decree no. 152 of 2006 "Environmental Regulations" (referred to as the "Environmental Code"). These measures gave practical form to the commitment on the part of public authorities to provide citizens with *credible* and *reliable* sources of environmental information, in this way contributing to the broader process, on both the international and national levels, that finds the European Union at the forefront of efforts to coordinate and spread environmental knowledge and increase the environmental awareness of individual citizens. As part of this process, each EU member state is expected to equip itself with necessary and suitable tools to spread and communicate data and information.

In the case of a research body and institutes such as the ISPRA, which is assigned to carry out this necessary task, the knowledge produced and the information obtained in various manners must be shared not only within the scientific community but also on the broader social and territorial levels, allowing it to become both a factor in development and a catalyst for participation and interest on the part of society as a whole. Of particular importance in a similar context is ISPRA's assigned role of developing projects and initiatives to make available for general use all the geospatial data and information acquired in the course of activities financed with public funds (art. 23, paragraph 12-*quaterdecies* of Legislative Decree no. 95 of 6 July 2012, converted into Law no. 135 of 7 August 2012 – *Spending review*). This challenge calls for all possible approaches to be taken to gathering together skills, information and cultural and scientific contents (platforms of technological cooperation, sharing of national and international standards, access to environmental data, thematic and digital libraries, museum and science-centre organisations etc.). ISPRA's specific functions of research, combined with its responsibilities of monitoring and control, give the institute a strategic role in the spread of information and awareness. This dual function, appropriately geared towards meeting the priorities set by the Ministry of the Environment, can be effectively applied to achieving a sustainable use of the environment only if a strategic synergy is in place with the rest of the social context (institutions, agencies, public and private operators, the citizenry, schools and universities, the world of business etc.). The opportunity is an important one for the environment, which should ideally be viewed not only as a system to be protected and safeguarded, but also as a resource and an opportunity for reviving economic prosperity and growth in Italy.

A major challenge for ISPRA: optimising the knowledge produced and promote scientific and environmental knowledge as a key factor in economic and social development.

An overview of the knowledge to be spread

For some time now, a wide range of initiatives have been launched to resolve environmental problems and promote sustainable development of society. But though solutions and actions of undeniable importance, in terms of both technological advances and content, have been proposed, numerous issues but some of them controversial, remain unresolved, meaning that further reflection should be done. A critical vision of scientific culture, the available technology and ongoing innovation necessarily leads to the conclusion that the general public must be informed, stimulated and provided with an awareness of the environment and the risks posed by the current approach of development, which still has need of structural and social changes to become sufficiently geared towards sustainability. It cannot be denied that the current paradigm of environmental awareness and knowledge has yet to produce – within the institutional sphere and in terms of the perceptions and behaviour of the general public – a consolidated, long-term approach to the environment capable of resolving its problems, and this despite the fact that theoretical studies regarding economics, social affairs, politics and culture consistently point to an integrated

A critical vision of scientific and environmental knowledge is needed to fully support the transformation of society in the direction of a model of sustainable development.

analysis of "economics, development and the environment" as being the three pillars of sustainability within a knowledge-driven society.

The critical attitude referred to above, whose ultimate goal is to give rise to a *new attitude* towards the environment, echoes the increasingly relevant words pronounced by the Nobel laureate in economics Elinor Ostrom on the occasion of an international conference on the science of sustainability held at the University of Rome's "La Sapienza" campus in 2010: "Each individual, through his or her buying habits, can do a great deal. Purchasing with an eye towards the future, paying attention to the concept of savings and perceiving the value of common goods, are practices that can lead us to construct a future of sustainable development (…). Failures should not breed discouragement, but rather the realisation that true success is achieved by finding ways to correct the errors of the past, which means not only establishing a dialogue between the world's different communities but also forging a long-term vision through joint initiatives and day-to-day efforts".

Spreading correct, authoritative, transparent and independent scientific information would be an adequate response on the part of institutions to both individuals and various groups within society, all as part of a long-term strategy to promote social change that moves in the direction of sustainable social and environmental development. Here is the underlying reason for the monitoring and reporting on the state of the environment as a whole (air, water, soil, works with environmental impact, protected areas, all human activities affecting the environment etc.), as well as for the spreading of scientific data on environmental matrixes, all of which constitute one of the main areas of activity of an organisation whose institutional responsibilities regard the environment, as in the case of ISPRA.

A new attitude towards the environment should be promoted under a long-term vision that draws on correct, authoritative, transparent and independent scientific information.

Possible goals for improvement?

Drawing inspiration from Ostrom's assertion that, "True success is obtained by finding ways to correct the errors of the past", it is important that government authorities "forge a long-term vision through joint initiatives and day-to-day efforts", increasingly focussing their activities on the spread of environmental knowledge and awareness. New areas of operation could be explored by ISPRA: by analysing the data gathered during research on the subject (by the OECD – PISA, the Eurobarometer, the BES, the reports of the CNEL and other environmental reports), an overview could be established that makes possible comparison of the different results, with effective monitoring of the amount of knowledge spread to date, and the ways in which this has been accomplished, plus study of the extent to which the knowledge, awareness and skills needed to arrive at a sustainable approach to development have been increased, together with the ways in which this has been done (or not done!) accomplished. It would also be worthwhile for ISPRA, in collaboration with the system of regional and provincial environmental protection agencies and in accordance with the instructions of the Ministry of the Environment, to review past experiences and research involving initiatives of information, education, heightening of public awareness and training, so as to establish indicators of quality capable of assessing the effectiveness of the process of initiatives, projects and programs undertaken by the

ISPRA can meet the challenge of establishing an overview of reports on environmental awareness and information, so as to monitor the effectiveness of efforts to distribute and make available environmental data.

government authorities and public agencies in this field. Another key effort meant to harmonise indicators of sustainability and "network" activities is the joint effort of the Global Green Growth Institute, the OECD (Organisation for Economic Co-operation and Development), the UNEP (United Nations Environment Programme) and the World Bank, which have established an international network of development specialists (the Green Growth Knowledge Platform, or GGKP).

The Green Growth Knowledge Platform, an international network of development specialists.

Together they engaged in global research meant to produce tools that could contribute to encouraging green economics and moving towards sustainable development, with specific efforts including the formulation of a set of internationally accepted indicators of sustainability. The activities of the GGKP network were recently documented (April of 2013) in the "Scoping Paper Moving towards a Common Approach on Green Growth Indicators". This report touched on the complexity of the process and its multidimensional nature, the inevitable involvement of the local/global spheres and the social ramifications of development decisions, plus the need for ongoing monitoring of the process and the benefits of identifying potential indicators of *green growth*, in part to provide a groundwork for an analysis of the *green economy* as a whole while, at the same time, reaching out to inform a broader public.

To reach similar objectives in terms of organisation, monitoring and control, emphasis must again be placed on the importance - indeed, the unavoidable need – of a joint in support of cooperative and network activities, with a mutual exchange of information between internal structures and outside institutes, and between the world of business and the market in general, so as to facilitate the proper procedures for a sustainable use of natural resources and, in the final analysis, to aid business enterprises in finding their way through the "green labyrinth". All in accordance with the 7th Framework Program for Technological Research and Development, along with the initiatives tied to the European Research Space. As European Commissioner for the Environment Janez Potocnik recently put it: "If we intend to favour sustainable growth, then we must see to it that products which make a more efficient use of resources and prove more ecological are known and recognisable on the market". An exhortation to follow approaches that provide reliable environmental which lends itself to comparison, so as to gain the confidence of consumers, business partners, investors and interested enterprises.

The demand for environmental information, training and education must be understood, in order to develop and refine offerings that spread knowledge and awareness through networks of cooperation.

There is the need to understand the demands arising from the public, and from the territory as a whole, with respect to environmental issues (calls for education, training and information for both businesses and the public, as well as the need for sharing of data among different institutes, information on patterns of behaviour and consumption to be followed in times of environmental crisis and emergency etc.). To reach this objective, tools of information feedback can be drawn on, allowing the users, possibly with the initial involvement of those already registered on the sites and the social network outlets of the institutes engaged in spreading environmental information, to make know their information/training needs, so as to establish through a direct reading of the demand, the most appropriate offerings in terms of tools, products, events and services. The participatory technological platforms, including those on a number of different institutional sites, together with other initiatives of collective participation, offer a possible solution. A similar commitment calls for resource and skills that can be retrieved only by creating a cooperative network system that brings together a number of body and institutes in an effort to revive the practice of shared projects that make it possible to accelerate the process of safeguarding and upgrading our environmental heritage through actions that succeed in overcoming the limits on the investment of public resources which inevitably accompany a spending review.

The tools used by ISPRA and the system of provincial and regional environmental agencies.

The tools used by ISPRA and by the regional and provincial environmental agencies to spread knowledge and awareness

In the interest of providing contributions and data that can aid in the formulation of a critical reflection "in response" to the questions raised, this chapter reviews the various tools and services for the dissemination of information which ISPRA, in carrying out its assigned tasks, develops and implements, at times in concert with the provincial and regional environmental agencies, as well as with other professional contributions. These include:

- environmental reporting, to inform technical experts, political decision-makers and the general public of the results of environmental analyses and research, as well as of policies currently underway, in this way giving an overview of the overall performance of government agencies, together with specific information on individual environmental topics (the Year-book of Environmental Data, individual technical reports and technical-scientific documentation);
- the spreading of environmental knowledge over websites (in the form of database, environmental information etc.) to provide technical experts and political decision-makers with input to supply responses that are scientifically reliable, adequate and balanced to the needs and requests of citizens, of public opinion and of the media in times of crisis, emergency and risks to health;
- library services both for the public administration 's own personnel and for interested outside users;
- activities of environmental education f on sustainability, so as to turn out products based on innovative approaches to learning that can contribute to the development of citizenship skills and be used in activities of "Long Life Learning" (LLL);
- environmental training activities to qualify human resources in environmental sectors through focussed, continuous and interdisciplinary training;
- tools of voluntary compliance with environmental standards (EMAS, Ecolabel UE, ISO), in order to achieve the goal of reconciling environmental improvement with the competitive demands of the marketplace.

DISSEMINATION OF ENVIRONMENTAL INFORMATION

Communication and information are the key methods of distributing environmental knowledge. These activities are of fundamental importance in providing policy-makers with the input they need to arrive at decisions and in heightening public awareness of topics tied to the environment and to environmental defence.

The involvement and participation of individuals and social groups is not only useful but should be considered of priority importance for the promotion of policies of sustainable development, given its dual effect on the communication process, in that it established a direct link between citizens/recipients and political decision-makers (bottom-up) while also facilitating the monitoring and control of the solutions enacted.

Reporting, mass media, web and library services are the main tools for distributing environmental information.

Reporting, mass media, web and library services are the main tools for spreading environmental knowledge to the public/target.

Reporting.

The reporting products of the regional and provincial environmental agencies distribute data and scientific information on both environmental conditions and the policies of defence enacted.

The reporting products generated by the activities of ISPRA and of the regional and provincial environmental agencies, all increasingly carried out according to shared approaches and processes of standardisation, make it possible to analyse and compare different territorial realties, with the dissemination of data and scientific information on environmental conditions and the various initiatives of defence undertaken. These data are also collected through the use of information monitoring systems. The most widely used types of reports include inter-thematic documents, such as the Environmental Data Yearbook and the Report on the State of the Environment, as well as the thematic reports. The products differ in terms of their final recipient and their purpose.

The Environmental Data Yearbook is a statistical compendium whose information base, made up of indicators and indexes, provides an objective, scientific overview of the state of environmental resources. Its primary target audience consists of experts and political decision-makers. It can thus provide valid support for additional reporting tools or for policies, plans and programs of environmental protection. Thanks to the wide range of versions offered, including the full edition and the *Key Topics*, as well as the abbreviated and multimedia versions, the ISPRA Environmental Data Yearbook can extend its reach to a generic, non-specialised readership.

The types of reports most widely used are: the Environmental Data Yearbook , the Report on the State of the Environment and the thematic reports.

The Report on the State of the Environment analyses the causes of environmental developments, evaluating the effectiveness of the policies implemented in response, making it an assessment of use to operators and politicians active in the sector.

The thematic reports examine in depth specific environmental matrixes, such as the water, air, climate, waste etc.. They are meant for political and technical roundtables and committees, as well as for local government officials and managers in the sector.

Over time, the ties between the different published products have matured, becoming increasingly close.

The mass media are tools used to transmit information to any number of indistinct recipients/users. Mass communications flows in a single direction: the message goes from a source or centre of emission to many recipients (a one-to-many communication) that, being unable to respond or interact directly with the source, undergo the communication passively. This form of communication can take place either over the air or by cable, on television or the radio, or in the print media (daily papers and periodicals).

Mass media.

