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FOREWORD

Italy has ratified the Kyoto Protocol on 1st June 2002.
The ratification law prescribes that:

1. Italy's greenhouse gas emissions should be reduced by 6.5%, compared to 1990 levels, as agreed under the European "burden sharing" adopted by the European Union on 4th March 2002;
2. the emission reduction policies and measures shall be finalised:

- to improve the efficiency of the Italian economy;
- to promote energy sources differentiation and energy security;
- to increase the share of renewables in the energy portfolio;
- to promote technology innovation in the energy and transportation sectors;
- to promote sustainable agricultural and forestry activities, and the related carbon sinks;
- to add value, and to improve the international technology cooperation supporting the participation of the Italian companies in the "Clean Development Mechanism" and "Joint Implementation";

3. 25 millions Euro/year have been allocated,for the period 2002-2004, to support pilot projects to enhance energy efficiency, to promote clean fuels and engines, to increase carbon sinks;

4. 68 millions Euro/year have been allocated, by 2003, to support projects in the developing countries aimed to reduce greenhouse gas emissions reduce, and to promote the adaptation to the adverse effects of climate change.

The third National Communication of Italy to the United Nations Framework Convention on Climate Change is based on the National Action Plan to reduce greenhouse gas emissions, adopted by the Interministerial Committee for Economic Planning on 19th December 2002. The National Action Plan is directed to implement the guidelines included in the Kyoto Protocol ratification law.

The National Communication furthermore updates:

- the assessment on vulnerability and climate change impacts and on related adaptation measures;
- the information on bilateral and multilateral cooperation in technology transfer, and on the related Italian financial assistance;
- the Italian activities in research and systematic observation on climate change, both at regional and global level;
- the Italian initiatives on education, training and public awareness, both at national and local level, promoted by governmental, regional an local authorities, private companies, universities and scientific institutions, non Governmental Organizations.

In conclusion, the third National Communication offers a complete picture of the present activities and of the most recent programmes of Italy to address the commitments under the Climate Change Convention and the Kyoto Protocol.

Corrado Clini

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CHAPTER I
Executive summary

National circumstances relevant to greenhouse gas emissions and removals

National emissions of CO_2 accounted for 1.9% of worldwide emissions in 1999, with emissions of the three major greenhouse gases representing 1.6% of the total. Italy's percentage weight out of total world greenhouse gas emissions, therefore, is relatively low.

The weight of Italian emissions of carbon dioxide is more limited compared to those of other developed countries with equal levels of income and population: specifically, per-capita yearly emissions of CO_2 in Italy for 1999 were almost 8 tons, while the average value for the EU was approximately 8.6, that of the OECD approximately 11.5 and that the United States approximately 20.
Italian emissions of CO_2 represent 14.0% of the total for the European Union; if only the three major greenhouse gases are considered, then national emissions account for 12.3%.

The key factor in the Italian emissions figures is the low ratio between the consumption of energy and the gross national product, equal in 1999 to 71.6 toe/billion It. Liras at 1995 prices. The Italian low energy intensity is "structural": the historic lack of energy, which has favoured the establishment of consumption patterns and infrastructures that are parsimonious in the use of energy, together with a production structure that is not too energy-intensive; then there is the high level of taxation, which, in the past, has consistently raised the cost of energy sources to the final user well beyond the figures typically found in other countries; plus the low per-capita income, the relatively mild climate and the high population density, which tends to shorten the average length of travel.

The drop in intensity which took place in the years immediately following the peak figure, which was reached in 1973, after strong growth in the 50's and 60's, was, on the whole, more pronounced than the decrease in other industrial countries, being accelerated by the relocation of production cycles with high levels of energy intensity. The subsequent downward trend was less evident than in other countries, especially in the 80'. From 1985 onward, energy intensity remained almost constant (a decrease of less than 2%), as opposed to a decrease of 7 % in the OECD as a whole and of 8 % on the European level. Compared to the leading industrialised countries, Italy has less margin for improving its energy efficiency.
The high marginal cost for Italy of the traditional in energy efficiency measures has oriented the National Action Plan towards an opened and peculiar set of options, identified because of their secondary effect in emission reduction.

Greenhouse gas inventory information

Emissions of carbon dioxide (CO_2), which account for 84.7 % of all national greenhouse gas emissions expressed in terms of CO_2 equivalent, show an increase of 5.4 % for the period 1990 to 2000. In the energy sector, in particular, emissions in 2000 were 6.7 % greater than in 1990.

Emissions of methane (CH_4) and of nitrous oxide (N_2O) account for 6.9 % and 7.9 % of the total CO_2 equivalent greenhouse gas emissions respectively. Emissions of CH_4 decrease of 4 % from 1990 to 2000, while N_2O shows an increase of 5.9 %.

Other greenhouse gases, including hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6), account for less than 0.5 % of total CO_2 equivalent emissions; their contribution to overall GHG emissions is therefore still negligible, despite their increase from 1995 to 2000 (+78,4%).

For the year 2000, total greenhouse gas emissions, expressed in terms of CO_2 equivalent, are 5 % higher than those of the base year, while the national target, in the frame of the European Union commit-

ment, is a reduction of 6.5 % for the period 2008-2012 respect to the base year.
The base year is 1990 for CO_2, CH_4 and N_2O, and 1995 for the other greenhouse gases.

Policies and measures

The Italian Action Plan is based on two emissions scenarios (the "trend scenario" and the "reference scenario" one), on measures in the agricultural and forestry sector, and on a set of further options for emissions reduction in the different sectors.

1. The "trend" emission scenario for 2010, *"under current legislation",* includes measures already adopted:
- minimum share (2%) of electricity production from new plants using renewable sources (law decree 79/1999);
- Prime Minister Decree of 4 August 1999 providing for selling by ENEL of approximately 15,000 MW, and compulsory conversion of existing oil fired thermo-electric plants into natural gas combined cycle plants for about 10,000 MW;
- increase in the use of coal in power plants from 9% to 14%;
- Decrees of the Ministry of Industry of 24 April 2001 to increase end-use energy efficiency;
- implementation of law 449/97, concerning deducibility of 41% of building retrofitting expenses, including renewable-energy based plants;
- exemption from excise duties of 300,000 t/year of bio-diesel, as set forth in art. 21 of law 388/2000.

2. The "reference scenario" includes the implementation of programmes adopted under domestic laws and European directives, as well as under Ministerial decrees and decision of the Interministerial Committee for Economic Planning:
- new combined-cycle plants and increase of gas and electricity import;
- increased use of renewable sources for a total amount of 75 TWh by 2010;
- reduction of energy consumption for residential uses;
- progressive phasing-out of landfills and increased energy production from waste;
- new infrastructures, with effects on the transportation of passengers and goods from road to railways and coasting navigation;
- promotion of the production and use of high-efficiency vehicles and fuels;
- optimisation of private transportation systems.

In particular for the measures (85 % of the measures) the net cost is less than zero, i.e., the profit of the investment is always positive without involving other financial procedures to support them.
On the other hand, the interventions in the transportation sector are expensive. On the whole, these measures require estimated investments in the range of 8940-10450 Millions Euro, while net costs, considering the investment profit, are in the range of 1170-1603 Millions Euro.
The reference scenario also includes the initiatives undertaken in China, in North-African countries and in the Balkans that may generate emissions or carbon credits under the Clean Development and the Joint Implementation mechanisms.

3. Measures in the agricultural and forestry sectors include the implementation of programmes and initiatives aimed at increasing the quantity and improving the management of forest areas and woodlands, reclaiming of abandoned territories, and protection of territories that face instability or desertification risks:
- management of existing forests;
- revegetation of farmlands and grazing lands;
- natural reforestation;
- afforestation and reforestation in existing wooded lands, in new areas and in areas subject to hydrogeological instability risk.

Measures in the agriculture and forestry sector need investments of about 526 millions Euro and will result in on increase in the capacity to remove carbon.
In the case of these measures, the positive externalities are important for the protection of the environment and territory, while it is difficult to estimate the profit of the investments.
Generally, these measures require smaller costs than the costs of other sectors, and roughly net costs can be estimated equal to the investments.

In order to identify additional emission reduction measures, an open "set" of programmes and initiatives has been defined in the sectors of energy, transportation, industry, agriculture and in the international economic and technological co-operation. These options have been identified to optimise the environmental effects of measures whose priority objective is to increase the energy efficiency of the Italian economy.

In general terms, at least 40-50% of the identified options at the least possible cost refer to the programmes and initiatives that are to be implemented within the frame of the Kyoto mechanisms.

Projections and the total effect of policies and measures

Italy must achieve a 6.5% reduction of greenhouse gas emissions by 2008-2012 compared to 1990.In other words, emissions should decrease from 521 Mt

of 1990 to 487 $MtCO_2eq$., so that the "gap" to be filled amounts to 34 $MtCO_2eq$.
However, 2000 emissions amounted to 546 $MtCO_2eq$. and projected emissions for 2010, under the trend scenario *("current legislation"),* correspond to 580 Mt CO_2 eq. In other words, the real "gap" is 93 Mt CO_2 eq.

The measures adopted to date, including the enactment of actions, programmes and initiatives contribute to formulating the so-called "*reference scenario*", that is, the emission scenario for 2010 corresponding to the implementation of measures already identified, leading to a reduction of 52 $MtCO_2eq$. compared to the scenario *under current legislation*.

The measures to be adopted in the agricultural and forestry sectors in order to increase carbon sinks entail a potential reduction of 10.2 $MtCO_2eq$.

Further reduction options, both domestic and through the Clean Development Mechanism and Joint Implementation, have been defined in order to fill the residual gap of 30 $MtCO_2eq$. A first assessment of these mitigation options – considering both "domestic measures" and international project - performed on the basis of:
- least net cost criteria,
- opportunities for the development of new initiatives in the energy technology sectors,
- opportunities available at the international level to open new markets for Italian companies,
- identifies a "package" of measures and projects corresponding to a reduction of 50-60 $MtCO_2eq$. in GHG emissions, with related investments between 7300 and 14500 million Euro, and net costs ranging from 300 to 800 million Euro.

Vulnerability assessment, climate change impacts and adaptation measures

In Italy, the most relevant environmental impacts related to the projected climate change in the Mediterranean region concern:
- coastal areas, as a consequence of sea level rise;
- rural areas or areas devoted to productive activities because of land degradation as a consequence of soil erosion, loss of organic matter and dryness;
- biodiversity and natural biotic landscape as a consequence, migration of ecosystems; northwards;
- human well-being and productive sectors depending mainly on climate conditions due to the projected increase in both intensity and frequency of extreme meteorological events and the different fresh water availability between the North and the South.

These impacts might affect mainly the agricultural and industrial production, tourism, human health and, last but non least, the insurance sector. Vulnerability to climate change in the national territory differs in relation to the different geographical features and natural eco-systems, the local economic development and the different adaptability conditions between Northern and Southern Italy.

Coastal areas: the major coastal areas at risk of sea flooding are the Padano-Venetian, Versilia, Fondi and Pontina plains with negative effects on the tourism industry (as for the Padano-Venetian and Versilia plains) and on the production activities (as for the Pontina and Fondi plains), due to the loss of seashore and damages to infrastructures and services.

Rural areas devoted to production activities: climate change might cause general soil degradation with a degree of severity depending on the local territorial context. In particular, in Northern Italy land degradation will be mainly caused by run-off erosion due to the increase of intense precipitations and floods. On the contrary, in Southern Italy degradation will mainly be due to the erosion because of dryness, salinisation, and nutrients loss as a consequence of precipitations decrease and increase of droughts.

Biological diversity: in general climate change might cause an overall migration of ecosystems of about 140-300 km northwards and about 100-200 upwards for the mountainous areas. Keeping into account the Italian oro-graphic and geo-morphologic complexity, the whole balance of the natural landscape will tend to change in relation to the different local adaptation capabilities. As for the forest ecosystems, some modifications could be also irreversible. They could be at risk of destruction in the south because of fires and soil dryness, in the north because of the habitat variation under different climate conditions.

Productive sectors and social well-being: climate change might enhance the anthropogenic pressure on the hydrological resources with a greater availability of fresh water in the north of Italy in contrast to a shortage in the south, emphasizing the already existing differences and development chances between north and south. In addition to the water factor, higher temperatures and CO_2 concentrations will increase the agricultural production in the north and decrease in the south. The northwards migration of ecosystems will also affect agricultural production.

In addition to the choice of the best strategies to minimise the impacts and the territorial and environmental vulnerability, climate change adaptation will

also imply cost-benefit assessments of the different adaptation scenarios. Although national adaptation strategies are coherent with those suggested by IPCC, they still need detailed economic analyses. These studies are in a starting phase and their outputs will be available in the near future.

Financial resources and transfer of technology

Chapter VIII provides an overview of Italian activities and resources in cooperation with other countries to fulfil the objectives of the UNFCCC concerning financial resources and technology transfer.

A brief description of Italian Official Development Assistance flows shows that in absolute values Italy remains one of the leading contributors, ranking seventh among the OECD countries in 1998 and 1999 and tenth in 2000.

On the multilateral level, the Italian commitment in environmental protection activities has gained continuity and coherence through the definition and implementation of more efficient co-operation strategies with the major international environmental bodies and institutions. There is now a full commitment on the need for synergy among the activities of the Global and Regional Conventions for Environmental Protection, as well as on the need to integrate such activities in wider international co-operation objectives, in particular for the fight against poverty.

An important, new and additional resource for global environmental issues is the Italian contribution to the Global Environment Facility – GEF.

Italy's contribution to GEF-2 equals 90.5 million US$, ranking sixth among all contributors. It has recently subscribed the third replenishment of the GEF confirming its 4.39% share of total contributions.

On the bilateral level, new and additional resources favouring technology transfer activities in the environmental sector, have been made available, stimulated by the anticipation of the ratification of the Kyoto Protocol. Such activities respond to the overall objectives of the Convention on Climate Change while also addressing preparatory actions for the Kyoto mechanisms.

Such resources were provided by the so called carbon tax law, establishing also that all national actions reducing greenhouse gas emissions must be accompanied by a series of international co-operation programmes.

One the most important activity of the Italian Ministry of the Environment and Territory, among several cooperation programmes with developing and transition countries, is the environmental co-operation programme with China. Totalling approx. 14 Million euros, it aims to stimulate other multilateral funding for environmental protection and for renewable energy sources.

Italian bilateral and multi-bilateral ODA in the environmental sector – also through ad hoc co-financing schemes implemented with some major international financial institutions, such as the World Bank, GEF, and the Multilateral Regional Development Banks – has been supporting the environmental institutions of Developing Countries and Transition Economies in the transfer of know-how and capacity building.

As regards scientific co-operation for the transfer of know-how, the Italian Ministry of Foreign Affairs, in co-operation with the Ministry of Education, University and Scientific Research, is supporting bilateral agreements with 43 Developing Countries and Transition-Economy Countries. Many of them include environment-related issues, such as climate change, terrestrial, coastal and marine eco-systems and clean energies, and are aimed at the exchange of information, researchers, methodologies and research approaches.

At the private sector level, various Italian industrial and service companies are actively transferring low-impact technologies and implementing projects aimed at the integrated management of natural resources and o waste, also through co-financing schemes supported by national and local public institutions.

Research and systematic observation

In the last years Italy has been strongly involved in the research on influence the anthropogenic on climate, climate variability and the impacts on the environment. Italy has adopted a National Climate Research Plan through the joint efforts of the Ministry for the Environment and Territory and the Ministry for Education, University and Research, which is a component of the National Research Plan.

As concerns monitoring activities, in Italy there is an efficient monitoring system for GHG (greenhouse gas) concentrations, which brought to an innovative development of measuring technologies. Furthermore several oceanographic ships are active in Italy for an extensive program of research cruises. The Italian scientific activities in Antarctica are continuing with a focus on climate change issues. The groups more involved in these activities are: ENEA (Ente per le Nuove Tecnologie, l'Energia e l'Ambiente), INGV (Istituto Nazionale di Geofisica e

Vulcanologia), ISAC (Istituto di Scienze dell'Atmosfera e del Clima) of CNR, (Consiglio Nazionale delle ricerche) CESI (Centro Elettrotecnico Sperimentale Italiano), and Servizio Meteorologico dell'Aeronautica Militare.
Italy has in INGV, ENEA and ICTP (Abdus Salam International Centre for Theoretical Physics) groups actively involved internationally in the global and regional modelling of the climate. The main activities are on:

- global climate simulations with coupled atmosphere-ocean models the SRES/IPCC also on the basis of emission scenarios;
- analysis of the regional scale patterns of the climate change based upon the coupled model simulations ensembles;
- development and implementation of a regional climate modelling system (RegCM) to be applied to the regional climatic simulations;
- internal variability, decadal and multi-decadal, of the Mediterranean Sea.

Activities in the field of impact studies are mainly concentrated on the study of the effects of sea level changes due to climate change in the Italian coastal areas.

In the last years Italy has made a relevant progress ecosystem modelling in the field of, and in particular an ecological model of the Adriatic Sea has been developed in order to estimate the impact of climate change.

Italy is active with international projects aimed to the reconstruction of the desertification history in the Mediterranean through the analysis of proxy data. Furthermore other activities are related to the study of the response strategies to desertification and mitigation strategies for the management of water and agricultural resources under an increased environmental, social and economic stress.
Italy is also actively participating to the Framework Programme of the European Commission and to several international projects with positive results.

Education, training and public awareness

Chapter 9 describes the various actions implemented in this field by both the public and the private sector.

The key document to refer to for these actions is the Deliberation n. 218/99 of 21/12/1999 by the CIPE (Interministerial Committee for Economic Planning), which has the objective to define an action plan for environmental information in the field of climate change. This action plan includes in particular:

- presentation and dissemination of the main documents under the IPCC and the UNFCCC, together with Italian national documents and programs regarding the implementation of the commitments under the UNFCCC and the Kyoto Protocol,
- dissemination of scientific information about the vulnerability of Italy related to scenarios of future climate change,
- dissemination of technical information about energy efficiency of industrial processes, of products and the end-uses;
- promotion of information programs at the local level aiming at promoting the dissemination of best practices and techniques for energy saving adopted by local Administrations.

The chapter also synthetizes activities undertaken by the central and many local governments, in particular in collaboration with organisations and municipality networks such as ICLEI, Climate Alliance and the Coordination of the Local Agenda 21 and the initiatives promoted by environmental NGO's.

CHAPTER II
National circumstances relevant to greenhouse gas emissions and removals

2.1 Structure of the government

2.1.1 Introduction: the prerogatives of the constitutional bodies responsible for implementation of the Kyoto Protocol

According to its Constitution, Italy is a bicameral parliamentary republic; the constitutional bodies are the Parliament, the Government, the President of the Republic, the Constitutional Court and the State Council. The essential function of the Government is to develop and implement action programs corresponding to the political will expressed by the electorate and by the Parliament. The Government consists of ministers, whose number is not predetermined, and who are assigned to lead individual ministries or specific administrative units.
The functions of the Government are the following:

- political functions: takes part in directing the country's political orientation, within the orientation set by the parliamentary majority
- legislative functions: may issue legal measures through acts which have the effect of laws, as per arts. 76 and 77 of the Constitution
- executive functions: leads the executive branch, while the individual ministers lead all the administrative sectors of the State

Implementation of the Kyoto Protocol, therefore, shall be the prerogative of the Government, under the supervision of the Parliament and, in this specific case, the Environmental Commissions of both branches of Parliament.

The Ministry responsible for the implementation of the measures of the Kyoto Protocol is the Ministry for Environment and Territory.
Organisation of the prerogatives of the Ministry of the Environment was initially established under Law 349/1986, which, for the first time, recognised environmental affairs as an independent topic from other areas falling under the jurisdiction of the Central State or the regions, setting it apart from the disciplines of urban planning, territorial management and health care. At present Legislative Decree no. 300/1999 has enacted a reform of the government organisation in accordance with article 11 of Law no. 59 of 15 March 1997. Article 35 of the legislative decree established the Ministry for Environment and Territory, which is responsible, in particular, for the central-state functions and tasks regarding:

- promotion of national and international sustainable development policies, both nationally and internationally ;
- environmental impact assessment, prevention of and protection from atmospheric, acoustical and electromagnetic pollution, as well as industrial risks, plus the management of waste and reclamation efforts and the reduction risk factors;
- territorial planning, protection of biodiversity, as well as fauna and flora, and soil protection;
- management and defence of water resources, prevention of and protection from water pollution, protectionof the seas and of the coastal environment.

In effect, beside the traditional task of protecting the ecosystem, in part through the design and implementation of sustainable development models, the Ministry now has additional planning tasks whose objective is environmental defence.

As for the national energy policy, the Ministry of Production Activities has the task of determining policy within the specific sector, based on the general guidelines set by the government cabinet as a whole and by Parliament. Law no. 481 of 14 November

Edited by: Paolo Cecchetti (Ministry for Environment and Territory) e Domenico Gaudioso (APAT) for §§ 2.1.1 e 2.1.2; Emidio D'Angelo (ENEA) for § 2.1.3; Giulia Iorio (ENEA) for §§ 2.2, 2.3, 2.4, 2.4.3; Giovanni Perrella (ENEA) for §§ 2.4.4, 2.5.4; Mario Contaldi (APAT) for §§ 2.4.1, 2.4.2, 2.5.1, 2.5.2, 2.5.3; Franco Miglietta (IBIMET-CNR) for § 2.4.5; Sandro Federici e Roberta Quaratino (University of Tuscia), Piermaria Corona (University of Firenze), Antonio Macrì (ISTAT), Franco Cozza e Lorenza Colletti (Ministry for Agricultural and Forestry Policies) for § 2.4.6; Pasquale De Stefanis (ENEA) for § 2.4.7.

1995 established the Authority for Electricity and Gas, stipulating the scope of its powers and responsibilities. The Authority, which is granted full autonomy and independence in terms of its judgments and evaluations, is assigned both purely administrative functions involving the management of the sector and guarantee functions of a semi-legal, arbitration-based type. In addition to taking whatever measures are necessary for the operation of the market and the regulation of the sector under its control, the Authority is required to play an advisory role for the Government and Parliament.

2.1.2 The new role of the regions and local government bodies

The Italian Republic is one and indivisible, being organised, for the purpose of promoting local autonomy, into 20 regions, of which 5 are governed under a special form of autonomy and 15 under ordinary autonomy". Italy is an example of a Regional State, meaning a form of state in which a sovereign public entity coexists with other territorial entities that are given a legal status valid only domestically, together with a certain degree of legislative and administrative independence. In addition to the regions, the territorial entities into which the Italian State is subdivided are the provinces and the municipalities. Only the Regions, however, are constitutional entities, given that they have autonomy in designing their policy, and are part of the constitutional structure of the State. Article 115 stipulates that the Regions are autonomous entities with powers that are to be used within the set principles of the Constitution. These measures, coordinated with art. 5, under which the one and indivisible Republic acknowledges and promotes autonomous local powers, grant to the Regions the status of autonomous territorial entities that pursue general ends, meaning that they are political entities possessing powers which are wide-ranging but subject to the limits and controls of the Central State.

In implementation of the constitutional norms, and based on Law 59/97, the Government issued Legislative Decree no. 112 of 31 March 1998, modifying the previous measure, which had shifted prerogatives to the regional governments and to local independent government bodies. The most recent trend would seem to favour the transfer to the regions of responsibilities once managed on the central level in order to achieve the objective of establishing a system of administrative federalism, even though the great majority of the prerogatives in the field of the environment have been left under the control of the central government. The sole prerogative of some significance to be removed from State control is the power of planning: all national plans were eliminated, with the exception of the plan for defending the sea and the coats from pollution, the plan for purifying waste water, and the plans for the national watershed.

Even in the context of a limited transfer of functions, such as that which has taken place in the field of the environment, the implementation of Legislative Decree 112/98 provided the regions with an opportunity to rearrange, within a unified framework, their own prerogatives, together with those of the provinces, of the individual and associated municipalities and of the mountain communities, setting a number of common principles for the entire field, or for interconnected compartments of the same, such as the environment and energy. Within this scenario, many regions, drawing on the legal norms currently in force, have redesigned their internal rules and regulations, reserving:

- for the provinces, the entire planning system in the field of the environment and energy, under the assumption that the provincial plans for territorial coordination, first contemplated under Law 142 and later reinforced by the provisions of art. 57 of Legislative Decree no. 112/98, are designed to safeguard environmental resources and optimise the use of energy resources; as a result, the overall system for the authorisation of all production and service-industry activities is the prerogative of the provinces.

- for the municipalities, full responsibility for services to citizens and initiatives on the municipal level, employing the municipal urban-planning instruments for decisions regarding the approach to environmental defence and energy concerns (acoustic zoning, reclamation initiatives, long-distance heating, energy savings);

- for the regions, the role of taking concerted action with the Central State regarding underlying decisions on legislative and administrative guidelines, as well as strategic planning, in coordination with local government bodies, and after having received the opinions of the local economic, social, scientific and environmental forces, plus the setting of quality objectives and the monitoring of the results.

A noteworthy development in all the regions is the widespread delegation of functions to the lower-level local government bodies, and especially the provinces, in application of the subsidiary arrangement of government responsibilities and the principle under which the regional government maintains the functions of establishing guidelines and coordinating all activities,

Conference of the Presidents of Regional Governments and of Autonomous Provinces

AGREEMENT PROTOCOL OF THE CONFERENCE OF THE PRESIDENTS OF REGIONAL GOVERNMENTS AND OF AUTONOMOUS PROVINCES FOR THE COORDINATION OF POLICIES AIMED AT REDUCING EMISSIONS OF GREENHOUSE GASES INTO THE ATMOSPHERE

The Regions and Autonomous Provinces, having taken note:

- that the initiatives they have undertaken, for the purpose of protecting the environment, together with the heath and the quality of life of the resident populations in their territories, have been geared, among other things, towards limiting air pollution;
- that, under the provisions of art. 69 of Legislative Decree no. 112/98, the functions involving the production of clean technology and policies of sustainable development pursue the same goals as those of the Central State;
- that it would appear necessary to arrive at a reduction in greenhouse gases, so as to contribute to maintaining the commitment made by the Italian State under the obligations of the EU stipulated in international accords and formalised in Resolution 137/98 of the Inter-Ministerial Committee on Economic Planning on 19 November 1998;
- that this objective has been pursued with a diversified set of policies and initiatives, based on the individual territorial realties, in particular in the field of energy, with the general responsibility falling to the Regions and the Autonomous Provinces;

further considering the need to reach agreement on concerted efforts regarding certain fundamental tasks, so as to heighten the efficiency of the overall action resulting from a joint synergy;

emphasising that such efforts can prove all the more meaningful when actions on the national level, which have a direct effect on community efforts, are undertaken in concert with the Regions and the Autonomous Provinces, which serve as an obligatory point of contact with the initiatives undertaken by local government bodies and with socio-economic entities within their territories;

in acknowledgment of the fact that the principle of the integration of policies and subjects underlies the strategy of sustainable development affirmed on more than one occasion by the EU;

in the awareness that policies of technological innovation play a decisive role is sustainability;

undertake to guarantee:

that their various policies shall be oriented, to the greatest extent possible, towards the reduction of greenhouse gases;

that initiatives and financing, both Central-State and local, shall be coordinated for the priority objective of sustainability;

that optimal strategies for the reduction of greenhouse gases shall be formulated as part of the Plans for the Safeguarding and Reclamation of Air Quality;

that an Environmental Energy Plan shall be drawn up by the end of the year 2002, based on the individual energy balances and favouring:

renewable sources and technological innovation;

rationalisation of the production of electricity;

rationalisation of energy consumption, in particular with regard to the civil sector, with measures eventually to include the introduction of energy certification;

the linking of different planning sectors in the interests of overall sustainability;

optimisation of the role of policies for the support of technological innovation, as well as macroeconomic tools regarding taxation, fees and incentives;

promotion in the production sector of eco-efficiency and international cooperation.

Turin, 5 June 2001

while the planning and management functions are transferred to the next lowest administrative level. The placement of both planning and administrative activities under the control of local government bodies makes it possible to tie decisions made on the environment and energy to those taken in other sectors, achieving concrete enactment of the objectives of sustainable development. One objective reached is the overall simplification and acceleration of the procedures involved, with the guarantee that the responsibility for a given activity shall be assigned to a single entity. The arrangement established on the regional level provides each body with an all-encompassing vision of the problems in its own territory as well as the effects of the individual activities. In this way, the strategy of simplifying through procedures, which led to a de facto consolidation of responsibilities on the central level, has been improved upon, making it possible to restore the set of functions that inspired Law 59/97.

There can be no denying that the legislative preroga-

Main sources of legislation on decentralisation in the field of energy

Law 308/82: *implements a partial decentralisation of decision-making and management functions regarding the awarding of incentives for energy savings and for renewable energy sources.*
Law 10/91: assigned tasks more closely involved in decision making to the regions, which (though to different degrees) have delegated these to the provinces to a significant extent. The law also calls for the preparation of regional energy plans (art. 5).

Law 59/98: calls for transfer also to be made to the regions and local government bodies of the resources needed to conduct and manage energy policy.

Legislative Decree 112/98: grants functions and administrative tasks of the Central State to the regions and local government bodies. The decree refers to the regions as the "temporary recipients" of the functions transferred to them, given that they must establish through regional laws which administrative functions remain their prerogative, at the same time conferring all the others to local government bodies and, at times, to autonomous operating bodies (such as the chambers of commerce or the ARPA, Regional Environment Agencies).

Legislative Decree 96/99: distributes administrative functions between the regions and the local government bodies, with this distribution remaining valid until each of the regional laws goes into effect.

Listing of the prerogatives of the administrative branches of the Central State, the regions and local government bodies

Prerogatives of the Central State

- Administrative functions regarding research, supervision of the ENEA, the importation, exportation and storage of energy and the prospecting and extraction of hydrocarbons at sea.
- Construction and operation of plants for the production of electricity at thermal powers greater than 300 MW.
- Setting of national objectives and programs on renewable energy sources and energy savings.
- Promotion of voluntary agreements in line with the country's strategic objectives (this function was carried out on the occasion of the implementation of the resolution passed by the Inter-Ministerial Committee on Economic Planning on 19 November 1998 for the reduction of greenhouse gases and the signing of the Pact on Energy and the Environment, which served as the reference framework for a later series of accords in specific sectors and territories).
- Functions regarding the territory, in particular with reference to the observation and monitoring of instances of transformation, plus the criteria governing the collection and computerisation of cartographic materials, the formulation of technical standards and the promotion of innovative programs.
- Functions regarding the environment, in particular with reference to the transposition into national legislation of international conventions and European-Community directives, the preservation of protected areas and the safeguarding of biodiversity, plus initiatives regarding the marine environment and environmental-impact evaluations.

tives of the regions have contributed to the modernisation of the country, in part by offering a rich store of ideas and proposals from society at large, as well as elements for in-depth reflection originating from the distinctive characteristics of the local territory. It is in light of these developments that the Conference of Regional Presidents was able to approve the Agreement Protocol of Turin on the achievement of the objectives of reducing climate-altering gases, in this way contributing to guaranteeing the commitment made by the Italian State under the obligations of the European Community and international accords. This goal, formalised by the Turin agreement, was already being pursued by many regions, precisely because their legislative and planning approaches were geared towards an integration of policies, as well as the forecasting of an environmental energy plan, the development of technological

Prerogatives of the Regions

- Formulation of regional energy plans.
- Administrative functions regarding energy, including those involving renewable sources, nuclear energy, petroleum and gas.
- Planning for territories and sectors (Regional Development Plan, sector plans – waste, energy, water, health care, infrastructure – Integrated Territorial Plan).
- Programs providing incentives and support for the socio-economic and environmental development of the regions (structural funds for 2001-2006, incentives for the competitiveness of small and medium-size firms, "Carbon Tax" funds, 1 excise tax on gasoline etc.).
- Legislative measures (providing guidelines and coordination for local government bodies in their assigned functions and implementing national laws, standards of quality for levels of environmental pollution in critical areas, levels for the performance of services, systems and plants, technical specifications, technological qualifications etc.).
- Regional information and compatibility with the national system of information and statistics.
- Regional system of monitoring and network systems (see High Technology).
- Active and direct responsibilities under the policies and guidelines of the EU (in particular in processes designed to compensate/reclaim disadvantaged areas or areas suffering from delayed development, as well as in those for the safeguarding/optimisation of areas of special environmental value.
- Coordination of territorial pacts and, in general, negotiated planning.