The network of ISPRA and the provincial and regional environmental agencies (the institutional source of environmental information) addresses the media through articles, letters, e-mails, press releases, interviews and press conferences, in the interests of distributing useful information and promoting activities, services and products to an increasingly large audience that includes the general public, technical experts and political decision-makers.

The network of ISPRA and the provincial and regional environmental agencies addresses media through articles, letters, e-mails, press releases, interviews and press conferences.

More extensive monitoring of the environmental information carried by the mass media, as compared to what is currently in place, covering on-line consumption of contents and of the media using the new technology (web TV, web radio, smartphone, tablets), would make possible more thorough identification of the topics given top priority by public opinion, as well as those that draw especially high levels of attention or requests for news and updates, in this way favouring feedback and interaction with the target.

In fact, the communications promoted by government institutes, and especially those of the environmental agency system, are increasingly web communications.

Web.

Environmental information is distributed on the web using on-line reviews, newsletter, databanks, Rss feeds (Rss: Rich Site Summary or Really Simple Syndication), documents offered for downloading and specific thematic areas of institutional internet sites that have become virtual contact points with citizens.

Environmental information is distributed on the web using on-line reviews, newsletters, databanks, Rss feeds, documents offered for downloading and specific thematic areas of institutional internet sites.

The proper operation of these information systems, from their architecture to the graphic treatment, as well as the way in which the contents are organised, determines the quality of the interaction with the public while guaranteeing democratic access to rights and services.

With the arrival of web 2.0, born in the early 2000’s, the web underwent an evolutionary change that witnessed the development of new on-line services and applications featuring high levels of interaction.

Starting with the use of e-mails and search engines, the static nature of web 1.0 (the web of the early 90’s) gradually became obsolete, with the role of the user of information and contents moving in the direction of author/co-producer of the same.

Blogs, forums, chats and the vast store of social media currently used on a regular basis by web navigators are now a part of institutional sites. Public environmental communication over the web amplifies its own capacity to successfully spread information, establishing a dialogue with a pool of users that increasingly takes the form of an active public ready to participate, as opposed to a highly p[liable mass of indistinct individuals.

Libraries and documentation centres, traditionally given the dual role of “guardians of knowledge” and mediators of information, provide users, both local and remote, with information sources pertinent to environmental topics and the earth sciences.

Library services.

In this way they not only safeguard, augment and optimise book and document resources, but they also spread knowledge within the sector, contributing to increase its reach and positive fallout on the general public.

Libraries and documentation centres with an interest in the environment offer multiple services, including reading facilities, external and inter-library lending, catalogue searches and consultation of online archives and resources, the organisation of exhibitions and events, plus initiatives supporting scientific research and environmental communication in the broader sense.

Multiple services are offered from reading facilities to external and interlibrary loan, online catalogues (OPAC) where publications of interest can be localised, plus database and specialised electronic resources (online periodicals and e-books), as well as the organisation of expositions and events dedicated to the presentation and promotion of publications of particular importance and worth, together with initiatives oriented to support scientific research and environmental communication in the broader sense of the term.

Among the environmental agencies, though distinct differences remain in terms of organisational procedures and the way in which services are supplied to users, a gradual computerisation of library systems is evident in all the different phases of book processing: from the acquisition of the catalogue entry to the supply of information and documents to the public.

To make documents more easily to an increasing number of readers, libraries have promoted the develop of networks of cooperation at various levels, favouring and simplifying the knowledge access and sharing of resources.

As far as library institutions are concerned, “networking” is both an intelligent approach to overcoming “local difficulties” (economic, regulatory, organisational, involving relations with suppliers) and a strategy that makes it possible to reach a wider user, both real and potential, specialised and generalist, in ways held to be more effective and advantageous when it meets an highly diversified need for information.

Thanks to the resources made available by technological advances, libraries and documentation centres, whose mission is the selection, sharing and spreading of scientific information on environmental topics, can represent as additional tools for the construction of a collective identity and for the revival of an active role, on the part of citizens, in decision-making processes regarding environmental protection and health, based on a cultural process characterised by transparency and democracy.

Environmental information through reporting and mass media

Over the last decade, environmental reporting activities in Italy have registered not only an increase in the number of products for distributing information, but also noteworthy developments in reporting methods.

With the establishment of the network of regional and provincial environmental agencies, whose responsibilities include territorial monitoring and control, the noteworthy flow of environmental data and information has been gradually harmonised and organised, establishing a national system of environmental knowledge.

With its "Three-Year Program for 2010-2012", the regional and provincial environmental agencies network began, among other things, a coordinated effort with ISPRA to draw up guidelines for reporting and to create a core set of indicators.

"Three-Year Program for 2010-2012" of ISPRA and regional and provincial environmental protection agencies.

The goal is to develop a process under which shared rules can be arrived at for the formulation of both environmental reports meant to fulfil precise obligations involving the communication of data and information and reports on specific topics, or sets of topics, pertinent to the state of the environment.

Since 2003, ISPRA's Environmental Data Yearbook presents the results of the monitoring of the reporting products turned out by the provincial and regional environmental agencies, in particular as regards reports on the state of the environment/Environmental Data Yearbook , manuals/guidelines, reports on specific topics and minutes of technical-scientific events (conventions, seminars, study days etc.).

ISPRA's Environmental Data Yearbook presents the results of the monitoring of the reporting products of the provincial and regional environmental protection agencies.

It should be remembered that neither European-Community nor international reporting activities have been the focus of a structured analysis based on shared indicators.

Reports, Environmental Data Yearbook and updates on specific topics are of particular importance, given their frequency of publication, when it comes to assessing the effectiveness of environmental policies and informing citizens of the qualitative conditions of the environment in which they live, so as to promote eco-compatible forms of conduct and informed participation in decision-making processes.

To reach these objectives, policies have been implemented for spreading the environmental information in the possession of institutional parties, promoting the development of internet tools, portals, databanks of environmental indicators accessible to the public, plus websites and catalogues.

Table 12.1 summarises the environmental information distributed by the provincial and regional environmental agencies in 2011 and 2012 through reports and updates on specific topics.

Of the products referred to above, the most frequently used is the "single-subject" report, roughly a hundred of which were turned out in each of those years.

The topic of greatest interest is the air, accounting for approximately 47.6% of the single-subject reports published by the agency system in 2011 and 41.8% of those turned out in 2012 (Figure 12.1).

Table 12.1: Environmental information distributed through reports and publications[1]

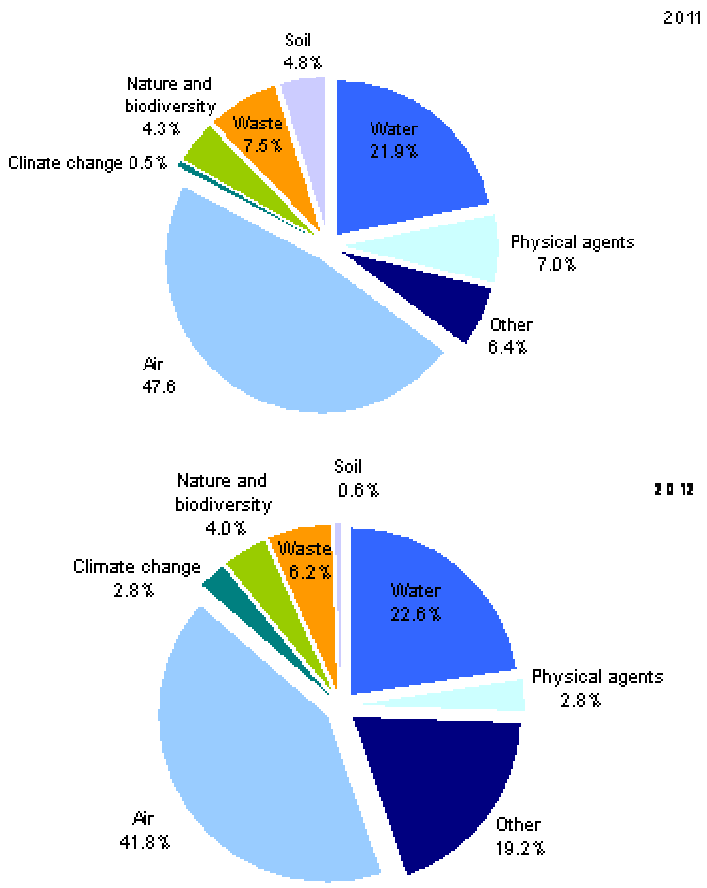
Overview of the environmental information distributed by the agency system in 2011 and 2012 through the Environmental Data Yearbook and single-subject reports and updates.

Agency network	2011		2012	
	Environmental Data Yearbook / Reports on the state of the environment	Thematic reports	Environmental Data Yearbook / Reports on the state of the environment	Thematic reports
	Presence/absence	No.	Presence/absence	No.
ARPA Piedmont	▲	2	▲	3
ARPA Val d'Aosta		1	▲	0
ARPA Lombardy		15	● ▲	0
APPA Bolzano-Bozen	-	-	-	-
APPA Trent		4*		0*
ARPA Veneto		8		0
ARPA Friuli-Venezia Giulia	-	-	-	-
ARPA Liguria	-	-	-	-
ARPA Emilia-Romagna	●	13	●	15
ARPA Tuscany	▲	24	●	32
ARPA Umbria		4		4
ARPA Marche		16		13
ARPA Lazio		1		4
ARTA Abruzzo		7		8
ARPA Molise	-	-	-	-
ARPA Campania		1		5
ARPA Apulia	▲	39	▲	51
ARPA Basilicata		1		1
ARPA Calabria	0	6	0	6
ARPA Sicily	●	1	●	-
ARPA Sardinia		3		6
ISPRA	●	41	●	29

Legend
● : Environmental Data Yearbook
▲: Reports on the state of the environment
Note
* Estimate

It should be noted that, in many cases, the "reports on the state of the environment" are closer to "Environmental Data Yearbook " (listings of statistical data on environmental components and factors), as opposed to "reports" in the true sense of the term (documents that present not only statistics on environmental components and factors, but also information on the underlying assumptions of environmental policies).
The number of combined "Environmental Data Yearbook /reporting" publications registered for each year was less than ten. It should be noted, however, that some of the agencies which do not provide such products, such as the regional agencies of Veneto and Umbria, do maintain updated on-line databanks of environmental indicators.

[1] Source: ISPRA-ARPA/APPA data processed by ISPRA



The subject of greatest interest is the air, accounting for approximately 47.6% of the single-subject reports published by the agency system in 2011 and 41.8% of those for 2012.

Figure 12.1: Breakdown of single-subject reports among subject areas (2011, 2012)[2]

Web-based environmental information and communication

Communication of environmental risk: the case of ISPRA website

The demand from citizens for information from ISPRA in 2011 was notably higher on the occasion of two high-impact calamitous events: the earthquake in Japan and the resulting incident at the Fukushima nuclear power plant, and the flooding in Spezzino and Lunigiana areas occured in autumn 2011.

The report “Statistical Analysis of Web Users of ISPRA Portal”[3] was published in 2012, highlighting the role of web instruments of environmental communication and information, especially on the occasion of high-impact calamitous events. In fact, ISPRA website registered its peak number of *Visits*, *Visitors* and *Pages Visited* in March 2011, at the time of the earthquake in Japan that triggered a series of incidents at the Fukushima nuclear power plant. This event was monitored by ISPRA, which set up a nuclear emergency room in operation 24 hours a day to receive information issued by the International Atomic Energy Agency and publish updates on its site to keep citizens informed. In the month of March 2011 (34,438 visitors) and April 2011 (35,152 visitors), the number of visits to the site's “News” section alone tripled, as compared to the monthly average data (12,600 visitors). The increase is explained by the fact that all the updates about Fukushima power plant were published in this section, starting from the day of the accident. The page dedicated to Fukushima alone registered 20,040 contacts in the month of March

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[2] Source: ISPRA-ARPA/APPA data processed by ISPRA

[3] The report “Statistical Analysis of the Web Users of the ISPRA Portal” is available only on-line at the address http://www.isprambiente.gov.it/files/pubblicazioni/rapporti/Rapporto_171_2012.pdf

and 22,061 in April. Further demonstration of the large-scale interest for topics involving environmental risk, particularly for the nuclear emergency, is the number of visits to the document "WENRA - *Western European Nuclear Regulatory Association* Declaration", which was the most read document in 2011 with 792 visits only in the month of April. The figures on visitors to the most frequently consulted website areas dedicated to specific topics fully confirm the above observation: the topic "Radioactivity and radiation" was the most frequently consulted one in March of 2011.

The analysis of ISPRA's website access data also brought to light a second peak of *Visits*, *Visitors* and *Pages Visited*, occurred in the month of November 2011, at the time of the flooding in Spezzino and Lunigiana (October 25th) and in Genoa (November 4th). Once again, an increase in visitors was registered during the period in question to the pages dedicated to specific topics related to the calamitous events: "Cartography", "Water" and "Defence of the Land". It seems to be evident, therefore, the role played by current news, especially with regard to emergency situations arising from calamitous events of noteworthy impact, in determining the demand for information from citizens. In light of these considerations, we believe it is worthy to focus our attention on the topic of the communication of environmental risk, especially with respect to the web and the specific role of the communication of government bodies and institutions, particularly of public research institutes.

What role does the web play in the communication of environmental risk by government bodies and institutions, especially by public research institutes?

The web and communication of calamitous events: a two-way street[4]

The tools of web communication, and web 2.0 technologies in particular, have become increasingly important for risk managers and scholars of risk communication, with this being especially true in recent years. One of the areas in which such applications appear most promising is definitely the management of high-impact emergencies and calamitous events, during which online communication tools, and especially social media (blogs, social networks and micro-blogging platforms) have provided noteworthy demonstrations of their potential to operate in support of traditional systems of alert in terms of post-impact management. Catastrophic events such as the 2004 tsunami in the Indian Ocean, hurricane Katrina in 2005 and the earthquakes in Haiti in 2010 and in Japan in 2011 have made clear the key role of such technologies in the dissemination of alarm messages to populations exposed to calamitous events and in the collection of information of relevance on the ongoing situations (Lindsay, 2011)[5].

Thanks to their ability to support two-way processes of communication, web communication tools, and especially those employing web 2.0 technologies, have taken on an increasingly important role in the management of emergencies and calamitous events, being used in support of traditional systems of alert and post-impact management.

Internet has begun to play an increasingly important role when it comes to dealing with such emergencies, thanks to its capacity to support bidirectional processes of communication which, moving beyond the linear approach typical of the mass media, with the information flowing from the issuer to the receiver, makes it possible to achieve effective management of both outgoing and incoming information flows, improving the "situational awareness" of both risk managers and exposed populations. On many occasions, this has made possible a

[4] Author: Andrea Cerase, researcher at the University of Rome, "La Sapienza" campus

[5] Lindsay, B. R. (2011). *Social Media and Disasters: Current Uses, Future Options, and Policy Considerations* (Vol. 41987). Congressional Research Service

more efficient use of the available information, both in terms of organising emergency operations and with respect to providing useful information to the people affected by the calamity, therefore providing in this way immediate and effective responses to the needs of populations exposed to the calamitous event: first and foremost, the need to “know what’s going on”, together with the need to “know what to do”, so as to improve people’s capacity for self-protection in case of technological accidents or natural catastrophes.

The strongpoint of internet, especially of social media, is their capacity to sustain interpersonal communications, activating the existing social networks, that is the set of relations that connect individuals to each other, ultimately laying the foundation for the fabric of society (Wellmann and Berkowitz, 1998)[6]. For some time now, numerous studies have shown that, on the occasion of disaster or high-impact events, the role of the media proves to be of secondary importance compared to that of interpersonal sources, especially when it comes to the processes through which the population is alerted (Drabek 1969, Drabek and Stephenson 1971)[7]. Even back in 1963, at a time when there was no internet or satellite television, more than half of the American people learned about the death of President Kennedy through interpersonal sources: the relevance of the event indeed activated an intensive word-of-mouth communication process that rapidly brought the news to almost the entire population (Greenberg, 1964)[8].

Numerous studies have shown that, when it comes to processes of alert in the wake of disastrous events, the role of traditional media is of secondary importance in comparison with the role played by interpersonal sources: the strength of social media is its ability to activate existing social networks, setting off intensive, far-reaching word-of-mouth communication.

More recently, and within a much more complex technological scenario, two research efforts on the communication processes triggered by the terrorist attack of September 11, 2001, undertaken in the United States and Italy (Rogers and Seidel, 2002[9]; Morcellini, 2002[10]), generated extraordinarily similar results, demonstrating not only the importance of interpersonal sources but also the role and the emerging potential of the internet in the news dissemination.

Since then, the ongoing development of web technology, which has become increasingly lightweight and portable, together with its use by a growing segment of the population, as well as the increasing availability of user-friendly interfaces, have made it possible to use and share information in ways that would have been considered unthinkable just a few years ago, but that today can be employed successfully even in situations calling for emergency communications. The potential offered by this channel points to noteworthy opportunities in the future.

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[6] Wellman B., Berkowitz S.D. (eds, 1998), *Social structures: A Network Approach*, Cambridge University Press, Cambridge

[7] Drabek T. E. (1969), "Social processes in disaster: family evacuation" in *Social Problems*, 16 (Winter), 336-49. Drabek T. E., Stephenson J. J. (1971), “When disaster strikes” in *Journal of Applied Social Psychology* 1: 187-203

[8] Greenberg, B. S. (1964). Diffusion of news of the Kennedy assassination. *Public opinion quarterly*, *28*(2), 225-232

[9] Rogers, E. M., & Seidel, N. (2002). Diffusion of news of the terrorist attacks of September 11, 2001, in *Prometheus: Critical Studies in Innovation*, Volume 20, Issue 3

[10] Morcellini, M. (edited by, 2002). *Torri crollanti: comunicazione, media e nuovi terrorismi dopo l'11 settembre*. Franco Angeli. Milan

On the occasion of the seismic event that hit the town of Sora and the area of Frosinone on February 16th, two key observations could be made with respect to the use of social media: 1) the rapidity of the process through which news is spread with an emergency underway; 2) the capacity to direct traffic towards the institutional sources to be found on the web. Only a few seconds after the 4.8 magnitude quake, the first messages on the event had already appeared on Twitter, contributing to the routing of a mass of contacts to the "institutional" websites of the INGV and ISPRA, with the result that users were able to obtain confirmed, reliable information on the situation as it developed, and significantly in advance of the more traditional media.

This clearly demonstrates on one hand how the social media can be employed by users to "construct" a formidable network of sensors throughout the territory, capable of monitoring and instantly carrying information pertinent to events underway; on the other hand how, once a possible threat has been learned through the new media, the majority of users tend to seek confirmation and verification from sources held to be dependable, such as the traditional media (television, radio, print media), or from the sites of the protection authorities themselves, which can fill the need for more incisive, timely information. A further, critical consideration regards the role of public communicators and the reliability of the messages conveyed on the web.

The literature on risk communication (Peters, Covello and McCallum, 1997)[11], as well as the guidelines implemented by some of the leading protection agencies, such as the EPA (Environmental Protection Agency)[12], highlight a central consideration: the *credibility of the information sources*. Information carried by sources held to be unreliable or compromised is interpreted as being irrelevant, useless or even damaging. Numerous examples of news on such events, not distributed by the traditional media (tv, radio etc.) until hours after their impact, demonstrate that also the organisation of journalistic activities can sometimes make it impossible for such channels to provide timely, effective responses to the public's urgent need to receive certain, unimpeachable and reliable information on the calamitous event underway. For that matter, contradictory, incomplete or poorly drafted messages can be interpreted as lacking in credibility, with a risk of even greater damage from the calamitous event. Credibility and timeliness, therefore, appear to be complementary dimensions of the social need for information, meaning that the web, in light of the above considerations, can constitute a resource of critical importance when it comes to communicating such events.

In the management of emergencies, information arriving from sources held to be unreliable is interpreted as being irrelevant, useless or even damaging.

At the same time, knowing the technologies and the platforms is not enough: once again, the critical skill regards content, meaning the ability of those who work below the line to collect, summarise and publish the most accurate and up-to-date information, providing an irreplaceable service both to citizens and to operators in the traditional media.

Social media allow users to quickly obtain confirmed, reliable information, often significantly in advance of the traditional media.

[11] Peters, R. G., Covello, V. T., & McCallum, D. B. (1997). The determinants of trust and credibility in environmental risk communication: An empirical study. *Risk Analysis*, 17 (1), 43_54

[12] Reckelhoff-Dangel, C., & Petersen, D. (2007). *Risk Communication in Action, The Risk Communication Workbook*, United States Environmental Protection Agency, Cincinnati (OH)

Before an internet dialogue can be established, however, networks must be constructed so that the various institutes and agencies responsible for protecting the environment can cooperate with each other, providing clear, timely and reliable information. A similar capability cannot be improvised, but calls for know-how, coordination and adequate organisational and technological structures, in order to service citizens when their need is most acute.

The process of distributing an alert within a social network.

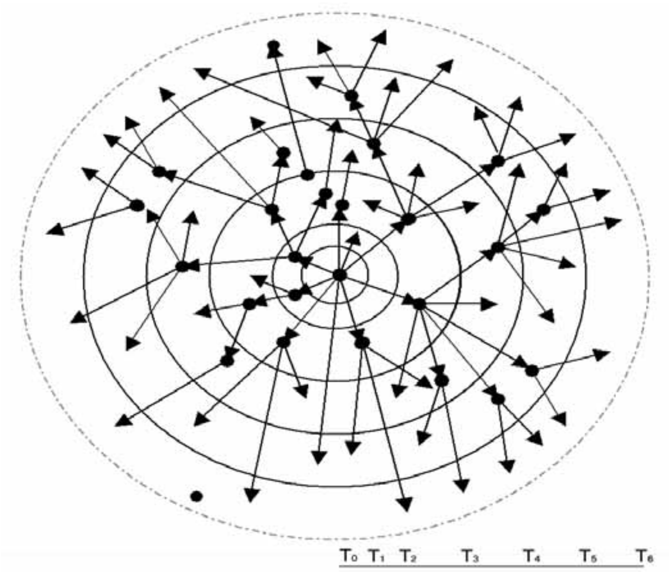


Figure 12.2: The distribution of an alert within a social network[13]

Figure 12.2 shows a graphic illustration of the process of distributing an alert within a social network: the process is triggered from a single node of the network, meaning that an individual draws up an alert (having personally witnessed a calamitous event, or having learned of it from another source, such as a media) and transfers it to other nodes, normally family members, relatives and friends, which in turn send it to still other nodes, utilising the various channels of interpersonal communication, such as direct interaction (word of mouth), land-line telephones, mobile phones, social networks and e-mails, to quickly reach all the nodes of the network. The concentric circles (T_0, T_1 … T_n in the legend) correspond to the intervals of time that calibrate the process.

Instruments of communication on institutional websites

Numerous research efforts have confirmed the role of the internet, in particular social media, when it comes to distributing messages of alarm, together with the information needed to heighten the level of "situational awareness" not only of the exposed populations but of public decision-makers as well, in order to provide a decisive response to the social demand for information, structuring it around two key considerations: credibility and timeliness in communicating "what is going on" and "what to do". Are government bodies and agencies taking this situation into consideration? Is it possible to estimate the levels at which the main public institutions that, for various reasons, deal with the environment, use tools of on-line communication?

The institutions that deal with the environment are meeting the challenges, and taking advantage of the opportunities, presented by new web technologies, venturing into social media in order to set up a channel that, in the event of a calamity, could be used to distribute information.

[13] Source: Andrea Cerase, 2013

The indicator *Environmental Communication on the Web* is an initial attempt to do so. Published in the 2012 Environmental Data Yearbook issued by ISPRA, it is established through the monitoring of 29 websites, and specifically the websites of the regional agencies of environmental protection, of the Ministry of the Environment, Land and Sea and of seven public research institutions[14], including ISPRA.
The results of the monitoring for January 2013 (Figure 12.3) show that the institutional websites have met the challenge and taken advantage of the opportunities offered by new web technologies and also social media, establishing a channel that, in the event of a calamity, could be used, whenever held appropriate, to disseminate the information.

Institutional sites have met the challenges and taken advantage of the opportunities offered by new technologies, venturing into social media as well.