Prerogatives of the Provinces

- Implementation (with programming of the initiatives) of the regional planning involving specific territories and sectors on a provincial level.
- Formulation of the Territorial Coordination Plan (Law 142/90) for the establishment of regulations and guidelines for the administrative activities of the municipalities in certain sectors and for subjects of inter-municipal interest.
- Numerous functions of a technical-administrative and managerial nature already delegated to the regions, or in the process of being transferred in implementation of Legislative Decree 112/98 (i.e. authorisations for plants producing thermal energy of up to 300 MW); sectors of responsibility: air pollution, waste, water, secondary schools.
- Optimisation of water and energy resources, planning of initiatives for energy savings and the promotion of renewable energy sources.
- Databanks (air, water, wastes etc.) compatible with the regional information system.
- Controls on thermal plants in municipalities < 40,000 inhabitants.

Prerogatives of the Municipalities

- Administration and management of services to citizens (solid urban waste, transport, public lighting etc.).
- Urban-planning zoning of municipal areas, authorisations and concessions for production activities (including the unified contact point), construction regulations.
- Municipal Energy Plan (Law 10/91, art. 5, last paragraph).
- Urban Traffic Plan, acoustical zoning etc..
- Controls of thermal plants (>40,000 inhabitants), plant safety under Law 46/90.
- Monitoring of the municipal environment.
- Eventual endorsement of Agenda21.
- Relations with municipalized enterprises.

Chart of regional measures for the transposition of Legislative Decree no. 112/98 into regional law

	Industry	Energy	Environmental defence
ABRUZZO Regional Law 11/99 Regional Law 57/00 Regional Law 110/00	Regional functions performed under the coordination of the Agency for the Promotion of Production Activities.	The provinces are responsible for the energy certification of buildings and for training activities, 412/93.	The Territorial Plan for Provincial Coordination serves as an environmental defence plan. The provinces are responsible for the environmental impact evaluations for works in appendix B of the Presidential Decree of 12 April 1996.
BASILICATA Regional Law 7/99	Regional contact point for production activities (art. 16). All regional prerogatives.	The provinces observe the indications of the Regional Energy Plan, authorising the operation of thermal plants and training courses.	The provinces are responsible for air and water pollution and various types of waste. The Regional Environment Agency (ARPAB) supports the regions and the local government bodies.
EMILIA ROMAGNA Regional Law 3/99	The provinces are responsible for coordination of the network of unified contact points. The region carries out initiatives for the capitalisation of small and medium-size industrial enterprises.	The Region adopts the Regional Energy Plan and supports innovative plants. Convention with ENEA. The provinces are responsible for authorising transport networks; the municipalities for urban energy upgrading and long-distance heating.	The Regional Environmental Defence Plan (art. 99). The regional plan safeguards water bodies. Regional directives for the unified management of waste.
LATIUM Regional Law 14/99	The Region retains the management of all types, of industrial subsidies.	The Region is responsible for energy diagnosis, feasibility studies, water projects and plants; the provinces for contributions under arts. 8, 10 and 13 of Law 10/91 and for confirmation of the compatibility of the municipal plans; the municipalities for the energy certification of buildings.	The region performs environmental impact evaluation functions through the ARPA. The provinces are responsible for the authorisation of landfillsites, the analysis of waters and the determination of plans of action.
LIGURIA Regional Law 3/99 Regional Law 5/99 Regional Law 9/99, Regional Law 18/99 Regional Law 6/00 Regional Law 29/00 Regional Law 39/00	Regional Law 9/99, the Region determines areas of priority interest among local production systems and approves a plan of initiatives in industrial areas, drawing on the regional budget law. Integration of unified contact points – "Liguria on Web" project.	Regional Law 18/99, Section IV. Project for the transformation of the regional agency according to a corporate structure. The provinces identify the areas for long-distance heating and those not appropriate for the channelling of water for energy purposes. The municipalities are responsible for the energy certification of buildings.	Regional Law 18/99. The Region adopts the principles of sustainable development (art. 11, Agenda 21). Comprehensive environmental authorisation (art. 19). Detailed definition of prerogative and procedures for the waste sector (arts. 21 to 50)
LOMBARDY Regional Law 1/00	Implementation of negotiated planning through development contracts.	The Regional Energy Plan is the instrument for the implementation of the regional energy policy. The Region promotes the use of financing through third parties and the creation of local energy agencies. The provinces determine the programs for the initiatives to be taken and the criteria for the financing.	Central role of the Territorial plan for Provincial Coordination as a strategic guideline for the management of the territory on a level superseding the individual municipalities.
THE MARCHES Regional Law 10/99 Regional Law 12/99	Contributions to the municipalities for the activation of unified contact points (art. 36). Regional plan for industrial activities (art. 21).	The municipalities are responsible for the energy certification of buildings and for the granting of subsidiaries for energy savings.	The regions are responsible for the functions of coordination resulting from the cancellation of the plan for the reclamation of the Adriatic Sea; the provinces for air pollution.

MOLISE Regional Law 34/99		The provinces are assigned functions of planning and control regarding renewable sources of energy; energy planning, on the regional level, based on agreements and conventions with ENEA.	Distribution of powers among the regions, provinces and municipalities regarding water, noise, air and electromagnetic pollution. The provinces are responsible for Environmental ImpactAssessments.
PIEDMONT Regional Law 44/00	The Region is responsible for granting incentives and identifying local production systems. The Regional Observatory on industrial production sectors. The unified contact point as a tool for promoting the local production system.	The municipalities may promote the establishment of local energy agencies linked with ARPA. The provinces are responsible for authorisations, including storage deposits and the processing of oils.	The provinces are responsible for wastes and air and water pollution. ARPA provides technical-scientific support and monitors environmental resources.
APULIA Regional Law 17/99 (environment) Regional Law 19/99 (energy) Regional Law 24/99 (industry) Regional Law 25/99 (territory)		The Region allocates, for energy-related activities, 1% of the excise tax on gasoline; it coordinates the initiatives of local government bodies for the implementation of Presidential Decree 412/93, reporting annually to the joint conference.	The Region sets the air-quality standards as well as the guidelines for the control systems , in addition to coordinating their operation; it issues directives to the provinces, drawing on ARPA, regarding authorisations and the control of emissions; the municipalities receive notifications for activities that do not produce significant pollution.
TUSCANY Regional Law 85/98 Regional Law 87/98 Regional Law 88/98	Regional Law 87/98 Possibilities of provinces delegating powers to "districts". Governed by the law for the planning of initiatives. The Region retains the prerogative of granting incentives to industry. The provinces are responsible for the training of operators.	Regional Law 88/98, Chapter VII The Region is responsible for the Regional Energy Plan, including the incentives referred to under arts. 11, 12, 13 and 14 of Law 10/91, the electricity concessions and the electric power lines from 100 to 150 KV. The provinces are responsible for oil and gas pipelines, as well as the procurement and storage of hydrocarbons.	Regional Law 88/98 The Region reserves as its prerogative the general criteria, the guidelines, the control of the plans for reclamation and the identification of critical areas. The provinces are responsible for all the functions not reserved for the regions.
UMBRIA Regional Law 3/99	The provinces are responsible, for all subsidies to industry, even if these are the result of European-Community initiatives. The Region establishes the criteria for the granting of the subsidies.	The Region adopts the Regional Energy Plan. The Region contributes to drawing up the planning agreement referred to underart. 30 of law 9/91. The municipalities are responsible for limiting energy consumption. The provinces are responsible for the subsidies referred to under arts. 8, 10 and 13.	The provinces, drawing on the support of ARPAs, are responsible for air and water pollution. The provinces are also responsible for the defence of the soil and the optimisation of water resources.
VENETIA Regional Law 11/01		The provinces are responsible for the granting and payment of subsidies for construction, for the control of the energy yield of municipalities <30,000 inhabitants and for mineral policing functions in geothermal activities. The municipalities are responsible for energy certification of the buildings and for the control of thermal plants when >30,000 inhabitants.	The Region issues the opinion referred to under art. 17 of Presidential Decree 203/88 for plants >300 MW. The provinces are responsible for decisions on appeals against refusals of municipal authorisations for the installation of thermal plants. Within 2 years the Region approves a unified text of rule and regulations.

innovation and international cooperation among businesses, collaboration with national agencies and guarantee authorities and the involvement of the world of technology and science, including the regions' own agencies, plus the national agency system, the world of industrial production, environmentalists associations and citizens. The fact is that only a relationship of synergy between the regions and the Central State, closely connected with synergy inside the regional territory itself, can guarantee concrete implementation of the fundamental decisions, strategies and international commitments entered into by our Central State.

2.1.3 Laws for the transposition of Legislative decree 112/98

The regions governed under ordinary statutes issued (with the exception of Campania and Calabria, for which Legislative Decree 96/99 continues to be in forced as a substitute measure) laws for the transposition and implementation of Legislative Decree 112/98.
In general, it can be noted that all the regions show a widespread tendency to delegate functions to the underlying local government bodies, and to provinces in particular, in application of the principle of subsidiary transfer of power, as well as the principle under which the regional governments maintain the functions of formulating guidelines and coordinating activities, while the functions of planning and management are transferred to the next lowest administrative level.

Energy Decentralisation
Functions transferred:
art. 30 Legislative Decree 112/98 (paragraph 1: administrative functions regarding energy; paragraph 2: functions referred to under arts. 12 and 14 – incentives – and 30, energy certification)
art. 34 Legislative Decree 112/98 mines and geothermal resources
art. 105 Legislative Decree 112/98 concessions for the operation of highway systems
Prime Minister's Decree on the identification of resources 12 October 2000 Official Gazette of the Italian Republic 30 December 2000, Ordinary Supplement 224

Environmental Decentralisation
Functions transferred:

art. 70 letter a)	Protection and observation of coasts
art. 73	Environmental initiatives (in substitution of cancelled three-year program)

Table 2.1.1 - lists the financial transfers made available annually on the regional budgets for the sectors of the environment, energy and business incentives.

REGION	Carbon Tax	**Energy**	1% gasoline excise	**Total energy**	**Environment**	S.M.E. Incentives	**TOTAL**
Val d'Aosta	2,281	1,185		3,465	6,026	2,814	12,305
Piedmont	12,269	4,766	7,041	24,075	66,537	118,724	209,336
Lombardy	24,721	9,136	15,075	48,933	112,160	227,398	388,490
Autonomous Province of Trent	3,071	1,680		4,751	13,636	3,082	21,469
Autonomous Province of Bolzano	2,903	1,952		4,855	13,636	3,082	21,573
Venetia	12,777	4,293	7,833	24,903	63,907	133,732	222,542
Friuli Venezia Giulia	4,829	1,655		6,484	20,741	22,110	49,334
Liguria	5,706	1,598	2,720	10,024	20,207	23,182	53,413
Emilia Romagna	12,960	2,918	7,530	23,408	60,302	109,880	193,590
Tuscany	9,450	2,681	6,848	18,979	55,280	97,552	171,811
Umbria	3,762	1,353	1,377	6,491	17,318	20,636	44,445
Marche	4,602	1,359	2,350	8,311	24,695	43,684	76,690
Latium	10,530	3,041	9,307	22,878	60,314	48,776	131,968
Abruzzo	4,072	1,465	1,980	7,517	23,294	35,912	66,724
Molise	2,212	657	342	3,210	8,486	11,390	23,086
Campania	7,529	2,376	6,042	15,946	58,948	117,786	192,680
Apulia	9,851	2,652	4,760	17,263	49,104	85,224	151,591
Basilicata	2,639	798	641	4,078	15,859	16,482	36,419
Calabria	3,824	1,277	2,368	7,469	27,975	40,736	76,179
Sicily	9,555	2,742		12,297	63,444	89.780	165,521
Sardinia	5,458	1,574		7,031	32,808	88,038	127,877
Total	155,000	51,155	46,265	252,4200	814,675	1,340,000	2,437,044

art. 74	Rule and regulations governing areas at risk for environmental crises
art. 81	Surface water
art. 84	Air pollution

Prime Minister's Decree on the identification of resources 12 October 2000 Official Gazette of the Italian Republic 30 December 2000, Ordinary Supplement 224

Decentralisation of incentives for businesses

Prime Minister's Decree on the identification of resources, 25 May 2000, Official Gazette of the Italian Republic 28 June 2000

The regions handle the incentives granted to businesses under regional law; in general terms, they have established a regional fund for industry form initiatives in support of businesses, and they are engaged in drawing up criteria and procedures for the unified management of infrastructures and services in ecologically developed areas.

With regard to the functions of the unified contact point for production activities assigned to the municipalities, the regions work, in a general sense, to coordinate the services and assistance provided to businesses in terms of establishing the locations and providing authorisations for production plants and for the creation of industrial areas.

A number of regions have established their own unified regional contact point for production activities.

2.2 Population

Following an initial phase of demographic development, which saw the resident population double over a period of 120 years (a figure that proves all the more significant when one considers the marked amount of emigration during various periods in the last century), the national population has now levelled off at approximately 57 million. The situation is the result of a stable birth rate, which, at slightly more than one child per woman, is one of the lowest in Europe, plus the migratory balance, which stands at around 100,000 units. The aging trend of the Italian population has grown even more acute: as of 1 January 2001, the aging index was 127%. Italy is the absolute leader among the European countries: as of 1 January 2001, the most recent year for which comparative figures are available, the aging index was 127%, compared to an average of 96% among the countries of the European Union. A number of different factors contribute to heightening the aging of the population. On the one hand, the low birth rate (approximately 1.2 children per woman) continues to exacerbate the imbalances in the age structure, diminishing the younger age groups and producing aging from the "foundation" of the population pyramid. At the same time, the growth in the elderly sector of the population, the result of increased life expectancy, which has allowed an ever greater number of individuals to reach an advanced age, has led to aging "at the top". It should be noted that, in recent years, the effects of the aging of the population have been limited to a certain extent by the positive contribution of migration from abroad, though enough to avoid a growing imbalance in the ratio of the young to the elderly. Consideration should also be given to the fact that the "extremely elderly", meaning people aged 80 and older, have come to represent a considerable – and growing – portion of the population. The small amount of population growth that did occur over the previous year was due to immigration: the resident foreign population (approximately 1.3 million people) is changing its

Table 2.2.1 - Municipalities and population by categories of demographic magnitude as of 31 December 1999

Number of Inhabitants	North-Centre		South		Italy		Cumulative Italy		
	Municipalities	Inhabitants	Municipalities	Inhabitants	Municipalities	Inhabitants	Municipalities	Inhabitants	
Up to 5,000	4,113	7,214,927	1,727	3,460,359	5,840	10,675,286	5,840	10,675,286	(18.5%)
5,001–20,000	1,164	10,770,563	621	5,861,156	1,785	16,631,719	7,625	27,307,005	(47.3%)
20,001–50,000	189	5,757,209	146	4,397,902	335	10,155,111	7.960	37,462,116	(64.9%)
50,001–100,000	49	3,409,516	50	3,321,361	99	6,730,877	8,059	44,192,993	(76.6%)
100,001- 250,000	20	2,883,374	8	1,213,486	28	4,096,860	8,087	48,289,853	(83.7%)
250,000- 500,000	4	1,290,396	3	928,866	7	2,219,262	8,094	50,509,115	(87.6%)
more than 500,000	4	5,484,367	2	1,686,413	6	7,170,780	8,100	57.679.895	(100.0%)
TOTAL	5,543	36,810,352	2,557	20,869,543	8,100	57,679,895	-	-	

Source: ISTAT

make-up, as extended families begin entering the municipal resident registries.