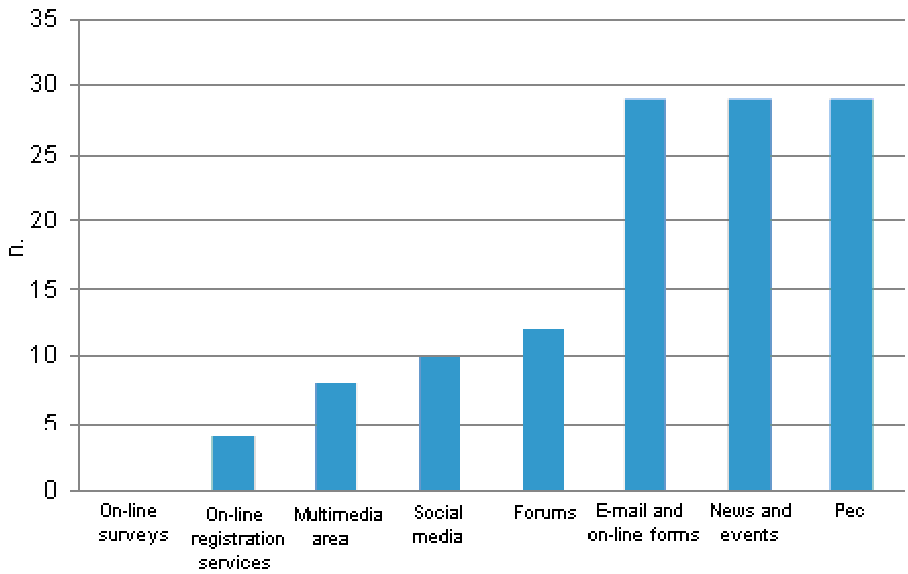
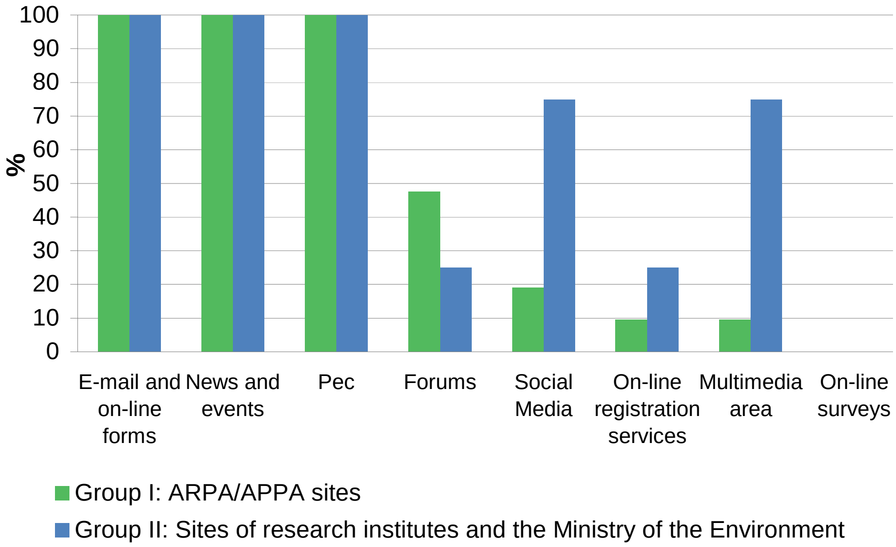


Figure 12.3: Tools for communication on the institutional sites of 29 public institutes that deal with the environment in various ways (2012)[15]

Figure 12.4 illustrates the differences in the way the various instruments of on-line communication are used by the websites of the group of environmental protection agencies, as opposed to the public research institutions monitored. As can be seen, while a period of maturity has been reached in terms of traditional instruments, meaning that no differences can be observed (e-mail, PEC and news of events are to be found on all the sites monitored), the more innovative instruments, such as social media, are utilised to a greater extent on the sites of public research institutions, showing that they are more acutely aware of the need to establish new channels of communication capable of supporting bidirectional processes while providing citizens with timely and widely distributed information, when necessary.

Public research institutions are more acutely aware of the need to establish new channels of communication capable of supporting bidirectional processes.

[14] CNR, CRA, ENEA, INGV, INFN, ISPRA and ISTAT
[15] Source: ISPRA-ARPA/APPA/MATTM/research institutes data processed by ISPRA



E-mail, PEC and news of events are found on all the sites monitored, while social media re more frequently utilised by the sites of public research institutes.

Figure 12.4: Comparison between the presence of communication tools on environmental agencies institutional sites and on the sites of some of the leading public research institutions that deal with the environment[16]

Library services and resources for users

Libraries and documentation centres in Italian territory specialised in environmental topics[17] make a noteworthy contribution to spreading information and knowledge in the fields of environmental protection and the earth sciences. As institutions whose inherent vocation is to serve as forums for encounters and exchanges furthering research and innovation, libraries play a key role in promoting the culture of sustainability, becoming promoters of increasingly towards beneficial transformations in society. The most engaged are those that belong to national cooperation networks (SBN, NILDE, ACNP, SBA, MAI etc.). The sharing function can regard a variety of strategic activities:

Libraries with a specific interest in the environment cover an important sector in terms of distributing knowledge in the field of environmental protection and the earth sciences, offering multiple services to both internal and external users.

- subscriptions (consortiums can obtain more favourable conditions in negotiations with publishers and news aggregators, spreading out the considerable economic burden while handling the thorny issues tied to licenses for on-line periodicals);
- cataloguing (joint management);
- searching through collective on-line catalogues (METAOPAC);
- exchange and supply of documents.

The libraries serve not only scholars and freelance professionals (for example, to hydrological risk), but also students working on school research projects, as well as citizens who wish to stay up-to-date on environmental topics, in order to exercise their rights in a fully informed manner or start up business activities related to clean and renewable energy.

[16] Source: ISPRA-ARPA/APPA/MATTM/research institutes data processed by ISPRA

[17] The site of the lSPRA library has a page on Italian libraries specialised in environmental topics, listing telephone numbers, internet sites and the services offered:
(http://www.isprambiente.gov.it/it/biblioteca/servizi/biblioteche-di-interesse-ambientale-1)

The main services provided to users are:

- opening the facilities to the public, with access to information free of charge;
- on-site reading and consultation, plus computer stations available for use;
- bibliographic orientation, reference services and localisation of information resources at other library institutions;
- internal and inter-library loan (ILL) and document delivery (DD);
- on-line consultation of resources (OPAC, electronic periodicals, databases on the environment and the law and on technical regulations).

The information services and resources made available to the users of the libraries and/or documentation centres of the environmental protection agencies system are not supplied in the same way throughout the national territory. In fact, in 2012 some of the agencies had neither a library nor a documentation centre, and were even lacking library services (Valle d'Aosta, Trentino Alto Adige, Veneto, Friuli-Venezia Giulia, Calabria, Basilicata and Sardinia).

"Green" libraries or "eco-libraries" play a key role in today's society, providing the instruments of knowledge needed to address environmental issues in a informed manner.

Figure 12.5: Regions where there are libraries and/or documentation centres of the environmental protection agency system (2012)[18]

Green libraries

There can be no questioning about the repercussions of environmental issues, given the evidence of a close connection between emissions of toxic substances traceable to anthropic activities and the damage done by pollution to the health of living beings.

[18] Source: ISPRA-ARPA/APPA data processed by ISPRA

In response to the environmental emergencies of recent decades, policies focussing on respect of the environment and sustainable development must be implemented.
New approaches centred around more limited levels of production, reduced energy consumption and protection of “limited” natural resources are called for.
About this aspect, with the goal of providing the tools of knowledge needed to deal with environmental issues in an informed manner, “green” libraries and “eco-libraries” play a key role in today’s society.
The category of “eco-libraries and green libraries” can be rightfully said to include all library institutions that, in staying in step with the times, with technological development and with the needs of their users, decide to promote the spread of environmental “best practices” for the salvation of our planet’s health.
Based on categories outlined at a recent convention[19], three different types of “eco-libraries” can be identified:

In today’s society, “green libraries” contribute to popularising environmental “best practices” for the health of our planet.

- those that are “architecturally” (and energetically) green;
- those that are wholly or partly specialised in environmental issues[20];
- those that promote initiatives and projects in support of the protection and optimisation of the environment and the spreading of ecological culture within the territory, for the benefit of the user basin[21].

In short, investments should be increased and library networks should be given an increasingly dynamic, tangible role as tools to promote environmental knowledge and encourage a transformation in awareness in the direction of sustainable lifestyles – as called for under the principles of *Long Life Learning* (LLL).

[19] Talk by the Chairman of the Apulia Chapter of the AIB: W. Morgese, *Eco-Libraries: sharing and alliances based on strategic content*, at the convention *Libraries in Search of Allies. Beyond cooperation, towards new strategies of sharing*, the Stelline Foundation, Milan 14-15 March 2013.
[20] For example, the libraries of the ARPA and APPA environmental agencies and of ISPRA, as well as the library network of the WWF and the library of the European Academy of Bolzano
[21] For example, the “Mediterranean Showcase” Library in Bari.

ENVIRONMENTAL TRAINING STRATEGIES AND TOOLS AND SUSTAINABILITY-ORIENTED EDUCATION

The challenges of global sustainability facing the generations of today and tomorrow, including financial crises, climate change, deterioration of the environment, social inequality and imbalances in access to resources, prove that the current model of development is not sustainable, but rather suffers from critical shortcomings, as does the approach to knowledge, based on a schematic division between the various fields and disciplines, that has held from the start of the industrial era to the present.

Indeed, it has been clear for some time now that, given the complexity of current developments and problems, an effort should be made to restore an all-encompassing, systemic vision of reality that places each element in a broader context, analysing the resulting interactions and interrelations, though without losing the wealth of scientific knowledge already acquired.

Formulation of the concept of "sustainable development" from the Rio de Janeiro Summit onward has addressed the parallel need to radically transform models and systems of training, education and communication.

It is no accident that the formulation of the concept of "sustainable development", from the Rio de Janeiro summit onward, has been accompanied by a parallel effort to emphasise the need to radically transform models and systems of teaching, education, training and communication, bringing the related contents and methodological approaches in line with the new vision[22]. The distinguishing elements of this ongoing cultural shift essentially consist of a cross-disciplinary outlook, a focus on local subjects and settings in programs of training and education and an approach to lifelong learning (permanent training and education), as recently confirmed by strategies and guidelines on the national, European and international levels (the Lisbon Strategy, Europe 2020, the UNECE Strategy for Education to Sustainable Development, the International Implementation Scheme of the UN Decade of Education for Sustainable Development – UNESCO 2005). These are also the constituent elements of the new "science of sustainability", which, starting from university instruction, is meant to serve as an innovative model for creating professional skills and know-how that fit with new models of development oriented towards constructing more sustainable societies.

Looking to the future, environmental training must be capable of covering the innovative factors introduced by measures of environmental protection, supporting the growth potential of new professional skills and meeting training needs for the rapidly expanding areas of employment in the green economy. At the same time, environmental education should favour activities of research and interdisciplinary professional training that combine scientific and humanistic learning, so as to facilitate informed and responsible participation of citizens in the affairs of their own areas and communities.

[22] Agenda 21, chap. 36 - Promoting education, awareness and training, Rio de Janeiro, 1992

As specifically regards ISPRA and provincial and regional environmental protection agencies network, an institutional step towards achieving such objectives is the intention of the Ministry of the Environment to plan, develop and organise activities of training and ongoing education on regulations and operating instruments in the field of the environment, while also promoting and carrying out initiatives of environmental education, eventually through the creation of a specific structure of excellence[23].

Environmental training supply

Environmental training is currently one of the main tools for applying educational policies to the creation of a society capable of promoting intelligent, sustainable and inclusive growth.

Environmental training nowadays is one of the main tools for applying training policies to the creation of a society capable of promoting intelligent, sustainable and inclusive growth, such as the Europe that José Manuel Barros hopes to achieve[24].
Since 2000 with the Lisbon Strategy, emphasis has been given to the critical role of training as a tool for reinforcing European competitiveness and as a way to ensure social cohesion.
As have the other member states, Italy has transposed the provisions of the European directives into national measures. For instance, Law no. 92 of 28 June 2012, "Measures for Reforming the Labour Market with an Eye towards Growth", legislation based on the "Europe 2020" Community strategy, highlights the need to promote and sustain systems of ongoing training able to provide tools and responses for the current phase of rapid technological change and to meet the labour market's demand for professional skills[25]. To this end, it is also important use tools to make vocational learning processes more flexible and easy. *E-learning* is one of the training methods that could be applied to meet the challenge of establishing a society of knowledge, improving the quality of learning and facilitating access to instruction by meeting specific training needs. The objective of the European Union in this field is to further sustain and develop the effective use of information and communications technologies (TIC) as part of systems of ongoing training and instruction. The adult learner becomes an active subject of his training to increase skills for professional development [26].
Therefore sustainability, or the improvement of social and economic conditions, plus the quality of life, can be seen as a key element in reformulating policies and systems of production and consumption, while environmental defence and protection can constitute an opportunity for professional and job-related development.

Environmental training creates professional figures capable of dealing with the complexity

In other words, environmental education is a tool for stimulating innovation by creating professional figures capable of dealing with the complexity of environmental problems through a multidisciplinary approach that successfully mediates the wide

[23] General Directive of the Ministry of the Environment of 2 August 2012, paragraph F, part two
[24] Europe 2020. A strategy for intelligent, sustainable and inclusive growth, European Commission, 2010
[25] 13th Report on Continuing Education for the Years 2011-2012, ISFOL, December 2012
[26] Decision no. 2318/2003/EC of the European Parliament and Council, 5 December 2003

range of interests and conflicts. All this assumes training that involves values and behavioral aspects which are of critical importance for a proper ecological approach able to ensure effective environmental action. As is made clear by the latest ISFOL Report, which examines environmental education offerings for the years 2004-2009, training initiatives are increasingly called upon to meet a demand for high-level training designed to develop top-flight professional skills and knowledge[27]. This growing need has been addressed by the university system, and specifically by the first-level degrees introduced under the university reform measure (Ministerial Decree 509 of 1999), which reinforced the system's training autonomy. The three-year degree curricula have met this need of environmental training through a significant innovation and diversification of the paths of study. In the period 2007-2008, environmental degrees accounted for 14% of all the three-year and specialised degree curricula implemented in universities. The universities were also, as shown once again by the ISFOL study, the – main promoters of environmental masters programs. This sector of training shows strong growth, as almost 300 masters programs were established in the academic year 2007-2008[28].

of environmental problems mediating the wide range of interests that come into play.

Generally speaking, the survey shows the training outlook to be growing and developing on the national level, with the addition of many curricula on environmental subjects, such as pollution and controlling and saving resources.
Professional training is increasingly an instrument of ongoing professional retooling and updating, of short periods, but at a medium to high level.

The ISFOL survey points to a developing outlook enriched by the addition of numerous curricula on key subjects.

The need of training comes mainly from the market and from companies that need to comply with current regulations, retool or reassign human resources or diversify and update their production processes and the services they offer.
The survey also reports that ongoing and permanent training is the favoured approach: it accounts for more than 77% of the different kinds of environmental training offered in the period 2008-2009.

[27] Environmental training offerings. Report for 2004-2009, ISFOL, December 2009.
[28] Three-year environmental degrees: job placement and continuation of studies, ISFOL, 2012

Table 12.2: Environmental education by types of courses and by year – ISFOL survey[29]

Types of training	2003-2004		2004-2005		2005-2006		2006-2007		2007-2008		2008-2009	
	v.a.	%	v.a.	%	v.a.	%	v.a.	%	v.a.	%	v.a.	%
During mandatory schooling	19	1.3	9	0.7	13	0.9	51	4	6	0.7	24	2.1
After mandatory schooling	33	2.3	77	6.1	138	10	16	1.2	53	6	68	6
Post secondary school	231	16.4	161	12.7	119	8.6	125	9.7	199	22.7	95	8.4
Ongoing training	881	62.6	893	70.3	921	66.8	968	75	557	63.5	857	75.9
Permanent training	49	3.5	37	2.9	18	1.3	39	3	26	3	23	2
Professional licenses or certifications	19	1.3	5	0.4	13	0.9	6	0.5	12	1.4	21	1.9
Training for business creation	24	1.7	4	0.3	3	0.2	1	0.1	-	-	3	0.3
Training for users at risk of exclusion	36	2.6	32	2.5	20	1.5	30	2.3	6	0.7	12	1.1
Training for the unemployed	91	6.5	40	3.1	128	9.3	43	3.3	17	1.9	17	1.5
Training for equal opportunity	25	1.8	11	0.9	5	0.4	11	0.9	1	0.1	8	0.7
Other activities	-	-	1	0.1	-	-	-	-	-	-	1	0.1
Total	1,408	100	1,270	100	1,378	100	1,290	100	877	100	1,129	100

During the period 2008-2009, ongoing and permanent training accounted for more than 77% of the different kinds of environmental training offered.

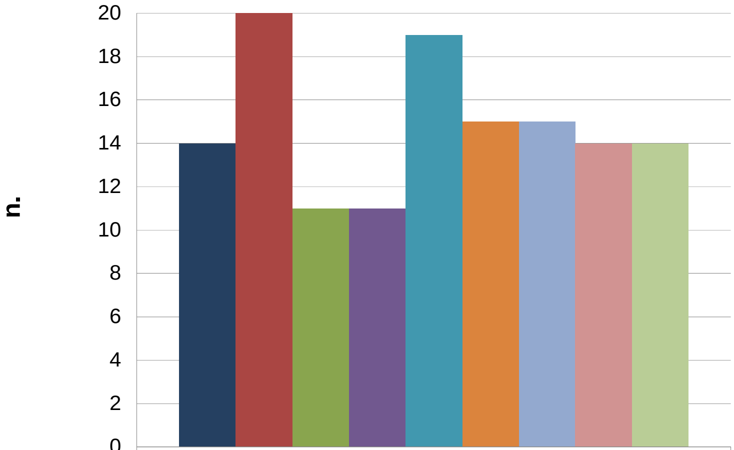
Initiatives of ongoing environmental training have also been carried out by the provincial and regional environmental protection agencies and by ISPRA. The provincial and regional agencies have also shown an ongoing commitment to offering paths of professional training, though the number of initiatives has varied over the years, with a decrease registered for the period 2011-2012, when the training courses held during each year amounted to slightly more than 12% of the total of the training initiatives organised during the period 2004-2012.

In the period 2004-2012, regional and provincial environmental protection agencies also showed an ongoing commitment to offering paths of professional training on environmental subjects.

Despite the decrease registered, more than 2,000 courses were offered during the period in question and over 40,000 environmental technicians were trained.

In the years 2011 and 2012, the number of technicians involved in training initiatives totalled more than 9,000 units.

[29] Source: ISFOL Environment Project - Ifolamb 2009



Year - Surveyed Agencies	Average courses held per organization
2004 - 10 Agencies and ISPRA	14
2005 - 9 Agencies and ISPRA	20
2006 - 17 Agencies and ISPRA	11
2007 - 14 Agencies and ISPRA	11
2008 - 18 Agencies and ISPRA	19
2009 - 13 Agencies and ISPRA	15
2010 - 16 Agencies and ISPRA	15
2011 - 18 Agencies and ISPRA	14
2012 - 18 Agencies and ISPRA	14

The average number of courses held and apprenticeships sponsored by each agency is almost identical to the figures for earlier years.

Figure 12.6: ISPRA-ARPA/APPA environmental training offerings[30]

In keeping with the national overview that emerges from the ISFOL study, the courses promoted by the regional and provincial environmental protection agencies have also been primarily short-term initiatives, especially in recent years, when a further decrease in their average duration was recorded. This downward trend can be seen as a repercussion of more rigorous budget policies brought about by the recent economic-financial crisis, a situation that has forced government bodies to reduce the funds available for the training of human resources.

Short-term courses have gone from accounting for 95% of the total in 2004 to 98% in 2011 and 2012.

Short-term courses have gone from accounting for 95% of the total in 2004 to 98% in 2011 and 2012, when courses calling for more than 50 hours of training accounted for only 2% of the initiatives promoted.

[30] Source: ISPRA-ARPA/APPA data processed by ISPRA

Table 12.3: ISPRA-ARPA/APPA environmental training offerings, average duration of the courses[31]

Agencies surveyed by year	Average hours of instruction per course
	number
2004 - 10 Agencies and ISPRA	31
2005 - 9 Agencies and ISPRA	22
2006 - 17 Agencies and ISPRA	19
2007 - 14 Agencies and ISPRA	22
2008 - 18 Agencies and ISPRA	19
2009 - 13 Agencies and ISPRA	30
2010 - 16 Agencies and ISPRA	31
2011 - 18 Agencies and ISPRA	16
2012 - 18 Agencies and ISPRA	14

In 2012 the agency system provided an average of 14 hours of instruction per course.

At the same time, the percentage of courses financed by funds from outside the sponsoring organisations rose to respective figures of 11% and 12% of all the initiatives held in the years 2011 and 2012, as compared to a figure of 6% for 2004. As a rule, the courses held in the period 2011-2012 were meant to heighten professional skills and know-how in terms of monitoring and controls, especially with respect to water resources, air quality, waste and physical agents. Looking at examples of more flexible training methods adopted by the regional and provincial environmental protection agencies, in 2011 the Piedmont ARPA instituted an e-learning training course, as was done in 2012 by the Emilia-Romagna ARPA and by ISPRA. The latter, on the strength of the positive response to the on-line training initiative provided in 2012, also planned e-learning and “blended” courses for 2013, for example the second course on Good Laboratory Practices for certification of the laboratories of the agency system and the course for technicians in environmental acoustics, an initiative recognised by the Lazio Region. In terms of tools of environmental training aimed at creating high-level professional figures in the field, mention should also be made of the internships and apprenticeships organised in collaboration with Universities and other educational institutes. During the period 2004-2012, more than 3200 apprenticeships were organised by the environmental protection Agencies and by ISPRA, including approximately 870 in the years 2011-2012 alone. The abovementioned Law no. 92 of 2012 also introduced major innovations in terms of apprenticeships, tasking the Conference of State and Regional Governments the task of drawing up the guidelines whose provisions were to be followed by the regions in stipulating the specific measures governing this training tool. Not until the second half of 2013, the deadline within which the Regions must include the points indicated by these guidelines in their legislation, can the effects of these regulatory modifications in terms of the professional training of young university graduates begin to be assessed.

The e-learning methodology for courses in environmental training has been implemented by a number of environmental protection agencies and by ISPRA, though still to a limited extent.

[31] Source: ISPRA/ARPA/APPA data processed by ISPRA

The scenario for which a brief description has been given illustrates a sector of training – namely environmental training – that is rich in potential and constantly evolving, though, as was also pointed out by ISFOL, what is lacking is an overall vision, a coordinated set of actions designed to identify and monitor training needs while evaluating the effectiveness of the training, all in response to the growing demand for specialised, highly qualified education. It was to this end that the Ministry of the Environment, in its General Directive of 2 August 2012, stressed the need to create a structured system for specialised environmental training, assigning the task to ISPRA. The goal is to establish a *Specialised School of Environmental Studies* able to develop top-flight and ongoing training in the field of the environment, especially as regards new regulatory developments and techniques for carrying out activities of monitoring and control. The school's guiding principles would be efficiency, in order to optimise the economic resources invested by the public sector in the training of human resources (as per art.11 "*Restructuring of Public Training Institutes*" of Legislative Decree no. 95/2012) along with effectiveness, ensuring that the courses created meet the training needs already voiced, or that will be put forth in the future, by the provincial and regional environmental protection agencies, by the Ministry itself and by the other public bodies and research institutes.

The environmental training sector is rich in potential and constantly evolving. As such, there would appear to be a need, on the national level, for a structured organisation able to provide an all-encompassing vision and a coordinated system of actions.

Sustainability-oriented education

Sustainability-oriented environmental education topic presents a number of different points for reflection. In cultural and strategic terms, there is the potential role of such education in light of the critical shortcomings shown by the economic and social models that held sway during the last century.

A recent UNESCO Report on the Decade of Education for Sustainable Development, that officially ends in 2014, contends that sustainability-oriented education, far from having completed its mission, becomes more relevant with every passing day, seeing that a great deal must still be done to reach the goal of reversing negative trends, such as ecosystems deterioration and social and economic inequality instances. UNESCO is looking for education towards sustainability to become a driving force that cuts across all the various sectors in promoting innovation and transformation, though for this to happen, the member states must do more to reform their educational programs and overcome the barriers that separate the educational community (schools, universities) from the other components of society (politics, work) with which it must interact[32].

[32] UNESCO, *Planning the Education of Tomorrow. Report for 2012 on the UN Decade of Education for Sustainable Development*: http://unesdoc.unesco.org/images/0021/002166/216606e.pdf

The fact is that environmental education, currently viewed as a tool for facilitating processes of learning oriented towards environmental and social sustainability, could make a very real contribution to addressing the worldwide situation of crisis, promoting a holistic, constructively critical view of reality that would approach the more pressing dilemmas of today by imagining an alternative future and by looking innovative solutions that ensure a more lasting, empathetic approach to the most dramatically urgent problems.

Education towards sustainability becomes synonymous with education for change.

This outlook, thanks to which education oriented towards sustainability becomes synonymous with *education for change*, leads to some methodological considerations:

- concrete steps must be take towards integrating content and methods, both through educational planning and by training of educators with multidisciplinary curricula formulated from the perspective of the "science of sustainability";
- the specific professional figure of sustainable development educators is emerging, meaning an educator who mediates and facilitates the learning processes and experiences by combining different types of capabilities: theoretical knowledge, modes of thought and behaviour, practical and relational skills[33];
- the value, indeed the absolute need, to place a greater focus on creating and reinforcing networks and partnerships, if possible with contributions from a variety of different subjects and within accredited, coordinated institutional systems.

But given the lack of coordination among the institutions involved, the constant cuts in resources and the merging and elimination of organisational structures engaged in these activities, the national context would appear to fall short of providing what is truly needed. At the same time, a wide variety of services and activities are offered, especially at the local level, where it is relatively easier to establish working relationships between local governments, schools and associations, and where successful initiatives can be proposed that, even at low levels of funding, obtain the active involvement of the population, especially if the topics addressed are of interest to the local area and community.