Looking at the national growth in the emission of greenhouse gases over the last 40 years, only a small portion can be traced to demographic trends. In this context, the pressure of the demographic factor on the emission of greenhouse gases nationally tends to event out. In terms of the future, the stability of the population shall become a factor capable of contributing to a reduction in national emissions. For that matter, even the possibility of a sharp rise in immigration would not appear able to increase the resident population and create pressure on the level of emissions.

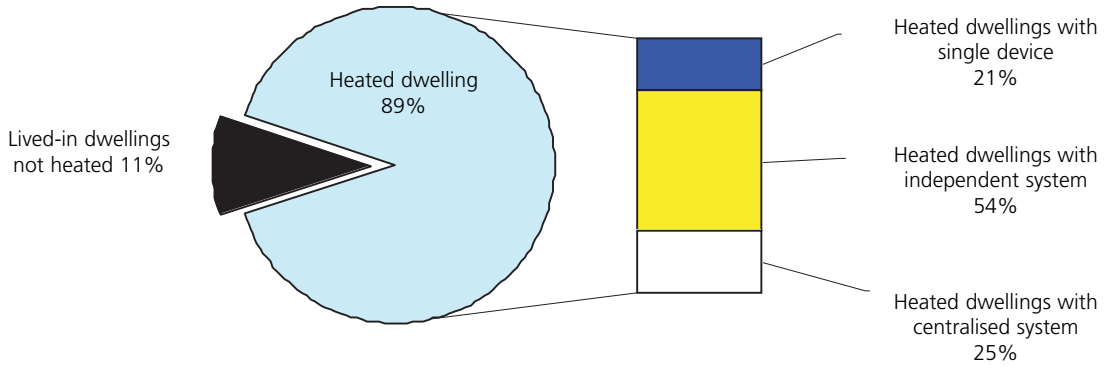
The "quality" of the population can have a certain influence on per capita emissions. For example, the rate of urbanisation (Table 2.2.1) and the distribution of urban areas between warm and cold zones determines the demand for mobility for work and study, as well as the demand for the heating of indoor settings, both factors which modify per capita emissions of greenhouse gases. Though the gradual aging of the population leads to a decrease in the demand for mobility, it also lays the ground work for a greater need for climate-control, in both winter and summer;

Table 2.2.2 - Dwellings: structural data. The figures represent thousands of homes.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Habitations	**24,961**	**25,185**	**25,401**	**25,599**	**25,798**	**25,971**	**26,262**	**27,405**	**27,930**
Habitations lived in	19,670	19,809	19,946	20,068	20,224	20,360	20,930	21,143	21,356
- single-family	5,507	5,546	5,585	5,599	5,699	5,743	5,798	5,825	5,934
- multi-family	14,162	14,262	14,361	14,469	14,526	14,617	15,132	15,318	15,422
Heated habitations lived in	**17,448**	**17,586**	**17,722**	**17,863**	**18,006**	**18,142**	**18,282**	**18,421**	**18,961**
- single family	4,913	4,952	4,990	5,030	5,074	5,112	5,152	5,192	5,433
- multi-family	12,535	12,634	12,732	12,833	12,932	13,030	13,130	13,229	13,528
- heated with single device	4,229	3,919	3,902	3,913	3,924	3,934	3,917	3,973	4,040
- heated with independent system	7,756	8,400	8,584	8,697	8,812	9,321	9,568	9,848	10,323
- heated with centralised system	5,463	5,267	5,236	5,253	5,270	4,887	4,797	4,600	4,598
Habitations with hot water	**23,662**	**24,178**	**24,512**	**24,857**	**25,165**	**25,334**	**25,622**	**26,792**	**27,525**
- electric system	10,059	9,898	9,576	9,395	9,105	8,657	8,455	8,453	8,332
- natural gas system	9,909	10,628	11,354	11,980	12,646	13,367	13,964	14,657	15,324
- other energy source	3,694	3,652	3,582	3,482	3,414	3,310	3,203	3,682	3,869
- m^2 per habitation	**93,1**	**94,0**	**94,5**	**95,0**	**95,6**	**96,1**	**96,1**	**97,0**	**97,5**
- m^2 per single-family habitation	108,2	109,3	109,3	109,3	109,8	110,1	110,4	110,8	111,1
- m^2 per multi-family habitation	87,2	88,1	88,5	89,0	89,6	90,0	90,0	90,8	91,3
Degree days*	1,620	2,072	1,674	1,771	1,481	1,512	1,725	1,633	1,571
Normalised degree days*	1,789	1,762	1,725	1,698	1,673	1,680	1,624	1,616	1,584

Source: ENEA processing of ISTAT data; * Source: Eurostat

Figure 2.2.1 - Heated inhabited dwellings by type of heating system –1998 (percentage figures)



with advancing age, the need for care rises as well, and this can lead to an increase in emissions tied to the consumption of energy. Even the percentage of immigrants from outside the European Union is not a neutral factor in terms of emissions of greenhouse gases. During the initial phase of immigration the average per capita emission decreases because the immigrants have less intensive models of consumption in terms of the emission of carbon. Later on the immigrants, who substitute natives in the less well-paying sectors of employment, adopt endogenous modes of consumption, which normally lead to higher emissions than those prevalent in their countries of origin. Another effect of immigration is to reduce "carbon leakage" from developing countries to other countries, slowing if not stopping the transfer of the more carbon-intensive activities outside of the country.

2.2.1 Dwellings

The number of dwellings in Italy in the period 1990-1998 is listed on Table 2.2.2. The figures for 1991 are taken from the 1991 census, while the others are estimates. The number of idwellings in 1998 was 27,930,000, with an increase of 11.9% over 1990 (+8.6% of inhabited dwellings). The ratio between inhabited dwellings and not inhabited dwellings remains stable, as does the ratio between single fam-

Figure 2. 3.1 - Macroeconomic indicators in Italy

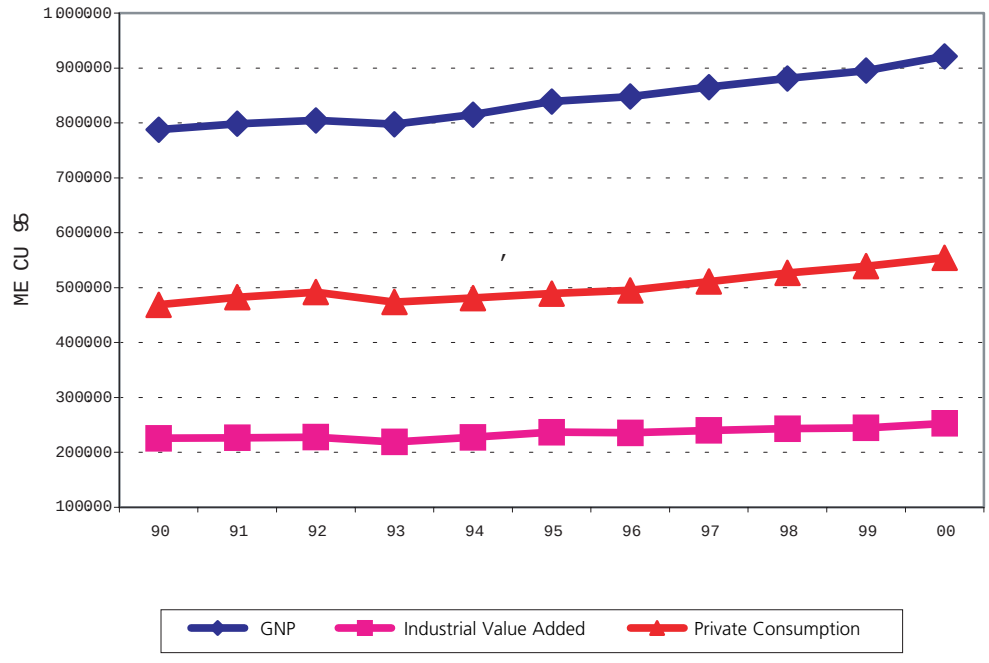


Table 2.3.1 - Gross National Product per inhabitant at market prices for a number of countries. Values at current prices with purchasing power parity ($US)

Countries	1997	1998	1999	Countries	1997	1998	1999
Austria	23,645	24,553	25,697	Norway	27,600	28,352	29,025
Belgium	23,765	23,529	24,672	Netherlands	23,949	25,215	26,488
Denmark	25,572	27,005	28,030	Portugal	15,912	16,220	17,064
Finland	21,149	22,125	23,413	Spain	17,024	18,014	19,045
France	21,123	22,059	23,068	Sweden	21,769	22,047	23,477
Germany	22,965	23,704	24,601	Switzerland	27,256	27,902	28,778
Ireland	22,070	23,139	25,878	United Kingdom	21,831	22,459	23,286
Italy	21,727	23,124	23,937	USA	30,798	32,230	33,725
Luxembourg	37,288	40,450	43,066	Japan	25,374	24,474	24,934
EU	21,313	22,195	23,163				

Source: OECD

ily and multi-family homes. The proportion of heated homes out of the inhabited homes has remained practically unchanged (approximately 89%), though there is a growing tendency to use independent heating systems (+33.1%) rather than centralised systems (-15.8%) or single devices (-4.5%) (see Figure 2.2.1). The national housing stock consists of nearly 28 milliondwellings, of which more than 21 million are occupied. There are approximately 3 million buildings that were built in the 1950's, whole more than 5 mil-

Table 2.3.2 - Gross National Product for a number of countries. Percentage change compared to previous period

Countries	**1995**	**1996**	**1997**	**1998**	**1999**
Austria	4.2	3.7	4.5	5.3	4.3
Belgium	1.6	2.0	1.6	3.5	2.8
Denmark	2.6	1.2	3.6	2.2	3.0
Finland	2.8	2.5	3.0	2.8	2.1
France	3.8	4.0	6.3	5.3	4.0
Germany	1.7	1.1	1.9	3.4	2.9
Greece	-	2.4	3.6	3.4	3.4
Ireland	10.0	7.8	10.8	8.6	10.8
Italy	2.9	1.1	2.0	1.8	1.6
Luxembourg	-	2.7	7.4	5.0	7.5
Netherlands	2.9	3.0	3.8	4.3	3.7
Portugal	-	3.5	3.8	3.5	3.0
Spain	-	2.4	3.9	4.3	4.0
Sweden	3.7	1.1	2.1	3.6	4.5
United Kingdom	2.9	2.6	3.4	3.0	2.1
EU	-	1.6	2.5	2.7	2.5
USA	2.7	3.6	4.5	4.3	4.1
Japan	1.6	3.5	1.8	-1.1	0.7
OECD	-	3.2	3.1	2.0	2.5

Source: OECD

Table 2.3.3 - Domestic resources – year1999

	1995 Prices		Index numbers
	Billions of Lire	%	1995 base = 100
GNP at market prices	1,894,407	79.7	112.3
Imports of goods and services	481,801	20.3	98.2
TOTAL	2,376,208	100	109.5

Source: ISTAT

Table 2.3.4 - Figures for the Gross National Product

Lire / 1995		
Years	Billions	Change %
1970	940,737	-
1980	1.341,394	-
1990	1,677,885	-
1995	1,787,278	-
1996	1,806,814	1.1
1997	1,839,624	1.8
1998	1,867,796	1.5
1999	1,894,407	1.4

Source: ISTAT

lion were constructed in the 60's. The percentage of rented dwellings does not exceed 25%. Public constructions account for 5-8% of the total stock.
There are a number of shortcomings in statistical information on housingin Italy: the reliability in terms of number and structure is good for the census years and in the years immediately following census taking, apart from the fact that the census information is made available with a significant delay. It should be noted that certain types of information are completely lacking, such as that regarding the thermal insulation of inhabitations.
The sector in which the most energy is used is the heating of indoor settings: the consumption of the residential sector represents approximately two-thirds of all civil energy consumption (residential and civic).
A comparison with similar data for heating consumption in the other European countries shows that the Italian stock of buildings is much less insulated than that of other countries, to the point where thermal leakage per square metre is lower, in absolute terms, than in France, Germany, Sweden and Denmark, even though the degree days of heating are much fewer in Italy (SENSER, 1997). Italy also shows a lower level of average space available to inhabitants than is the case in many other developed countries, with ample room for growth.

2.3 Economy

2.3.1 Macroeconomic outlook

The per capita gross national product (GNP) is the second general factor that explains levels of emissions of greenhouse gases and the differences in these levels between from one country to another. The GNP per inhabitant is above the European average, but still lower than that of Germany, the USA and Japan (see Table 2.3.1).
The performance of the main macroeconomic indicators – GNP, the value-added of industry and private consumption – are shown in Figure 2.3.1. The average annual growth rate of the GNP during the period 1990-1999 was 1.5%, in line with the other six leading industrialised countries (Table 2.3.2). This period was characterised by a year of recession, 1993 (-0.9%), and by two years of limited growth, 1992 (+0.8%) and 1996 (+1.1%). In 1994 and 1995 economic growth was extremely high, registering respective figures of 2.2% and 2.9%.
In 1993 the industrial recession was rather serious (-3.9%) and wider-reaching than in other sectors. The year of scarce growth, 1966, witnessed a period of industrial stagnation. This stagnation was followed by growth in 1998 (+1.8%) and in 1999 (+1.6%).

Table 2.3.5a - Breakdown of value-added at market prices and Gross National Product – year 1999.

Branches			**Index numbers**
	Absolute values	%	1995 base = 100
Agriculture. forestry and fishing	**55,897**	**3.0**	**96.3**
Industry		**32.2**	**106.7**
Energy products	*115,906*	*6.2*	*102.4*
Products of industrial transformation	*393,810*	*21.1*	*107.3*
Construction	*90,338*	*4.8*	*109.4*
Services	**1.208,094**	**64.8**	**113.9**
Commercial operations. hotels and public establishments	*304,870*	*16.4*	*109.1*
Transport and communications	*123,734*	*6.6*	*107.7*
Lending and insurance	*440,759*	*14.7*	*116.4*
Rental of buildings	*165,900*	*8.9*	-
Services of the Public Administration and defence	*94.193*	*5.1*	*119.6*
Miscellaneous services	*244,539*	*13.1*	*116.1*
Value added at gross market prices	**1.864,046**	**100.0**	**111.0**
Activities not classifiable as sales	225,364	12.1	119.8
Bank services charged (-)	83,851	4.5	92.4
Value added at net market prices	1,780,195	95.5	111.9
VAT and indirect taxes on imports	114,212	6.1	119.2
Gross National Product at market prices	**1,894,407**	**101.6**	**112.3**

Source: ISTAT

Table 2.3.5b - Uses – year 1999. Figures indicated at 1995 prices

			Index numbers
	Billions of Lire	%	*1995 base = 100*
National consumption	**1,467,941**	**61.1**	**112.6**
- of resident families	1,129,811	47.0	111.3
of which: transport	*146,306*	*6.1*	*109.7*
- of the Public Administration	329.029	13.7	117.2
- in the economic territory [(a)]	1,148,315	47.8	111.3
Gross fixed investments	**373,628**	**15.5**	**107.8**
of which: construction	*153,518*	*48.7*	*108.6*
transport equipment	*42,409*	*9.2*	*111.7*
- net fixed investments	103,777	4.3	107.8
- depreciation	269,851	11.2	107.8
Changesin stock	**28,393**	**1.2**	**-**
Exports of good and services fob	**532,798**	**22.2**	**101.9**
TOTAL		**100.0**	**109.4**

Source: ISTAT (a) They are the inland final consumation

Table 2.3.6a - Italian exports – percentage breakdown

	100.0	100.0	1998	1999
Agricultural, forestry and fishing products	4.9	4.7	4.5	4.1
Mining and quarry products	8.6	8.6	6.7	7.5
Metals and metal products	10.7	11.0	11.2	9.8
Non-metal bearing mineral products	1.3	1.2	1.2	1.2
Chemical products	13.8	13.6	13.6	13.6
Refined petroleum products	2.5	2.1	1.4	1.5
Transportation equipment	11.4	12.5	14.0	15.1
Machines and mechanical devices	7.8	7.4	8.2	8.4
Electrical and precision devices	13.7	13.8	14.4	15.0
Food, beverage and tobacco products	8.9	8.3	8.0	7.5
Textiles, leather goods and clothing	7.2	7.6	7.6	7.1
Wood, paper, rubber and other manufactured goods	8.2	8.1	8.4	8.4
Electric energy, water and gas	0.9	0.8	0.7	0.7
Other products not classifiable elsewhere	0.1	0.1	0.1	0.1
TOTAL (%)	**100.0**	**100.0**	**100.0**	**100.0**
TOTAL (in billions of current Lire)	**321,286**	**357,587**	**378,783**	**394,271**

Source: ISTAT

The final result for the value of industrial activities (measured in terms of the value added at constant prices) rose at an annual rate of 1.2% in the period 1990-2000.

In Italy the Gross National Product (GNP) totalled approximately 1,907 trillion Lire in 1999 (in 1995 Lire), compared to approximately 1,787 trillion Lire in 1995 (see Tables 2.3.3, 2.3.4.).

In 1999 agriculture accounted for approximately 3.0 percent of the country's overall value added, compared to a share of 32.2 percent for industry and 64.8% for services (see Table 2.3.5). The latter, in particular, showed higher growth than the economy as a whole (and in part explain the decrease in the carbon-intensity of the national income in recent years). Within the industrial sector, construction presented

Table 2.3.6b - Italian imports – percentage breakdown

	1996	1997	1998	1999
Agricultural, forestry and fishing products	1.7	1.7	1.6	1.6
Mining and quarry products	0.2	0.2	0.2	0.2
Metals and metal products	8.4	8.4	8.4	7.9
Non-metal bearing mineral products	3.8	3.8	3.7	3.8
Chemical products	7.8	8.2	8.2	8.9
Refined petroleum products	1.2	1.4	1.1	1.2
Transportation equipment	10.4	10.3	11.5	11.5
Machines and mechanical devices	20.9	20.9	20.6	20.4
Electrical and precision devices	9.8	9.5	9.7	9.8
Food, beverage and tobacco products	5.3	5.1	5.2	5.4
Textiles, leather goods and clothing	17.1	16.8	16.2	15.5
Wood, paper, rubber and other manufactured goods	12.9	13.1	13.1	13.3
Electric energy, water and gas	0.0	0.0	0.0	0.0
Other products not classifiable elsewhere	0.5	0.5	0.5	0.5
TOTAL (%)	**100.0**	**100.0**	**100.0**	**100.0**
TOTAL (in billions of current Lire)	**388,885**	**409,128**	**426,183**	**419,124**

Source: ISTAT

Table 2.3.7 - Commercial exchanges by geographic area and main countries – Year 1999. Figures in billions of Lire.

Countries and geographic areas	Export	Imports
EUROPE	**296,564**	**288,991**
European Union	*240,475*	*239,900*
- France	54,516	49,721
- Germany	69,119	74,950
- Netherlands	12,016	24,682
- Spain	26,609	16,958
- United Kingdom	29,801	23,948
Central-Eastern Europe	***31,432***	***28,835***
- Russian Federation	3,338	8,153
Other European countries	***24,654***	***20,256***
- Switzerland	14,827	15,088
AFRICA	**14,796**	**24,138**
North Africa	***10,095***	***16,484***
- Libya	1,679	6,000
Other African countries	***4,701***	***7,954***
- Republic of South Africa	1,610	4,292
AMERICA	**60,184**	**31,562**
North America	***43,452***	***22,135***
United States	39,803	19,408
Central Southern America	***16,732***	***9,427***
- Brazil	4,665	3,560
ASIA	**41,819**	**46,609**
Middle East	***13,765***	***9,423***
- Iran	1,308	2,771
Central Asia	***3,086***	***4,854***
- India	1,469	2,363
Far East	***24,967***	***32,332***
- China	3,551	9,682
- Japan	6,793	9,987
OCEANIA	**3,843**	**2,342**
OTHER TERRITORIES	**1,918**	**628**
WORLD	**419,124**	**394,271**

Source: ISTAT

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the greatest growth, though it represented a fairly small portion of the overall value added (4.8%), while agriculture, in contrast to the other two sectors, showed a decline.

The international outlook is characterised by significant instability and intense competitive pressure, a situation in which Italy's market share has fallen, dropping from 4.4% in 1998 to 3.9% in 1999. The Italian trade balance showed a surplus of 24,853 trillion Lire for 1999: the reduction in exports, –1.7%, stood in contrast to a rise of +4.15 in imports, resulting in a reduction in the balance of trade compared to the previous year (surplus of +47,399). The reduction in exports for 1999 compared to 1998 would appear to be a temporary development, given that the preliminary figures for 2000 point to growth in exports. The main outlet markets for Italian exports are the European Union (57.4%, led by Germany, 16.5%, and France, 13.0%), North America (10.4%, in particular the United State, at 9.5%, to which exports have increased). The make-up of exports has remained practically unvaried compared to 1998: the largest portion is represented by machines and mechanical devices (20.4%), followed by transport equipment (11.5%) and the textiles and clothing industry (Table 2.3.6a).

In 1999 imports of goods and services accounted for 20.3% of total national resources (at constant 1999 prices, see Table 2.3.3). Imports show growth, though the rate slowed in 1999 (+3.3% compared to 10.2% in 1997 and +9.0% in 1998). This trend was confirmed in the year 2000, when growth rate actually accelerated, essentially due to the unfavourable per-

Table 2.3.8a - Labour force in Italy (thousands of units, at mid-year)

	1998		1999	
	Thousands	%	Thousands	%
Labour force	**23,180**	**40.6**	**23,361**	**40.9**
Employed	20,435	35.8	20,692	36,.3
Agriculture	***1,201***	***2.1***	***1,134***	***2.0***
Industry	**6,730**	**11.8**	**6,750**	**11.9**
In strict sense	*5,186*	*9.1*	*5,175*	*5.3*
Construction	*1,544*	*2.7*	*1,575*	*2.8*
Services	***12,504***	***21.9***	***12,807***	***22.4***
Commercial activities	*3,266*	*5.7*	*3,308*	*5.8*
Other	9,238	16.2	9,499	16.6
Individuals seeking work	2,745	4.8	2,669	4.7
Not in labour force	**33,861**	**59.4**	**33,717**	**59.1**
Total resident population				

Source: ISTAT

Table 2.3.8b - Population and work force (thousands of units at mid-year)

	Resident population	Work force	Activity rate	Unemployment rate
1996	56,826	22,778	47.2	11.6
1997	56,941	22,895	47.2	11.7
1998	57,040	23,180	47.6	11.8
1999	57,078	23,361	47.9	11.4
2000	57,189	23,575	48.2	10.6

Source: ISTAT

formance of the related prices. The areas providing the greatest quantities of imports are the European Union (60.8%), Eastern Asia (8.2%) and Central-Eastern Europe (7.3%) (see Table 2.3.7). The largest portion of the imports consists of transport equipment (15.1%), electrical and precision devices (15.0%) and chemical products ad synthetic and artificial fibres (13.6%) (Table 2.3.6b).

An analysis of the different types of merchandise imported and exported shows that the average carbon intensity of the imports is greater than that of the exports. Even though a more in-depth analysis is called for, it is held that the national income consists of consumer goods and services which correspond to a per capita intensity of carbon dioxide emissions greater than that reported on the basis of national inventories.

2.3.2 Employment

The year 1999 registered a significant increase in levels of employment, thanks primarily to the new expansion of the services industry and the use of atypical employment contracts (temporary work, long-distance work etc.). An additional factor was the decrease in the unemployment rate, which went from 11.8% in 1998 to 11.4% in 1999. In the year 1999 the work force represented 40.9% of the Italian population, while employed workers accounted for 36.3% (see Table 2.3.8a and b). This situation was characterised by different in the various sectors: a significant drop was registered in the agricultural sector (-5.6%), continuing the trend observed in previous years, but at an even faster pace; industry in the strict sense of the term showed a slight decrease (-0.2%), a development offset by an increase in the construction sector (+2.0%). The services industry, as has been the case in recent years, provided key support to overall employment, with an advance of 2.4% in 1999, as services to businesses (+9.8%) led the sector, led by transport and communications (+3.2%) and trade

Table 2.3.9 - Energy contents of production / importation of materials – Years 1975, 1985, 1995. The figures are expressed in Mtoe.

	1975			1985			1995		
	Production	Imports	Total	Production	Imports	Total	Production	Imports	Total
Secondary energy / final uses									
Total production at high energy intensity	25.6	5.4	30.8	21.3	9.0	30.0	21.5	14.4	35.3
Total industry consumption, from B.E.N.	38.9			32.7			37.9		
Note:									
	a) 21.1% (% imports to high energy intensity production			a) 42.2% (% imports to high energy intensity production			a) 66.8% (% imports to high energy intensity production		
	b) 13.9% (% imports to total industrial production)			b) 27.6% (% imports to total industrial production)			b) 37.8% (% imports to total industrial production)		
	c) 65.8% (% "energy-intensive" industrial consumption to total industry)			c) 65.1% (% "energy-intensive" industrial consumption to total industry)			c) 56.7% (% "energy-intensive" industrial consumption to total industry)		

and public establishments (2.7%).

2.3.3 Evolution of quantities of carbon contained in goods

An analysis of the different types of goods imported and exported shows that the average carbon intensity of the imports is greater than that of the exports. Even though a more in-depth analysis is called for, it is held that the national income consists of consumer goods and services which correspond to a per capita intensity of carbon dioxide emissions greater than that reported on the basis of national inventories.
A recent study (Contaldi and Pasqualini, 2000) analyses the energy intensity of the industrial sector, which is generally measured by taking the ratio between the value produced and the quantity of energy consumed. In Italy, during the years from 1970 to '95, this ratio roughly doubled. Such a significant improvement has no precedent in the other industrialised countries. Specifically, the continuous increase in energy efficiency is not marched by a comparable increase in the known industrial processes. In this work, three possible underlying causes for the phenomenon are investigated: reduction of the percentage weight of energy-intensive sectors in the overall industrial structure; an increase in the importation of products with an elevated energy efficiency; a reduction in the quantity of raw materials needed to manufacture finished products. Two different methodologies were used to this end. The first is based on the use of domestic accounting data and is designed to quantify the effect on energy intensity of both structural variations and of modifications in the quantities of imports of raw materials and semi-finished materials meant for industry. The second is based on the theoretical increments in energy consumption tied to quantities of imports, assuming that the products are manufactured domestically according to average parameters of efficiency. Both methodologies lead to the same result, with the real increase in energy efficiency proving to be only half the figure calculated earlier. What is more, the improvement is concentrated in the period prior to 1985, and shows a trend towards stationary levels in more recent years. In conclusion, the increase in the percentage of imports represented by raw materials, semi-finished products and finished goods with high levels of energy efficiency have a noteworthy influence on the evolution of the ratio between industrial production and the quantity of energy consumed.

2.4 Characteristics of the macroeconomic sectors

Final consumption of energy remained relatively stable between 1990 and 1993, at around 112 Mtoe (not including non-energy uses). In recent years consumption has risen considerably, so that in 1999 it stood at approximately 124 Mtoe (+14.2% compared to 1990). The market share of natural gas continues to rise: from 27% in 1990 it went to 31% in 1999 (see Figure 2.4.1). The percentage weight of electri-

Figure 2.4.1 - Final consumption of energy by source

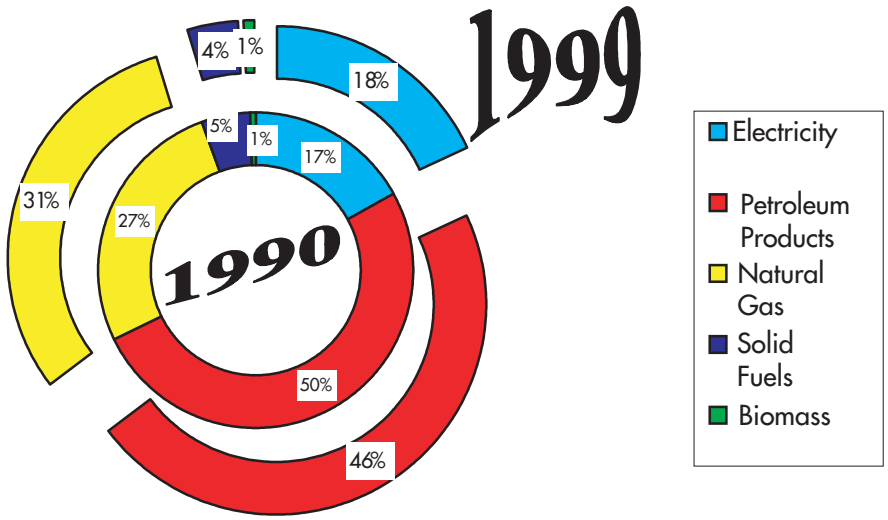
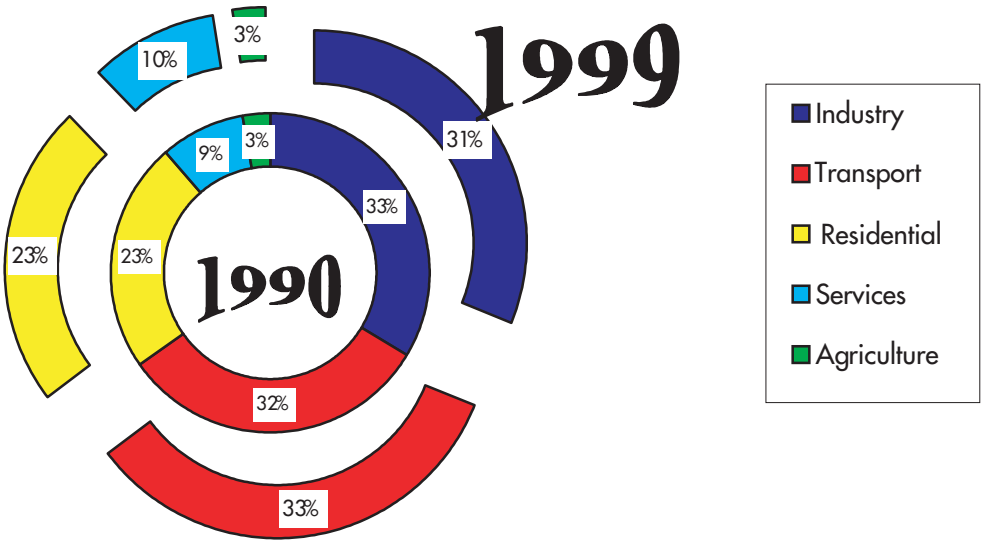


Figure 2.4.2 - Final energy consumption by sector



city also rose slightly, from 17% to 18%. In the case of coal, the downward trend in its share continues, registering 4% in 1999, compared to 5% in 1990. The consumption of biomasses was stable (1%), but this figure represents consumption calculated from the official statistics, meaning that it does not include biomass that is not supplied through commercial transactions.

Regarding the distribution of final energy consumption by sector (excluding non-energy uses), noteworthy trends are the growth in transport (from 32% in 1990 to 33% in 1999) and in the services (from 9% to 10% in 1999), as well as the decrease in the industrial sector (from 33% to 31%) and the stationary situation in the residential sector, at 23%.