Demonstrating as much is the success of the 2012 Week of Education for Sustainable Development promoted by UNESCO, during which hundreds of initiatives were carried out in Italy, with contributions from local government bodies, scholastic institutes, centres and laboratories of environmental education, and many others.

The 2012 Week of Education for Sustainable Development was devoted to the topic: "Food, Agriculture Ecosystems".

The topic proposed: *"Mother Earth: Food, Agriculture Ecosystems"*[34] makes it clear that education for sustainability entails throwing light on the links between a variety of environmental, cultural and economic considerations that should be examined on both a global and local scale. On the other hand, in the case of more extensive, long-term educational projects and campaigns, the available resources

[33] UNECE, *Learning for the Future. Skills in Education for Sustainable Development*, 2012: http://www.unece.org/environmental-policy/areas-of-work/education-for-sustainable-development-esd/education-for-sustainable-development-esdpublicationshtml/education-for-sustainable-development/2012/competences-for-esd/docs.html

[34] http://www.unescodess.it/iniziative/eventi/settimana_nazionale_educazione_sviluppo_sostenibile_2012

must often be supplemented with outside funding, first and foremost programs of the European Community. Not that these are within the reach of everyone, seeing that they often come with restrictive conditions, such as working relationships with a number of partners, an integration of various types of activities and beneficiaries, effective planning and management of the assigned funds and, in what has virtually become a requirement, the use of interactive communications programs, such as social networks, e-learning and multimedia tools.

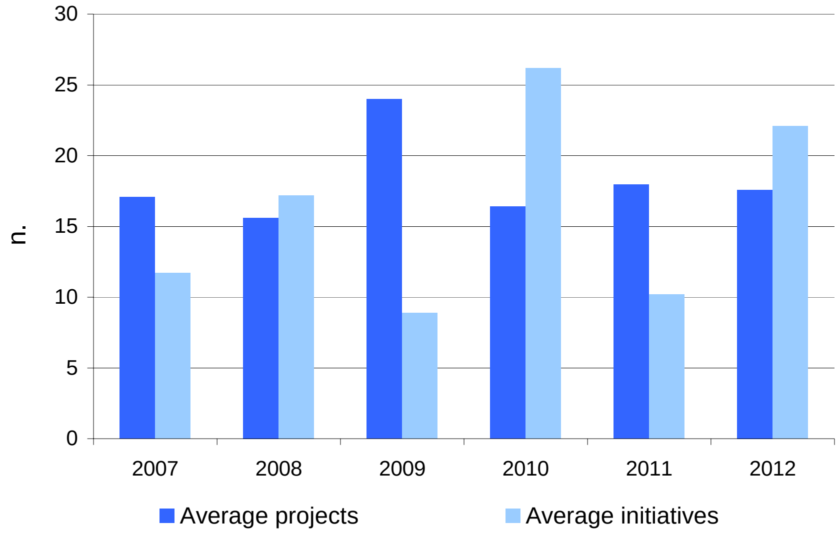
An important experience in this direction is the project LIFE Fa.Re.Na.It. ("Make Nature Networks 2000 in Italy), which currently finds ISPRA working in partnership with the CTS for the environment and other organisations. The integrated efforts of communication and training undertaken during the program to promote knowledge of the 2000 Nature Network and popularise eco-compatible practices currently includes an educational campaign aimed at schools, though less for the purpose of providing information than to stimulate the active involvement of students and teachers through a variety of means, such as the contest, "My Land is Worth It", which calls on the classes to draw up a project for the care and reclamation of a protected area in their territory. A school with an awareness of its surroundings can serve as a critical cultural hub through which to channel the underlying values that the project is meant to promote - respect of habitats and ecosystems, farming not as exploitation but as stewardship and optimisation of the fruits of the land, the link between a healthy environment and healthy people - in order to communicate and share them with the whole society[35].

The active involvement of schools is one of the strategic initiatives of LIFE Fa.Re.Na.It. a project in which ISPRA is one of the partners.

This field includes also the programs, projects and activities undertaken by the system consisting of ISPRA and the regional and provincial environmental protection agencies, though uncertainty and difficulties are the rule, due to the inevitable cuts occasioned by the government spending review, whose repercussions on the national level affect the viability and operating effectiveness of the Interagency Network for Sustainability Education coordinated by ISPRA, while locally they hamper the activities carried out by the environmental protection agencies within their respective regional/provincial network, and especially efforts to interface with local areas. The overview of the situation offered by the indicator *Environmental Education Initiatives for Sustainability*, a part of the 2012 ISPRA Environmental Data Yearbook, shows however that the average number of environmental education initiatives remained almost constant in the years 2007 to 2012, showing a peak in 2009 for projects and another in 2010 for singular activities (Figure 12.7).

The prevailing institutional uncertainty also has repercussions on the system consisting of ISPRA and the regional and provincial environmental agencies.

[35] http://www.farenait.it/it/junior



During the period 2007-2012, the average number of environmental education initiatives remained virtually unchanged, peaking in 2009 in terms of projects and in 2010 with respect to singular activities.

Figure 12.7: Average number of environmental education initiatives for sustainability held by ISPRA and the regional and provincial environmental agencies[36]

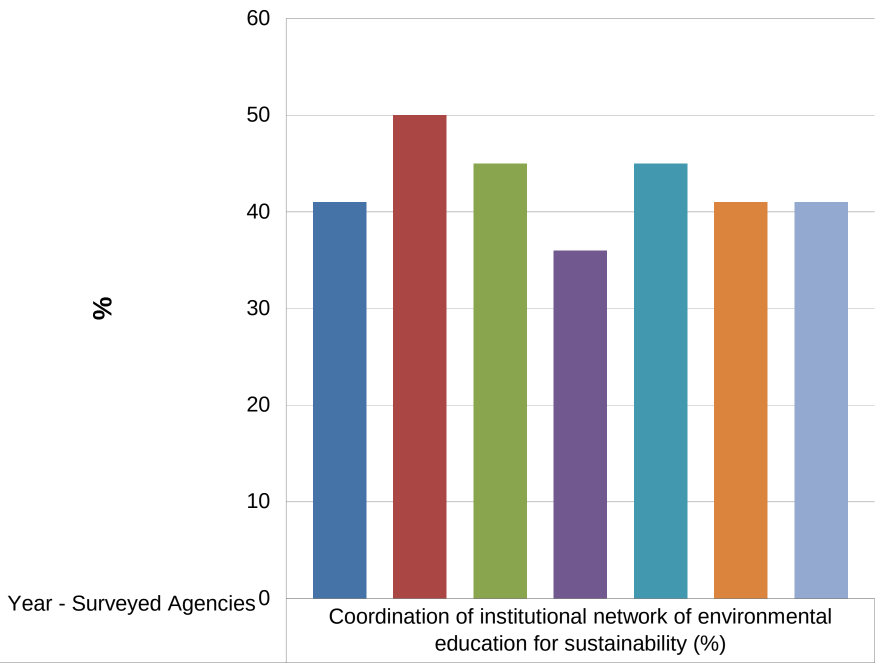
An interesting point is the break-down of the different types of beneficiaries of the educational initiatives, with the projects, as a rule, being aimed at the school-age population, while the singular activities (information sessions, guided tours and exhibitions, awareness campaigns, etc.) tend to focus on adults.

An analysis of performance in terms of integration, essentially the capacity/possibility of working in partnership with the other participants, and operating results, meaning the types of services carried out in the local territory, helps to complete the overview of the contribution made by ISPRA and the regional and provincial environmental protection agencies within the context of the larger national network of education for sustainability.

A noteworthy result, drawn from the data collected to formulate the indicator *Integration and Operating Performance within the Local Network of Environmental Education for Sustainability*, is the long-term success of the regional and provincial environmental agencies in carrying out their role of coordination within their respective network (Figure 12.8).

This shows that the regional governments still have a high level of trust in the environmental agencies, a consideration that promises to ensure the continuation of what has been built up over the years.

[36] Source: ISPRA-ARPA/APPA data processed by ISPRA



Year - Surveyed Agencies	Coordination of institutional network of environmental education for sustainability (%)
2006 - 14 Agencies-ISPRA	41
2007 - 16 Agencies-ISPRA	50
2008 - 14 Agencies-ISPRA	45
2009 - 15 Agencies-ISPRA	36
2010 - 16 Agencies-ISPRA	45
2011 - 21 Agencies-ISPRA	41
2012 - 21 Agencies-ISPRA	41

During the period 2006-2012, the regional and provincial environmental agencies enjoyed good long-term success in carrying out their role of coordination within their respective network.

Figure 12.8: Role of coordination played by the environmental agencies and ISPRA in the institutional networks of environmental education for sustainability[37]

One last reflection regards the distinctive nature of this topic when it comes to the procedures for evaluating activities. Two elements deserve mention: the inherent dynamism of the *focus on sustainability*, which effects both the knowledge of environmental phenomena and educational research; then there is the *central role of the subject in the learning process*, a factor of such importance that it is difficult to foresee and measure its impact on the personal convictions or actions of an individual or a group, that can be influenced by many factors related to both knowledge and emotions. This is why the main systems of monitoring and evaluation established to date aim to assess the quality of programs and projects in terms of the consistency between the underlying values and theoretical framework and their transformation into activities employing specific procedures for performance. The most advanced example in Italy may be the array of *Indicators of Quality for Regional Systems of Environmental Education* (SIQREA)[38]. Put to the test in a number of different regions, it allows the subjects to assess their own performance by using a grid consisting of indicators/descriptors of quality and quantity. To conclude, the quality and the significance of the indicators used for this area of interest in

The focus on sustainability and the key role of the human factor in the outcome of learning processes are decisive factors in determining what tools to use to monitor and evaluate activities of environmental education.

[37] Source: ISPRA-ARPA/APPA data processed by ISPRA
[38] http://www.arpat.toscana.it/documentazione/catalogo-pubblicazioni-arpat/imparare-a-vedersi

the Data Yearbook could be improved not only through the participation of more subjects but also by examining the different methods and procedures under which the initiatives are carried out. This would effectively integrate the quantitative information that is already available but used primarily for statistical studies.

ENVIRONMENTAL PERFORMANCE IMPROVEMENT TOOLS

With the growing awareness that environmental protection must necessarily involve stakeholders, in particular through the establishment of new ways of cooperation with market operators (producers and consumers), the improvement of the environmental quality of organisations and products has taken a key role . The primary references for this objective are the European regulations EMAS and EU Ecolabel, together with the international standards ISO 14000 series.

Improving the environmental quality of businesses, organisations and products has come to play a key role in efforts to protect the environment.

EMAS (EC Regulation no. 1221/2009) and EU Ecolabel (EC Regulation no. 66/2010) reflect the environmental policy initiated by the European Union under the Fifth Environmental Action Programme (1992-1999). Beside traditional “command and control” activities new voluntary tools have been conceived meant to promote better management of resources while encouraging organisations to take direct responsibility for the environment and disseminating information on their improved environmental performance of processes and products.

The enactment of the aforementioned regulations has demonstrated the importance of such tools in terms of environmental prevention and improvement. The key objective underlying the Sixth Environment Action Programme, as well as the European Commission’s new plans for action, “Sustainable Production and Consumption” and “Sustainable Industrial Policy” (COM 2008/397 def.), can be identified as the development and reinforcement of a set of measures that, based on production activities that respect the environment and on ecological consumption awarness, should lead, over medium/ long term, to the creation of a “green market” along with the implementation of Sustainable Production and Consumption (PCS) principles.

The enactment of the aforementioned regulations has demonstrated the noteworthy potential of such tools in terms of environmental prevention and improvement.

In practical terms, this new approach has led to:

- the intent, as stated in the Sixth EU Environment Action Programme, to increase the use of EMAS and the EU Ecolabel Regulations, to promote Green Procurement as a way of stimulating the growth of the “green market” and to improve the flow of environmental information from businesses to businesses and from businesses to consumers, encouraging the use of, among other tools, the Environmental Product Declarations (DAP);
- requests to member states for developing strategies to integrate the voluntary tools available (EMAS, EU Ecolabel, Product Declarations, ECO Design etc.), together with the related legal measures, in order to enact the “environmental efficiency” principle;
- the innovations introduced under the EMAS and EU Ecolabel

schemes, and specifically: the extension of EMAS from the industrial sector to all areas of activity, introduction of the indirect environmental impact concept, attention focussed on environmental performance indicators and the opening to the global market; consideration of social, along with environmental aspects, in formulating criteria for awarding the EU Ecolabel , as well as the certification of semi-finished products together with products meant for final consumption;

- the strategic role given to the public meant, in the more general sense of the term, as public sector and as citizens-consumers that can push the growth of "ecological demand".

The creation of the "green market" is an effort that involves:

Creation of the "green market" is an effort that involves: businesses, consumers and government bodies.

- companies that, in their planning and operating phases, can improve the environmental characteristics of their products and services;
- consumers that prefer ecologically worthy offerings and make correct use of what they have purchased;
- Public Administrations that can provide environmentally adequate services, play a role of smart consumer, inform citizens and direct their awareness and behaviour, introduce incentives, promote research and place development policies on a uniform footing.

In keeping with the European Commission's new plans of action, "Sustainable Production and Consumption" and "Sustainable Industrial Policy", under which production that respects the environment and informed consumption are synergistic elements to be stressed for achieving new modes of production and consumption, a wide variety of tools are available (EMAS, EU Ecolabel, Green Procurement, DAP etc.), all of them of proven worth: important is their right mixture that is the result of company's strategies, based on market competition, and in case of Public Authorities, on the outcomes of development decisions and programs.

In short, the driving factors around which harmonised strategies should be formulated are:

- forms of economic leverage, finding ways to simplify administrative procedures, taxes and subsidies in order to promote the use of environmental certification by organisations;
- the development of tools and incentives, on the local level as well, in order to encourage more ecologically sound consumption, taking action to influence demand and to supply information through initiatives designed to heighten the awareness of the public authorities that manage public tenders;
- influencing offerings of ecological products and services by introducing tools for comparing information, encouraging transparency and disseminating data, encouraging eco-design and compliance with environmental compatibility.

In line with the approach taken by the European Commission, which has made EMAS, EU Ecolabel and GPP an integral part of its new policies of sustainable production and consumption, the European Council and Parliament have issued new EMAS III and Ecolabel III texts that went into effect, respectively, on 11 January 2010 and on 19 February 2010. Between 1997 (the year in which the EMAS and EU

From 1997 to the present, penetration of EMAS and EU Ecolabel has grown, showing a positive annual growth rate.

Ecolabel programs effectively went into operation in Italy) and today, the penetration of the two programs has risen continuously, showing a positive annual growth rate (Figures 12.9 and 12.10).

The regions with the best results for number of EMAS registered organisations are: Emilia-Romagna, Lombardy, Trent-Alto Adige, Tuscany and Piedmont. The uneven territorial development reflects the different levels of awareness and/or incentives.

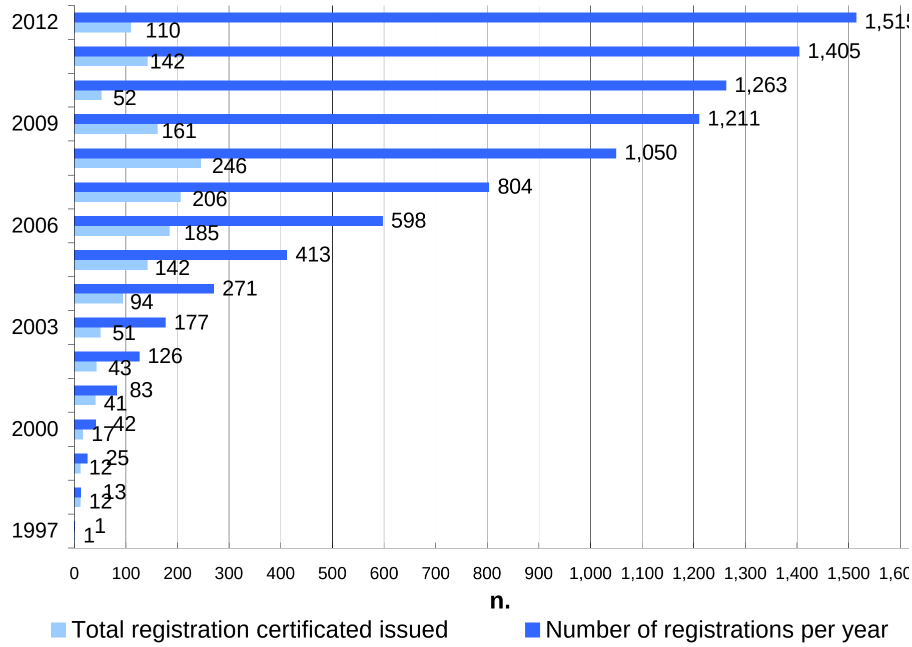


Figure 12.9: Trends in EMAS registration certificates issued in Italy[39]

The regions with the most EU Ecolabel licenses are Trent-Alto Adige, Emilia-Romagna, Tuscany, Lombardy and Piedmont.

Of the European states, Italy places third in terms of EMAS, behind Germany and Spain, while it holds first place with respect to the Ecolabel, followed by France and Denmark. The regions with the best results in terms of number of EMAS registered organisations are: Emilia-Romagna, Lombardy, Trent-Alto Adige, Tuscany and Piedmont. The region with the most EU Ecolabel licenses registered is Trent-Alto Adige, followed by Emilia-Romagna, Tuscany, Lombardy and Piedmont.

The EMAS and EU Ecolabel increases can be traced to, among other things, developed skills and professional know-how obtained by attending local EMAS and Ecolabel schools whose objective is to provide fundamental training to professional figures who are qualified to assist organisations (EMAS environmental auditors and consultants and EU Ecolabel consultants), in addition to establish, in collaboration with the academic world, specific university masters programs for high-level training.

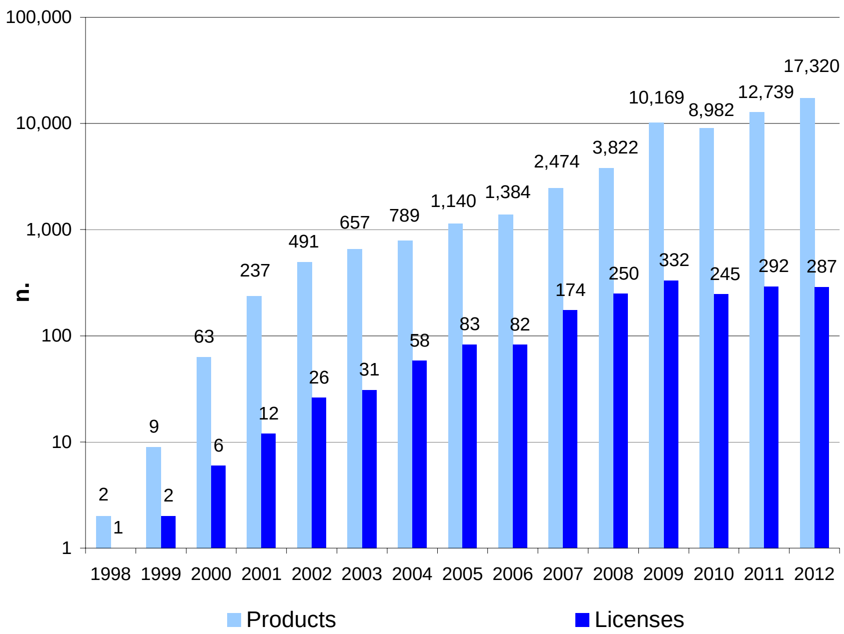
The growth of EMAS and EU Ecolabel (Italy is among Europe's leaders) is not yet structural, due to varying levels of awareness and/or incentives in the different regions and production sectors.

But though Italy is one of Europe's leaders, the growth is not yet structural. There are geographic discrepancies due to different levels of awareness or incentives between different regions, public authorities, production sectors, business and professional associations etc.. Despite the positive attitude shown towards EMAS by art. 18 of Law 93 of 23 March 2001 (though this was not supported by subsequent measures of application) and by the new consolidated act on the environment (Legislative Decree 152/2006), a practical and effective sponsoring of voluntary instruments by the competent government bodies and by the interested parties is still far from being a reality.

[39] Source: ISPRA

In the case of EMAS, the most critically important elements appear to be:

- the absence of a policy geared towards integrating the environmental needs of the population with the competitive demands of businesses on the marketplace, in addition to developing incentive plans for the organisations that participate in the program;
- the attitude of the public enforcement authorities that are responsible for authorisations and monitoring, plus the scarce propensity to support prevention policies.



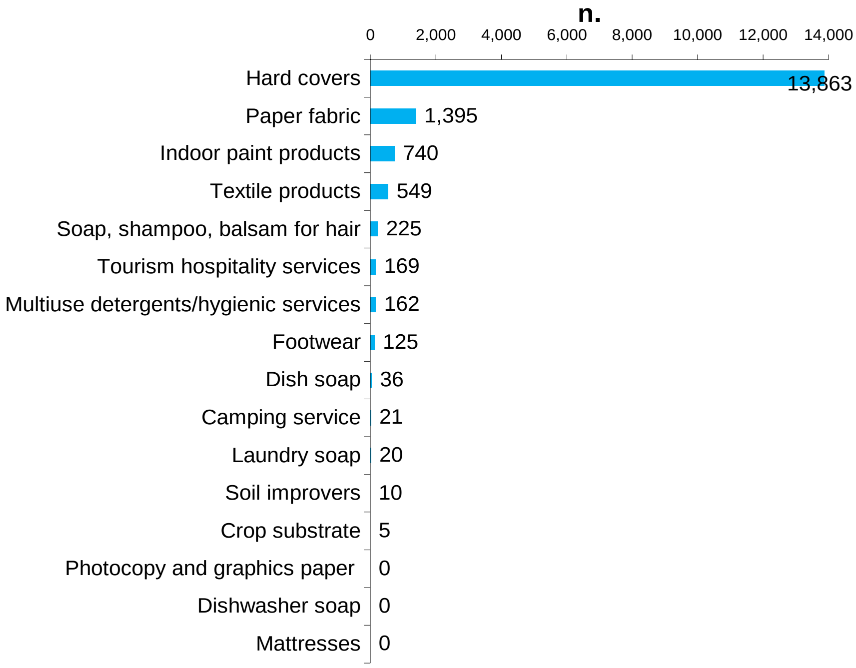
In Italy, as of December 2012, there were 287 valid EU Ecolabel licenses covering a total of 17,320 labelled products/services. The decrease in the number of license and products registered in 2010 stems from the fact that companies had to renew the contract for using the EU Ecolabel on the basis of newly established criteria.

Figure 12.10: Trends in EU Ecolabel products/services in Italy (31 December 2012)[40]

With regard to the EU Ecolabel, the interest of businesses in this certification has remained constant. In 2010 there was a slight drop in the number of licenses, and therefore in the number of certified products and services, due to the fact that the companies had to renew their contracts for the use of the label following the implementation of new criteria (companies that sent in their renewal application late, beyond the deadline stipulated in the pertinent regulations, had their licenses cancelled from the official registers), but in the years that followed the figures once again rose, resulting in a positive trend for this instrument.
The introduction of environmental criteria into government calls for tender, please the advantageous position of companies with EU Ecolabel certified products when it comes to showing compliance with these criteria, are a further stimulus for the EU Ecolabel environmental certification of products.
Net growth was recorded in the year 2012, as compared to the figures for 2010-2011, in certain groups of products, such as detergents, paints, soaps and shampoos, as well as paper and soil improvers. As shown in

[40] Source: ISPRA

Figure 12.11, of thirteen groups of products actively sold in Italy, the category with the greatest number of EU Ecolabel products is “hard covers”, with no fewer than 13,863 certified products.



In Italy, the category of products with the largest number of EU Ecolabel seals is “hard coverings”, with no fewer than 13,863 certified products.

Figure 12.11: Distribution of EU Ecolabel products/services in Italy by product category (31 December 2012)[41]

GLOSSARY

Environmental certification:
A recognition presented to companies that, through their operating systems, continuously reduce environmental impact due to their internal procedures while agreeing to work to prevent pollution.

EU Ecolabel:
The ecological quality label of the European Union, awarded to the best products and services from an environmental standpoint.

E-learning:
On-line learning procedures.

EMAS:
A voluntary European community system of eco- management and control, open to companies that manage their environmental impact according to high standards.

Feedback:
In processes of circular communication, the phase of listening to the target audience in order to gauge and confirm the success of the information and the communication initiative.

[41] Source: ISPRA

Environmental reporting:
The systematic collection and dissemination of data on the monitoring of the environment. The resulting presentation is the environmental report.
Rss Feed (***Rss*** = ***Rich Site Summary*** *or* ***Really Simple Syndacation***):
A format for the dissemination of web contents. With Rss flows, internet users can be kept up to date on new articles or comments published on sites that interest them without having to actually visit each one.

Social media:
A generic terms indicating the on-line technologies and practices that individuals employ to share content consisting of texts, images, video clips and audio recordings.

Social network:
A platform that utilises the new communications media, allowing users to operate their own social networks.

The ISO 14000 Standard:
A series of specifications for environmental management systems, recognised internationally and developed by committees of the ISO (International Organization for Standardization).