The productivity of energy for the entire economy and for final users is determined by taking, respectively, the primary energy intensity and the final energy intensity. During the period 1990-2000, both intensities showed a downward trend: –1.8% for final energy intensity and–4.5% for primary energy intensity (see Table 2.4.1 and Figure 2.4.3), confirming the low

Figure 2.4.3 - Primary and final energy intensity in Italy

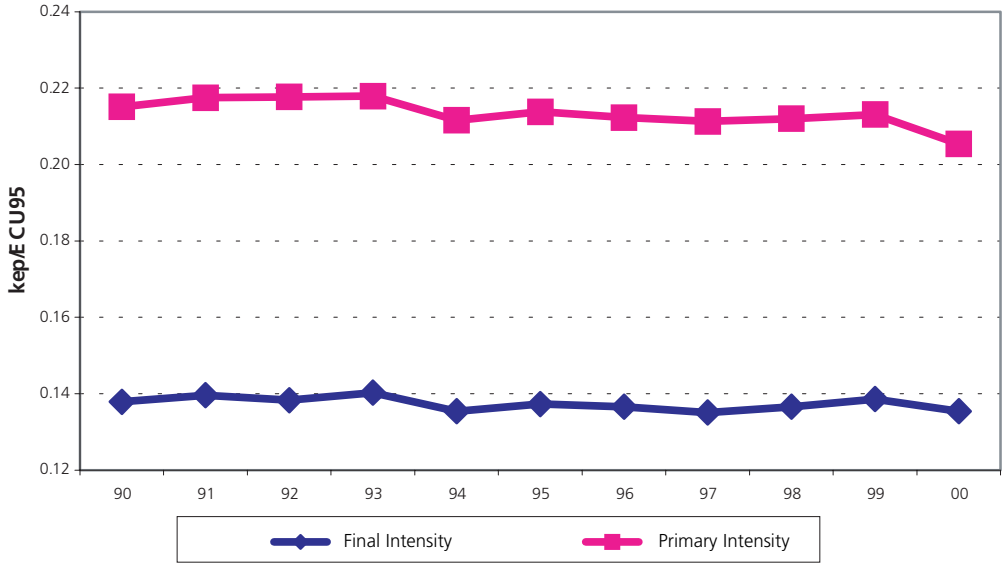


Table 2.4.1 - Annual percentage changesin primary and final energy intensity in Italy.

	1990-95	1990-2000
Primary energy intensity	-0.12	-0.45
Final energy intensity	-0.09	-0.18

levels of energy intensity in Italy compared to other industrialised countries.
These different variations between the primary and final intensities are reflected in the ration between the final energy intensity and the primary energy intensity, which went from 64.1% in 1970 to 65.9% in 2000. This result indicates that the decrease in the share of primary energy consumption was not tied to the final consumers, but to the transformation sector (primarily the production of electricity).

2.4.1 Energy sector

The energy production sector, which accounted for 6.2% of the country's total value added in 1999 (at constant 1995 prices), registered a number of different trends in the late 1990's: following a period of growth, activities involving the mining of energy-related minerals slowed beginning in 1998, while the index for the industrial production of coke plants and refineries showed a growth trend, registering a decrease only in the last year. Meanwhile, the trend for the production and distribution of electricity, gas and water was decidedly positive.
The Italian energy system as a whole (including both combustion and losses of combustible fuel) accounts for approximately 80% of the emissions of greenhouse gases. It would appear to be of fundamental importance, therefore, to compare the domestic energy situation with that of the other leading industrialised countries in order to understand why Italy is characterised by significant peculiarities which, on the one hand, provide it with advantages, though, at the same time, they increase the country's vulnerability. The most macroscopic factors regard the further decrease in the already low levels of specific consumption, the difficulty encountered in diversifying the generation of electricity, the growing dependence on imported hydrocarbons and burdens involved in upgrading to meet criteria of environmental protection.
A further constraint on decisions in the field of energy is economic in nature. Despite the fact that the Italian energy system is less inefficient than those of other countries, the energy required annually by our country has a high economic and financial cost in

terms of foreign trade (6-8% of national imports in the 1990's, but almost 30% during the oil crises of 1973 and 1981), Gross National Product (1-1.5% of the GNP at present, but more than 6% in 1981) and domestic resources in general. Given the need for energy, the economic constraint depends on the price of the energy carriers on the international market, whose levels are tied fairly closely to the price of oil.
Of the major industrialised countries, Italy remains among those with the highest level of dependency on imports from abroad, satisfying more than 80% of its energy needs with imported sources. The elevated dependency on imported sources of energy, though slightly offset by the low energy intensity, creates a situation in which increases in the price of energy, due to tensions on the international energy markets, have repercussions on the balance of payments and on the economic stability of the country. It will be difficult to reduce the dependency on imports during the next 15 years; even if marked development of renewable sources of energy were to be achieved while imports of electricity were kept within the levels typical of other European countries, this would not be enough to reduce the country's level of dependency below 80% by the year 2010. These strategies adopted in other countries to diversify primary sources by moving in the direction of nuclear and coal-fuelled energy have encountered particularly difficult obstacles in Italy, to the point where they have practically been abandoned, nor, with the present technology, would it appear feasible to think of future prospects for these sources. The reduction in the risk of pollution tied to nuclear and coal-fuelled energy have resulted in an average and marginal cost for the production of electricity which is greater than that of other countries. The obstacles encountered by policies for the development of alternative sources, together with the possibility of drawing on imported electricity at extremely favourable prices, has significantly slowed that process meant to eliminate petroleum products, and fuel oil in particular, from the generation of electricity in the early 1980's. Up through 1995, approx-

Table 2.4.2 - Gross production of electricity by plants fuelled with renewable sources (millions of kWh).

	1995	1996	1997	1998	1999
Hydro	37,780.8	42,035.6	41,599.8	41,213.6	45,358.0
Wind	9,9	32,7	117.8	231.7	402.5
Solar	4.2	4.7	5.8	5.6	6.3
Geothermal	3,435.6	3,762.4	3.905.2	4,213,7	4,402.7
Biomass and waste	387.1	604.2	820.3	1,228.8	1,822.3
Total	41.617.6	46,439.6	46,448.9	46,893.4	51,991.8

Source: GRTN

Table 2.4.3 - Electricity sector.

	1990	1995	1996	1997	1998	1999
Total electricity, TWh	235	261	263	271	279	286
Total emissions of CO_2, Mt	122	130	129	136	136	133
Grams of CO_2/kWh of gross thermoelectric production	686	665	665	666	660	643
Grams of CO_2/kWh of total gross production	564	538	535	529	523	501
Grams of CO_2/kWh of delivered electricity	556	535	533	533	529	505
Electricity produced from renewable sources, %	15,9	19,6	16,5	18,6	17,8	17,9
Emissions of CO_2 avoided, Mt (1990 as reference)		5,6	6,2	6,2	7,9	14,9
Emissions of CO_2 avoided by improving efficiency of combustible fuels		4,1	3,8	4,0	5,4	8,8

Source: APAT processing of ENEL/GRTN data

imately 50% of the electricity produced in Italy was still generated by petroleum sources, compared to a figure of just 9% on the European level.
In recent years, the relative weight of petroleum products as the primary input for the generation of electricity has decreased significantly, settling at approximately 40%. Consumption would have been even higher, were it not for the growing use of methane gas, which has increased its share of thermoelectric input from less than 7% in 1980 to 20% in the early 1990's, moving beyond 40% by 1999. Additional growth in the role of natural gas as a primary input for the generation of electricity would seem to be impeded, at least in the short term, by the inadequacy of the existing structures for transporting and storing the gas.
The production of electricity from renewable sources still plays a relatively limited role, but the trend is one of growth (+25% in 1999, compared to 1995), in part with an eye towards reducing emissions of CO_2.
The data for the electricity sector (see Table 2.4.3) show an increase in the consumption of electricity , +21.7% during the period 1990-1999, while total emissions have increased by 9%.
The implementation of various strategies of mitigation has reduced the specific emissions for the electricity produced by approximately 11%, in this way contributing to limiting total emissions for the sector.

2.4.2 Industry

Products of industrial transformation accounted for 21.1% of value added in 1999, while constructions represented 4.8%. The trend followed by manufacturing activities was wholly in keeping with the general index for industrial production, despite the fact that it showed a slight decrease in 1999: the sectors which demonstrated more marked development were wood ad wood products, paper, printing and publishing and the processing of non-metal-bearing minerals, while the sectors which registered the most significant decreases were textiles and clothing, footwear and leather products, whose performance mirrored that of previous years.
The industrial sector accounted for 32% of national income and was directly responsible for 14.9% of national greenhouse gas emissions. Following the crisis of 1992, and the positive turnaround in the two-year period 1994-95, a revival interrupted in 1996, industrial production in Italy followed a positive, albeit limited, trend. The preliminary data for the year 2000 point to a recovery.
In 1999 the Italian industrial sector consumed 38.5 Mtoe of energy, for an increase of 5.7% compared to 1990. The percentage weight of the metallurgical industry continued to fall: it went from 23% in 1990 to 19% in 1999 (see Figure 2.4.4), while the percentage of the energy-intensive sectors remained stable at 47%. Deserving of special mention is the mechanical industry, which increased its percentage weight from 9% in 1990 to 13% in 1999.

The figures for consumption show growth trends for natural gas, electricity and petroleum products following the drop in 1995 and 1996. The predominant energy sources in production processes are natural gas, which satisfies 41% of the demand for energy, up 3.3% over the previous year, electricity (28.7% of total consumption) and fuel oil (10.6%).
As a rule, growth in final consumption follows the index for industrial production and the index for value added. Only in the last year has the slowdown in production been accompanied by a contrasting acceleration in final uses, with an increase in energy intensity, which had remained virtually stable until 1998.

Figure 2.4.4 - Industrial consumption of energy by sector

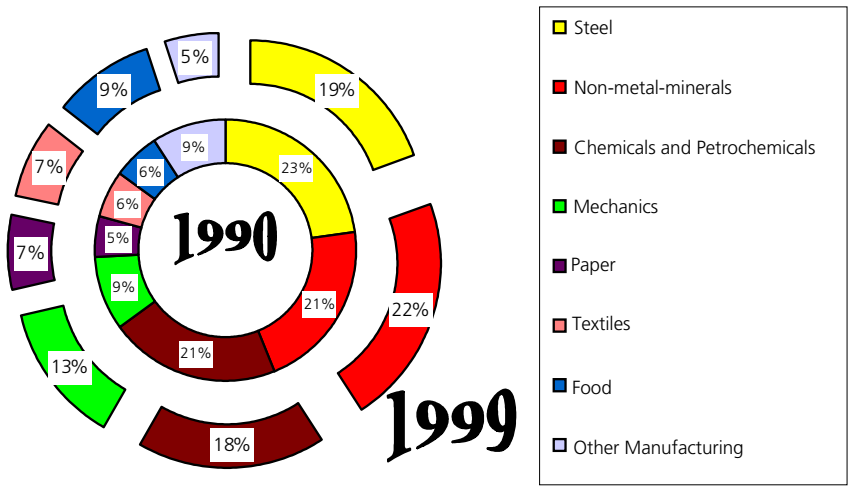


Figure 2.4.5a - Industrial energy intensities by sector

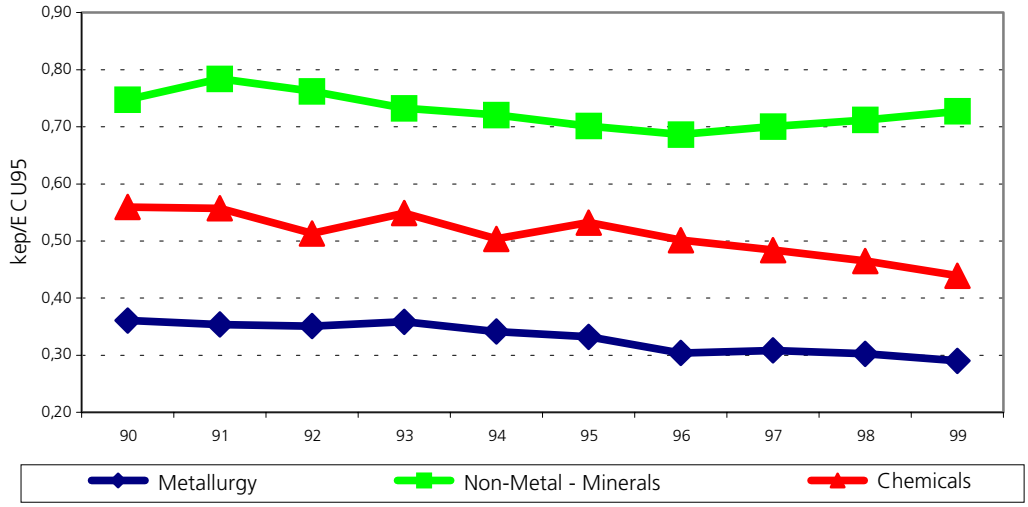
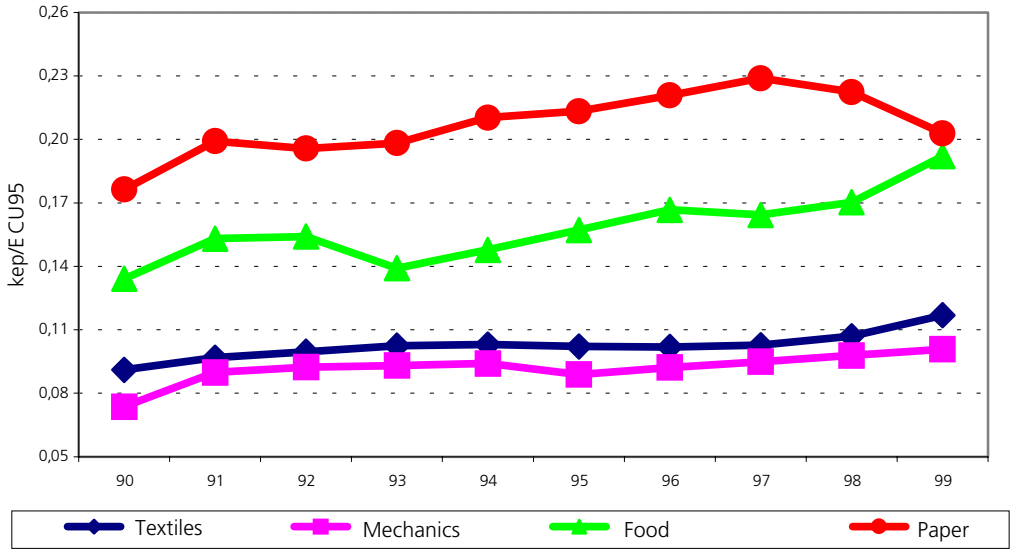


Figure 2.4.5b: Industrial energy intensities by sector



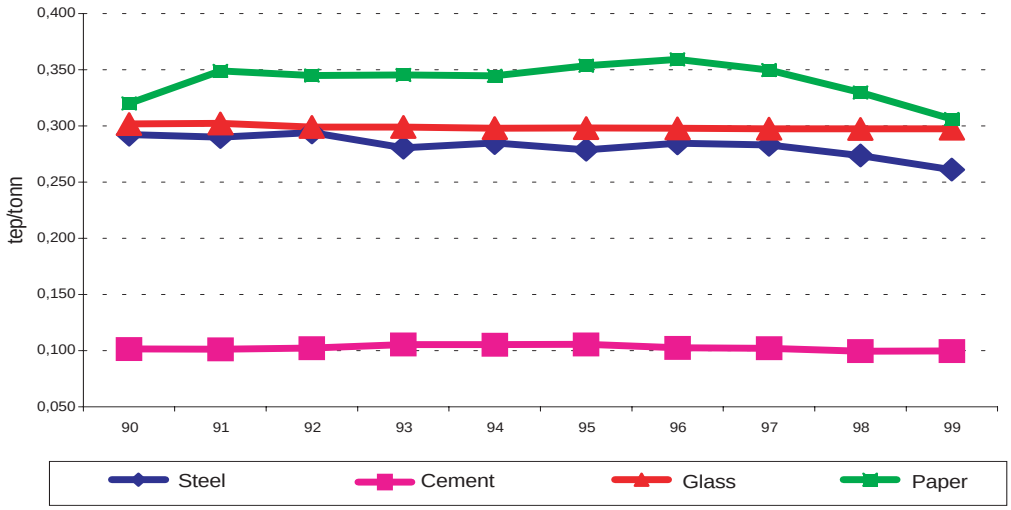
2.4.2.1 Energy intensities by sector

Figures 2.4.5a and 2.4.5b plot the course of energy intensities by sector.
In a long-term perspective, following the sharp drop in the wake of the two oil crises, the energy intensities for the different sectors were fairly stable, though the situation is still evolving. The metallurgy industry, as well as that of non-metal- minerals and the chemical industry, showed, for the period 1990-1999 a downward trend (at respective rates of –2.2%, -0.3% and –2.4% per year), while the mechanical industry, the paper industry, the farming and food industry and the textiles industry are growing slightly.