ACRONYMS

The meanings of some acronyms contained in the publication are given hereunder:

AA	Assigned Amount
AAU	Assigned Amount Unit
ACI	Italian Automobile Club
ACNP	Italian Union Catalogue of Serials
AEA	European Environment Agency
AEEG	Italian Authority for Electricity and Gas
AIA	Integrated Environmental Authorisation
AIE	International Energy Agency
AIEA	International Atomic Energy Agency
AISCAT	Italian Association of Motorway and Tunnel Concessionaries Companies
AMP	Protected Marine Areas
APAT	Agency for Environmental Protection and Technical Services
APHEKOM	Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe
APPA	Provincial Environmental Protection Agency (autonomous provinces only)
ARPA	Regional Agency for Environmental Protection
ASIA	Statistical Archive of Active Enterprises
ATO	Optimal Territorial Ambit
BaP	Benzo-a-pyrene
BCAA	Good Agronomic and Environmental Condition
BIOFORV	Working Group on Forest Nursery Biodiversity
BITS	Benthic Index based on Taxonomic Sufficiency
BOLAM	Bologna Limited Area Model
BPCO	Chronic Obstructive Bronchial Pneumopathy
BRef	Community reference document concerning BAT
BRI	Building Related Illness
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
CAD	Digital Administration Code
CAFE	Clean Air For Europe
CAI	Italian Alpine Club
CARG	Geologic cartography
CARLIT	Coastal cartography
CBD	Convention on Biological Diversity
CCM	National Center for the Prevention and Control of Diseases
CCTA	Environmental Protection Carabinieri Headquarters
CDR	Refuse derived fuel
CE (EC)	European Commission
CEE	European Economic Community
CEHAPE	Children’s Environment and Health Action Plan for Europe
CEM	Electromagnetic Fields
CFS	State Forestry Corp
CGO	Compulsory Management Standards
CIA	Confederation of Italian Farmers
CIESM	The Mediterranean Science Commission
CIRA	Italian Aerospace Research Centre
CISO	Italian Ornithological Studies Centre
CLC	Corine Land Cover
CLEAR-UP	Clean and resource efficient buildings for real life
CMCC	National Research Council’s Euro-Mediterranean Centre for Climate Change
CNOSSOS	Common Noise Assessment Methods
CNR	National Research Council
CNR-GNDCI	National Research Council - National Group for Protection against Hydrogeological Disasters

CNT	National Transportation Statistics Report
COFOG	Classification Of Function Of Government
COSMO	Consortium for Small-Scale MOdeling
COV	Volatile Organic Compounds
COVNM	Non-methane Volatile Organic Compounds
CPD	Construction Products Directive
CPUE	Catch Per Unit of Effort
CRA-CMA	Council for Research and Experimentation in Agriculture - Research Unit for Climatology and Meteorology applied to Agriculture
CSC	Contamination Threshold Concentrations
CSR	Risk Threshold Concentrations
CSS	Higher Health Council
DAISIE	Delivering Alien Invasive Species Inventories for Europe
DALY	Disability Adjusted Life Years
DAP	Environmental Product Declarations
DD	Document Delivery
DG SANCO	European Commission Directorate-General for Health and Consumers
DP	Prevention Department
DPC	Civil Protection Department
DPSIR	Driving force – Pressures – State – Impact – Responses
EBCC	European Bird Census Council
EBD	Environmental Burden of Disease
EBoDE	Environmental Burden of Disease in Europe
ECE	Economic Commission for Europe
ECF	European Climate Foundation
EDO	European Drought Observatory
EEA	European Environment Agency
EAU	European allowance Unit
EE-AoA	Europe’s Environment Assessment of Assessment
EFHECT	Exposure Patterns and Health Effects of Consumer Products in the EU
EIONET	European Environment Information and Observation Network
EMAS	Eco-Management and Audit Scheme
ENAC	Italian Civil Aviation Board
En-VIE	Co-ordination action on IAQ & Health Effects
ENEA	Agency for New Technologies, Energy and the Environment
EoI	Exchange of Information
EOS	Sustainability Oriented Education
EPBD	Energy Performance of Buildings Directive
EQB	Biological Quality Elements
EQR	Ecological Quality Ratio
ETC-LUSI	European Topic Centre Land Use and Spatial Information
ETS	Emissions Trading System
EU	European Union
EUA	European Allowance Unit
EUAP	Official List of Protected Areas
EUROSTAT	Statistical Office of the European Communities
FAQ	Frequently asked questions
FA.RE.NA.IT	A Network for Nature project 2000 in Italy
FBI	Farmland Bird Index
FEP	European Fisheries Fund
GARD	Global Alliance against Chronic Respiratory Disease
GEA	Environmental Education Group
GEF	Global Environment Facility
GER	Green Economy Report
GES	Good Environmental Status

GIG	Geographical Intercalibration Group
GIS	Geographical Information System
GIZC	Integrated Coastal Area Management
GLADIS	Global Land Degradation Information System
GMES	Global Monitoring for Environment and Security
GPL	Liquid Propane Gas
GPP	Green Public Procurement
GPSD	General Product Safety Directive
GSE	Energy Services Manager
GTS	Global Telecommunication System
HEALTH-VENT	Health Based Ventilation Guidelines
HESE	Health Effects of Schools Environment
HESE-INT	Interventions on Health Effects of School Environment
HNV	High Nature Value
IAEA	International Atomic Energy Agency
IAIAQ	Impact Assessment of IAQ
IAQ	Indoor Air Quality
IBA	Important Bird Areas
IBI	Italian Botanical Bulletin
ICCAT	International Commission for the Conservation of Atlantic Tuna
ICRAM	Central Marine Environmental Research Institute
ICZM	Integrated Coastal Zone Management
IEA (AIE)	International Energy Agency
IFFI	Inventory of Landslides Events in Italy
ILL	Inter-Library Loan
INEA	National Institute for Agrarian Economy
INES	National Inventory of Emissions and their Sources
INFC	National Inventory of Forests and Forest Carbon Sinks
INFEA	Environmental Information, Training and Education
INFS	National Institute for Wild Fauna (now ISPRA)
INGV	National Geophysics and Vulcanology Institute
IOC	Intergovernmental Oceanographic Commission
IPA	Aromatic Polycyclic Hydrocarbons
IPCC	International Panel on Climate Change
IPPC	Integrated Pollution, Prevention and Control
IREPA	Institute for Economic Research for Fisheries and Aquaculture
IRES	Corporate Income Tax
IRPEF	Personal Income Tax
ISCR	Higher Institute for Conservation and Restoration
ISO	International Organization for Standardisation
ISPRA	Higher Institute for Environmental Protection and Research
ISS	Italian National Health Institute
ISTAT	Italian National Statistics Institute
ITALIC	Information System on Italian Lichens
ITF	Italian Trust Fund
ITHACA	ITaly HAzard from CApable faults
IUCN	International Union for Conservation of Nature
IUUF	Illegal, Unreported, Unregulated Fishing
JRC (CCR)	Joint Research Centre (European Community Directorate-General)
JRC-IES	Joint Research Centre-Institute for Environment and Sustainability
LADA	Land Degradation Assessment in Drylands
LIFE	The Financial Instrument for the Environment
LIPU	Italian League for the Protection of Birds
LULUCF	Land Use, Land Use Change and Forestry
MA	Millennium Ecosystem Assessment-UN

M-AMBI	Multivariate-Azti Marine Biotic Index
MATTM	Ministry of the Environment and Protection of Land and Sea
MED	Minimum Erythemal Dose
MiPAAF	Ministry of Agricultural, Food and Forestry Policies
MIT	Ministry of Infrastructures and Transport
MITO	Italian Ornithological Monitoring
MIUR	Ministry of Education, University and Research
MSE	Ministry of Economic Development
MSFD	Marine Strategy Framework Directive
MTD (*BAT*)	Best Available Techniques
MUD	Unified Environmental Declaration Form
NAMEA	National accounting matrix including environmental accounts
NCDC	National Climatic Data Centre
NCEP/DOE	National Centres for Environmental Prediction/Department of Energy
NEC	National Emission Ceiling
NESDIS	*N*ational Environmental Satellite, Data and Information Service
NILDE	Network Inter-Library Document Exchange
NOAA	National Oceanic and Atmospheric Administration
NOISE	Noise Observation and Information Service for Europe
NORM	Naturally Occurring Radioactive Materials
OC	Organic carbon
OCSE	Organisation for Economic Cooperation and Development
OECD	Organisation for Economic Cooperation and Development
OMS (WHO)	World Health Organization
OPAC	On-line Public Access Catalogue
OSMER	Regional Meteorological Observatory
PAC	Common Agricultural Policy
PAI	Hydrogeological Plan
PAEE	Energy Efficiency Action Plan
PAN	National Action Plan
PCAR	Action Plans for Noise Containment and Abatement
PCBs	Polychlorobiphenyls
PCP	Common Fisheries Policy
PCS	Sustainable Production and Consumption
PEC	Certified Electronic Mail
PESERA	Pan European Soil Erosion Risk Assessment
PIL	Gross Domestic Product
PNA	National Allocation Plan
PNR	National Radon Plan
POM	Princeton Ocean Model
POP	Multiyear Guidance Programmes
POPs	Persistent Organic Pollutants
POSEIDON	Previsional Operational System for the mEditerranean basIn and the Defence of the lagOon of VeNice
POT	Peak Over Threshold
PPP	Purchasing Power Parity
PRAE	Regional Extraction Activities Plans
PPAE	Provincial Extraction Activities Plans
PREI	Posidonia oceanica Rapid Easy Index
PSN	National Health Plan
PSN	National Strategic Plan for rural development
PSR	Rural Development Programme
PTA	Regional Water Protection Plan
PTCP	Territorial Provincial Coordination Plans
PTS	Total Suspended Particulate
RADPAR	Radon Prevention and Remediation
RAEE	Waste Electric and Electronic Equipment

REACH	Registration, Evaluation, Authorisation of Chemicals
REC	Regional Environmental Centre for Central and Eastern Europe
RESORAD	National Environmental Radioactivity Surveillance Network
RF	Radio Frequency
RFI	Italian Railways System
RIBES	Italian Germoplasm Banks System for *ex situ* conservation spontaneous flora
RIR	Major Accident Hazard
RMLV	National Tide Gauge Network of the Lagoon of Venice
RMN	National Tide Gauge Network
RON	National Wave Gauge Network
RRN	National Rural Network
RSS	Rich Site Summary or Really Simple Syndication
RUSLE	Revised USLE
SAU	Agricultural Areas Utilised
SBA	University Library System
SBN	National Library System
SCALE	Science, Children, Awareness, Legal Instruments, Evaluation
SCAS	Chemical Status of Underground Waters
SCIA	National System for the collection, processing and propagation of Climatologic Data of Environmental Interest
SEARCH	School Environment and Respiratory Health of Children
SERIS	State of the Environment Reporting Information System
SIC	Sites of Community Importance
SIDS	Sudden Infant Death Syndrome
SIGC	Coastal Geographic Information System
SII	Integrated Water Service
SIMM	Hydro-Meteo-Sea System
SIMN	National Hydrographic and Tide Gauge Service
SIN	Contaminated Sites of National Interest
SINA	National Environmental Information System
SINAB	National Information System on Organic Farming
SINPHONIE	Schools Indoor Pollution and Health: Observatory Network in Europe
SINTAI	National Information System for the Protection of Italian Waters
SISBON	Information System of Sites undergoing Remediation Procedures
SISTAN	National Statistics System
SISTRI	Waste Traceability Control System
SNAP	Selected Nomenclature for Air Pollution
SoCo	Sustainable Agriculture and Soil Conservation
SOER	European Environment State and Outlook Report
SOMO0	Sum of ozone means over 0 ppb
SOMO35	Sum of ozone means over 35 ppb
SPC	Coastal Forecasting System
SPI	Standardized Precipitation Index
SSN	National Health Service
TAC	Total Permissible Catches
TEEB	The Economics of Ecosystems and Biodiversity
THADE	Towards Healthy Indoor Air in Dwellings in Europe
TSP	Total Suspended Particulate
UE	European Union
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCSD	United Nations Conference on Sustainable Development
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

UNFCCC	United Nations Framework Convention on Climate Change
USLE	Universal Soil Loss Equation
UV	Ultraviolet
VAS	Strategic Environmental Assessment
VIA	Environmental Impact Assessment
VIS	Health Impact Assessment
WAM	WAve Model
WFD	Water Framework Directive
WHO	World Health Organization
WISE	Water Information System for Europe
WMO	World Meteorological Organization
WWF	World Wildlife Fund
ZPS	Special Protection Area
ZSC	Special Conservation Area
ZVN	Areas Vulnerable to Nitrates