2.4.2.2 Unit energy consumption of energy intensive products

Figure 2.4.6 shows the unit energy consumption of energy intensive products: leather, paper, glass and cement.
In the long term, unit energy consumption shows a downward trend for all the products taken into consideration. Specifically, the reduction in the amount of energy consumed between 1973 and 1999 was 60% for the production of a ton of glass, 22% for the production of a ton of steel, 31% for the production of a ton of paper and 4% for the production of a ton of cement. A portion of these variations can be explained by changes that have taken place in the

Figure 2.4.6 - Unit consumption of energy intensive products



production structure (steel, cement, paper) or in the type of product (glass). The trends in question decreased significantly in the 1990's, and the indicators now show a certain degree of stability.

2.4.3 Mobility and transport

Emissions of greenhouse gases caused by the transport sector, which represent 23.1% of the total, are greater in percentage terms than the turnover of the transport production sector (6.6%, including communications), as well as the final consumption of families for transport spending (10.5%).
During the period 1990-2000 the mobility of passengers rose from 698.2 billion to 878.8 billion passenger km (+25.9%). The increase in mobility is found in all categories of transport, but especially in roadway traffic, which presents the highest levels. Roadway transport accounts for almost all of passenger transport (92.2%), showing for the period under consideration an increase of 27.2%. Larger increases were presented by shipping (+61.0%) and aviation (+80.6%), though their percentage weight remained limited, at 0.5% and 1.3% respectively of total passenger transport.

Indicators summarising the situation show that the growth in mobility which has occurred in recent years is not easy to calculate, given the lack of necessary information. A rough idea can be formulated, however, by taking the average number of kilometres travelled by a ton of freight or cargo, in the case of merchandise, or the number of kilometres per vehicle, in the case of roadway transport, or the number of kilometres per passenger for railway transport.
In 1999, the average distance travelled by a passenger on railway lines was 95 km, down from the figure of 97 km for 1998. In other words, the downward trend recorded in recent years continues, demonstrating a preference on the part of passengers for cars and airplanes.
The number of kilometres per vehicle was estimated on the basis of passenger kilometres (assuming an occupation coefficient of 1.7) and the number of

Table 2.4.4 - Passenger transport: traffic and energy consumption by mode of transport.

	1990		2000	
	Traffic (millions of passenger km)	Final consumption (Mtoe)	Traffic (millions of passenger km)	Final consumption (Mtoe)
Fixed system	51,698	0,329	52,080	0,369
Roadway	637,237	21,756	810,450	26,088
Shipping	2,887	0,060	4,648	0,097
Aviation	6,416	0,551	11,585	0,971
Total	698,238	22,696	878,763	27,524

Source: ISTAT

Table 2.4.5 - Indicators of mobility by category of transport

	1995	1998	1999	2000*
Railway (average km per passenger)	96.8	97.2	98.4	n.a.
Urban subways (average km per passenger)	7.4	7.3	7.3	7.2
Roadway (average km per vehicle)	14,287	14,470	14,878	14,231

Source: ENEA processing of data from the Ministry of Transportation and Navigation; * Estimated data

automobile equivalents (only gas and diesel-fuelled vehicles were considered). The figures ion the table show that the number of kilometres travelled per vehicle is following a downward trend (-1.3% compared to 1999, -4.0% compared to 1998), confirming the increase in mobility that has occurred in recent years, characterised by a rise in the average number of trips per vehicle, even if the trips are for shorter distances.

Emissions of CO_2, during the period 1990-2000, rose at a lower rate than the mobility of passengers, thanks primarily to improvements in the performance of the vehicle stock.
The mobility of cargo and freight in Italy, during the period 1990-2000, went from 235.7 billion to 281.9 billion km tons (in 1995 the ISTAT modified the criteria for collecting data on truck transportation). The rise in freight traffic (+19.6%) was also the consequence of the changes that took place in the organisation of production and national commercial activities, such as the outsourcing of logistical services, the request for reductions in delivery times and electronic commerce, with negative repercussions in terms of energy and the environment on account of the high level of consumption per unit of transport and the elevated emissions. The transport of cargo by water has been subject to a larger increase (+29.1%), but it is roadway transport that has absorbed the greatest volume of traffic (74.5%), while air transport accounts for only a negligible share.

The average kilometres travelled on roadways by a ton of merchandise in 1999 are indicated on Table 2.5.7, together with an indication of the tons and the km-tons. The data are broken down by type of transport and category of route.

Examining only domestic traffic, which is equal to 1,179,019,369 tons, 39.14% of the freight is moved on short routes (up to 50 km): 56.73% on the transporting party's own behalf and 43.27% for third parties. Approximately 80% of the freight moved on the transporting party's own behalf travels a maximum of 100 km, while the percentage for freight carried for third parties is approximately 45%. In the category of transport for more than 500 km, approximately 92% of the total tons are moved for third parties; in terms of kilometres-tons, this traffic represents approximately 32% of the traffic carried for third parties. These figures point to the fact that enterprises which operate on behalf of third parties are the normal choice for long-distance transport. Approximately 37% of the domestic traffic is handled by the companies transporting on their own behalf, while the enterprises that transport for third parties move approximately 63%.
Energy consumption in the transport sector practically doubled during the period 1975-1995, going from 18.9 to 35.2 Mtoe; in 2000 energy consumption reached 40.4 Mtoe, a figure that breaks down into 18.1 Mtoe of gasoline, 19.2 Mtoe of diesel fuel, 1.0 Mtoe of jet fuel, 1.6 Mtoe of LPG and natural gas and

Table 2.4.6 – Freight and cargo transport: traffic and energy consumption by mode of transport.

	1990		2000	
	Traffic (millions of passenger km)	Final consumption (Mtoe)	Traffic (millions of passenger km)	Final consumption (Mtoe)
Fixed systems	21,941	0,176	25,600	0,204
Roadway	177,945	7,930	210,108	12,212
Shipping	35,783	0,331	46,203	0,427
Aviation	33	0,14	40	0,017
Total	235,702	8,452	281,951	12,860

Source: ENEA processing of data from different sources

Table 2.4.7 - Transport of freight on domestic and international roadways, plus overall figures, by type of transport and length trip* - Year of 1999

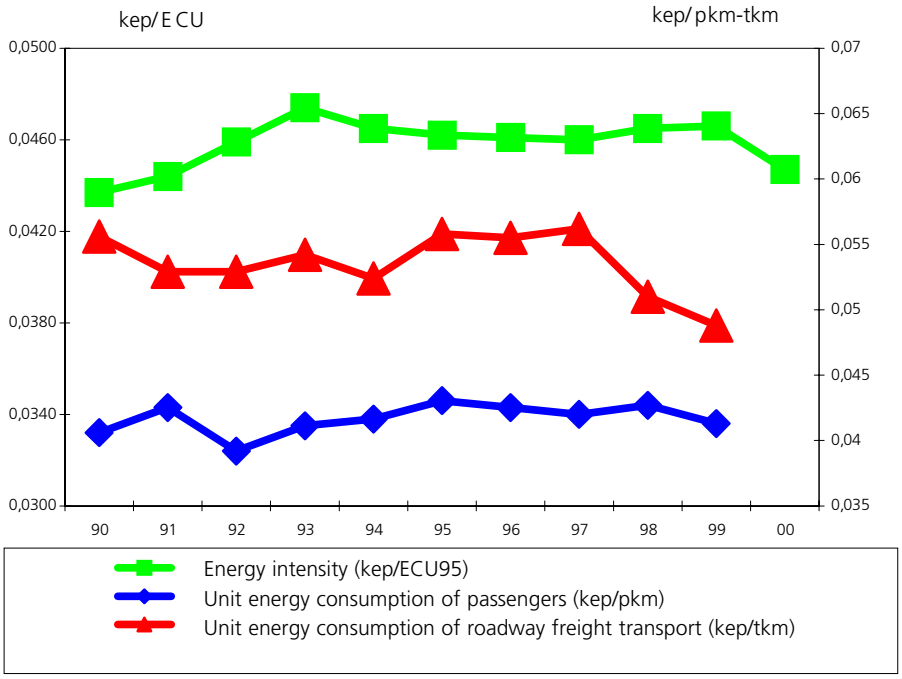
	Up to 50 km	51-100 km	101-500 km	more than 500 km	Total
Domestic transport					
Own behalf					
tons	261,766,288	85,219,855	84,044,624	5,211,157	436,241,924
km tons (thousands)	5,626,863	6,291,366	16,418,213	4,002,534	32,338,976
average km	21.5	73.8	195.4	768.1	74.1
tons	199,652,474	136,930,280	348,348,922	57,845,769	742,777,445
km tons (thousands)	5,271,610	10,459,663	79,312,093	44,997,953	140,041,319
average km	26.4	76.4	227.7	777.9	188.5
tons	461,418,762	222,150,135	432,393,546	63,056,926	1,179,019,369
km tons (thousands)	10,898,473	16,751,029	95,730,306	49,000,487	172,380,295
average km	23.6	75.4	221.4	777.1	146.2
International transport					
For third parties					
tons	1,060,943	514,090	960,637	1,518,817	4,054,487
km tons (thousands)	26,334	35,365	258,412	1,843,877	2,163,988
average km	24.8	68.8	269.0	214.0	533.7
tons	470,923	930,197	5,914,405	21,363,083	28,678,608
km tons (thousands)	14,941	75,273	1,840,701	25,617,124	27,548,039
average km	31.7	80.9	311.2	1199.1	960.6
tons	1,531,866	1,444,287	6,875,042	22,881,900	32,733,095
km tons (thousands)	41,275	110,638	2,099,113	27,461,001	29,712,027
average km	26.9	76.6	305.3	1200.1	907.7
Overall transport					
TOTAL					
tons	262,827,231	85,733,945	85,005,261	6,729,974	440,296,411
km tons (thousands)	5,653,197	6,326,731	16,676,625	5,846,411	34,502,964
average km	21.5	73.8	196.2	868.7	78,4
tons	200,123,397	137,860,477	354,263,327	79,208,852	771,456,053
km tons (thousands)	5,286,551	10,534,936	81,152,794	70,615,077	167,589,358
average km	26.4	76.4	229.1	891.5	217,2
tons	462,950,628	223,594,422	439,268,588	85,938,826	1,211,752,464
km tons (thousands)	10,939,748	16,861,667	97,829,419	76,461,488	202,092,322
average km	23.6	75.4	222.7	889.7	166,8

Source: Ministry of Transportation and Navigation
*The quantities refer to traffic carried on vehicles which have capacities of no less than 3.5t and are registered in Italy.

0.4 Mtoe of electricity. Roadway transport utilises almost all the energy consumed by the transport sector (94.8%). The growth in consumption has followed different patterns than has been the case for the mobility of passengers and freight. Final consumption of energy for the mobility of passengers rose by 21.3% during the period under consideration, with peaks of 76.2% and 61.7% for, respectively, air and waterborne transport (though these accounted for no more than 3.9% of total passenger consumption in 2000), while roadway transport consumption has increased by 19.9% (roadway transport accounts for 94.8% of the final energy consumption for passenger mobility). In terms of freight and cargo mobility, the period 1990-2000 witnessed a 52.2% increase in consumption. The largest increase was shown by roadway transport (+54.0%), followed by waterborne transport (+29.0%), airborne transport (+21.4%) and transport by fixed systems (15.9%). The percentage weight of each mode of transport remained practically unvaried, with roadway mobility absorbing 95.0% of the final consumption.

During the period 1990-2000, total CO_2 emissions caused by passenger transport rose by 21.3%, while there were reductions, thanks to technological improvements, in the emissions of carbon monoxide, nitrogen oxides and volatile organic compounds at respective rates of 23.7%, 32.1% and 13.0%. The emissions figures showed a more favourable trend outside of urban areas: the rise in CO_2 was more limited, 18.3% outside urban areas and 25.3% in urban areas, and greater reductions were recorded for CO -38.3% and 10.3% – and NOx -34.1% and 28.1% – while VOC emissions dropped outside of

Figure 2.4.7 - Energy intensity and unit energy consumption per passenger-km and ton-km



urban areas, by -44.0%, and rose in urban areas by +8.1%.

In terms of the emissions produced by transport of cargo and freight, increases were recorded in all the pollutants: CO_2 +51.6%, CO +17.4%, VOCs +19.4% and NOx +26.3%.

The growth in passenger mobility has been more acute in urban areas (+32.0%) than outside of them (+24.0%). In both cases, the growth translates into an increase in private transportation (+29.4% total, +35.1% urban areas and +27.0% in non-urban areas). Public transportation in urban areas has seen bus lines register a decline (-5.8%) in contrast to growth on the part of fixed systems (+34.3%), leading to total growth of +5.2% for the public sector.

The growth in the domestic mobility of passengers and freight was almost completely absorbed by roadway transport: 92.2% for passengers (75.6% with private motor vehicles) and 74-5% for freight.

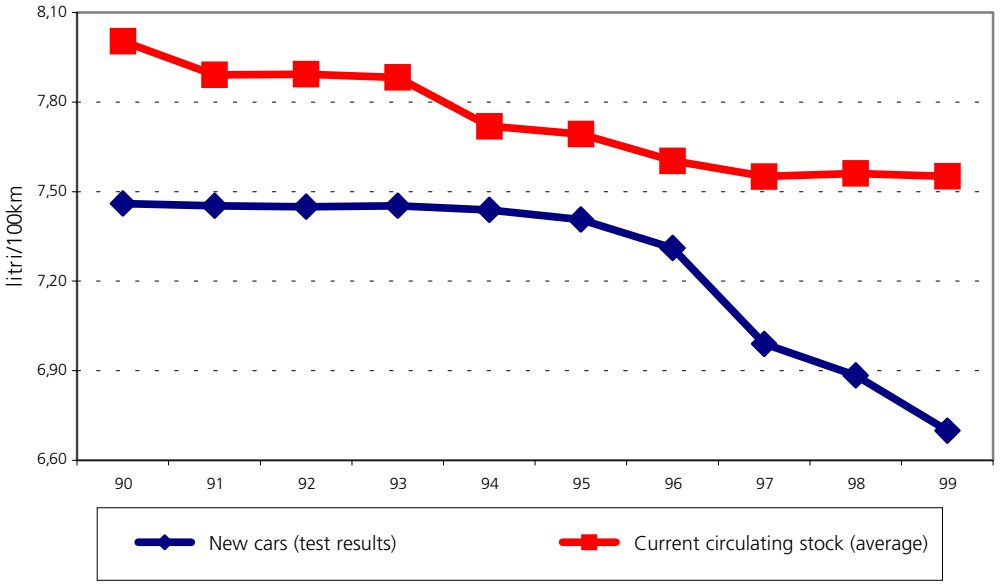
The increase in consumption proved lower than the corresponding increase in mobility, due to the improvements made in the energy efficiency of the vehicles following the oil crises and in response to environmental policies.

A factor that significantly slowed the reduction in intensity was the strong growth in roadway transport, and this despite the significant improvements in the specific consumption of fuels. Policies for the development of infrastructures of railway transport and urban mass transit, which have been weak to date, were able to make only a marginal contribution to slowing the growth in the use of roadway vehicles, without succeeding in reversing the established trend. The result has been a rise in the consumption of gasoline, diesel fuel and other fuels to more than 40 Mtoe and at average annual growth rates greater than 2%. The damage to the environment and the general costs to the national economy are always more apparent in the larger urban conglomerations and along the major roadway axes connecting different cities. The figures for the transport of freight prove to be especially anomalous compared to the trends in the majority of the other countries of the European Union, where railway and river transport are winning increasing shares of the market. In 1990 railways accounted for 10% of freight traffic in Italy, compared to a figure of 18% in Germany and 20% in France. Looking to the future, on account of the limitations placed on the transit of heavy vehicles by Austria and Switzerland, new railway lines will have to be developed through the Alpine passes. This prospect, together with the growing acknowledgement of the importance of the development of parking facilities and urban infrastructures, as well as subways and railway systems of inter-urban transport, all in the course of the next decade, make a decline on the growth of consumption appear as a possibility, though one that would probably not come to pass much before 2010.

2.4.3.1 Energy intensity of transport

The energy intensity of transport establishes the relationship between the energy consumption of the sector and the GNP (Figure 2.4.7). It is not an indicator of energy efficiency, but rather illustrates the trends of

Figure 2.4.8 - Specific average energy consumption of cars



energy consumption in the field of transport as these relate to economic growth. Following a slight decrease in 1993, energy intensity has remained fairly constant, indicating that the demand for energy in the transport sector was growing at the same rate as the rest of the company. In 1998 there was an increase in energy intensity that did not extend into 1999. In fact, energy intensity showed no rise or fall for 1999, while a decrease would seem to be in the offing for 2000.
Two additional indicators that provide a general idea of how energy is used in the sector are:
- unitary energy consumption per passenger-kilometre for passenger transport (kep/pkm);
- unitary energy consumption for ton-km for freight transport (kep/pkm).
Both indicators are falling slightly, demonstrating that the transport sector is less energy sensitive, and therefore more efficient.
The modes of transport are becoming more efficient, though a portion of the progress achieved has been offset by substitution with more intensive types of transport.

2.4.3.2 Cars

Two indicators have been calculated for cars:
- specific average energy consumption of cars;
- specific average energy consumption of new cars, based on tests.

In the case of new cars, the test result for specific energy consumption has fallen at a yearly rate of 1.2%, making for a reduction of 10.2% between 1990 and 1999, all of which indicates that the new cars are becoming more efficient every year. In recent years, new impetus in the direction of reducing specific consumption has arrived from the Italian government and from the leading Italian automobile manufacturers (FIAT).
In technical terms, the improvement in automobile efficiency has been influenced by changes in the dimensions of the cars purchased.
Average specific energy consumption fell considerably during the period 1990-1999: at an annual rate of –0.65% and a rate of –5.7% for the entire period.

2.4.4 Residential and tertiary sector.

The residential and tertiary sector is responsible for 15.6% of the emissions of greenhouse gases.
In 1999 Italian families spent 0.6% more than in 1998, and the trend for 2000 points to an additional increase (+4.3%). The portion spent on the consumption of food continued to decrease, and now represents approximately 20% of total spending. Among non-food categories of consumption, tobacco products, clothing and footwear and education present results that are practically stable, while the categories of homes, communications, free time, culture and games and transportation show growth trends. Of interest along these lines is spending for homes (+2.8%), which has a percentage weight of 22.4% out of total family consumption, and spending for transportation (+1.6%), whose percentage weight is 15.3%.
In 1999, 70.5% of energy consumption in the residential and tertiary sector was absorbed by residential

Table 2.4.8 - Consumption of families. Percentage changes.

	Change1999/1998
Food and beverages	–1.0%
Non foodstuffs	0.9%
- Clothing and footwear	–0.3%
- Home	2.9%
- Fuels and energy	1.5%
- Furniture, appliances and services for the home	3.1%
- Health care	-3.7%
- Transport	1.6%
- Communications	3.6%
- Education	-1.8%
- Free time, culture and play	-2.3%
- Other goods and services	-1.3%
Total	0.6%

Source: ISTAT

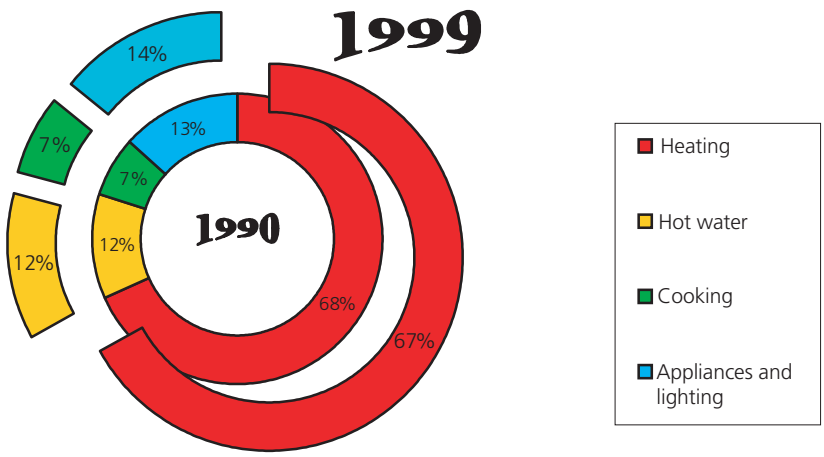
consumption (21% of final total energy consumption). Residential consumption utilised 28.7 Mtoe of energy for final uses, +5.6% compared to 1998. A 55.7% share of the residential demand for energy was satisfied by natural gas, 21.2% by petroleum products, 18.9 by electricity and 4.3% by solid fuels. With the exception of LPG, the use of petroleum products decreased (-28%) in favour of natural gas (+39% during the period 1990-1999), with significant consequences in terms of emissions of greenhouse gases. Despite a slight increase in absolute terms, the percentage weight of electricity remained

Table 2.4.9 - Energy consumption in the residential sector by source. Figures are in ktoe.

	1990	1995	1996	1997	1998	1999
Electricity	4,535	4,922	4,988	5,030	5,098	5,412
- heating	*138*	*138*	*140*	*141*	*140*	*149*
- hot water	*883*	*967*	*976*	*979*	*975*	*1,025*
Gas	11,478	13,974	14,700	14,354	15,503	15,936
- heating	*9,055*	*11,092*	*11,680*	*11,471*	*12,370*	*12,720*
- hot water	*1,422*	*1,826*	*1,945*	*1,834*	*2,048*	*2,054*
LPG	1,535	1,521	1,577	1,461	1,446	1,928
- heating	*899*	*927*	*969*	*906*	*903*	*1,200*
- hot water	*96*	*104*	*111*	*106*	*107*	*148*
Diesel fuel	6,547	4,203	4,190	3,908	3,934	4,042
- heating	*6,071*	*3,935*	*3,933*	*3,672*	*3,693*	*3,795*
- hot water	*476*	*268*	*257*	*236*	*241*	*247*
Fuel oil	408	46	37	46	83	115
- heating	*377*	*40*	*33*	*42*	*76*	*103*
- hot water	*31*	*6*	*4*	*4*	*7*	*12*
Coal	83	107	103	118	59	58
Wood	652	925	892	1,019	1,046	1,194
Total final uses	**25,238**	**25,698**	**26,487**	**25,936**	**27,169**	**28,685**
- heating	17,263	17,150	17,736	17,354	18,279	19,211
- hot water	2,916	3,181	3,303	3,171	3,384	3,492

Source: ENEA processing

Figure 2.4.9 - illustrates the results for residential energy consumption.



unaltered. A 67.0% share of the demand for energy in the residential sector was absorbed by heating, whole hot water accounted for 12.2%, kitchen uses for 6.6% and electrical uses for 14.2%. The main source of the energy consumed by the residential sector is natural gas, which has shown a significant increase over the last ten years (56% in 1999, whereas in 1990 it represented 45.5% of final consumption). This trend is particularly noteworthy in heating: in 1999, the share of consumption for heating represented by natural gas was 66.2%, compared to 52.5% in 1990.
The penetration of natural gas in the residential sector is also tied to the increase in the number of habitations with independent rather than centralised heating systems. At present, independent systems consume approximately 75% of the overall need for natural gas for the purpose of domestic heating.
Breaking down final energy consumption for domestic heating in 1999 by type of heating system, 14% regarded individual systems, 63% autonomous systems and 23% centralised systems.

The percentage weight of heating fell from 68% in 1990 to 67% in 1999, with fluctuations traceable to the severity of winter. Hot water was stable at approximately 12%, as was energy consumption in the kitchen (7%). Home appliances and lighting grew in importance, rising from 13% in 1990 to 14% in 1999.

Figure 2.4.10 - Average energy consumption perdwelling: total, heating and specific uses of electricity (with climate corrections)

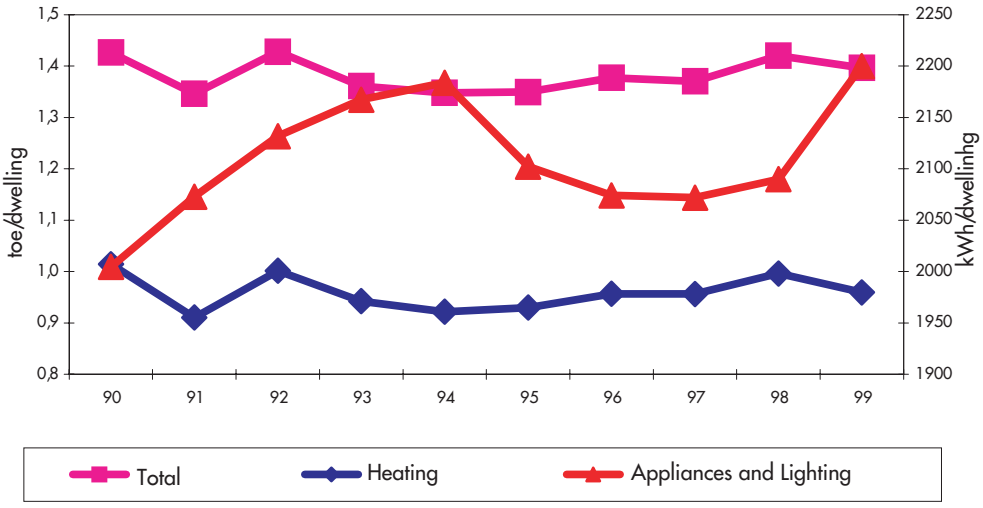
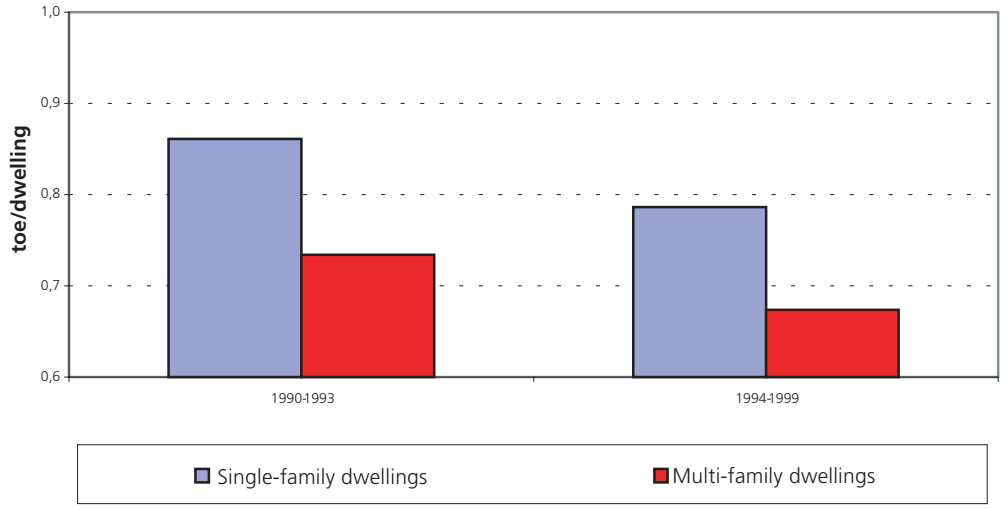


Figure 2.4.11 - Specific theoretical energy consumption of new dwellings



In 1999, the services sector consumed 12 Mtoe of energy, which corresponds to 29.5% of consumption for the civil sector and 9.0% of the total final uses. A share of 46.8% of consumption was absorbed by natural gas, while 40.7% was accounted for by electricity and 12.4% by petroleum products. In 1999 the demand for energy grew by 6.0% compared to 1998, a rate greater than the overall increase in the civil sector (+5.7%). The energy intensity of the services sector went from 9.6 toe/GLit 95 to 10.1 toe/GLit 95 (+4.5%).
The growth in the value added of the services sector during 1999 was in line with that of the economy as a whole (+1.6%), while the increase in the demand for energy was greater (6.0%, compared to 1.1%).
As was the case in the residential sector, the services sector also showed a decrease in the percentage weight of petroleum products. Electricity registered an increase of 42% compared to 1990, while its percentage weight rose from 37% to 41%.

2.4.4.1 Residential energy unit consumption

Figure 2.4.10 shows the results for energy unit consumption perdwelling, in terms of total uses, heating and specific uses of electricity.

Total energy unit consumption and consumption for heating were supplied with corrections for the climate. The first indicator roughly follows the unit energy consumption for heating, on account of the determining role of heating in the structure of energy consumption.
Total energy unit consumption proves relatively stable, apart from some fluctuations, registering a level of approximately 1.4 toe/dwelling following 1990, of which roughly 1 toe/dwelling is the result of heating.
Looking at the period of 1990-1999, a unitary annual reduction of 0.23% in total energy consumption can be observed, together with a drop of 0.60% for heating. Looking at the five year period of 1995-1999, on the other hand, there was an annual increase of 0.9% in total consumption and of 0.8% in consumption for heating.
Energy unit consumption for specific uses of electricity rose at an annual average rate of 1.1% during the period of 1990-1999. After a decrease during the years 1995-1998, in 1999 this consumption figure is rising rapidly.

2.4.4.2 Heating

Between 1977 and 1988, the period during which the reduction in energy consumption per dwelling was the most rapid, energy unit consumption per m^2 fell more quickly than did consumption per dwelling: -1.7% compared to –0.9%. This means that the growth in the percentage weight of dwellings was offset in part by a decrease in the energy unit consumption per dwelling (0.8% yearly).
After 1988, the difference between the two indicators was less marked, settling at around 0.5% a year.
Thermal regulations for new dwellings were reformulated on 3 different occasions following the first oil shock, in 1975, 1982 and 1989, with the energy needed for heating being reduced on each occasion.
New dwellings built in accordance with the latest energy standards consume roughly 11% less energy than do dwellings built before 1978, and roughly 5% less than those built between 1990 and 1993 (Figure 2.4.11).

2.4.4.3 Electrical appliances
In 1999, the demand for home appliances showed

Table 2.4.10 - Energy consumption in the services sector by source. The figures are in ktoe.

	1990	1995	1996	1997	1998	1999
Electricity	3,441	4,248	4,420	4,622	4,822	4,886
Gas	4,272	4,833	5,092	4,795	5,124	5,620
LPG	197	331	269	255	259	397
Diesel fuel	1,156	1,022	957	919	882	843
Fuel oil	263	169	149	163	226	243
Coal	20	17	17	15	7	9
Total final uses	**9,349**	**10,620**	**10,904**	**10,769**	**11,320**	**11,998**

Source: ENEA processing of data from the Ministry of Productive Activities

accelerated growth. The most significant rise was in the large appliances sector; the products benefited from a replacement cycle that was amplified by the introduction onto the market of products which were innovative in terms of energy consumptions. Only figures showed negative results, on account of the expansion of combined refrigerators. The penetration of electrical applications in the residential sector showed a trend that led to almost total distribution of refrigerators, televisions, washing machines and electric lighting (see Table 2.4.11). The data by ENEL, from which the statistical analyses were drawn, do not take into account the spread of other durable goods, such as Hi-Fi systems, which contribute to increasing the consumption of electricity in the residential sector (see Table 2.4.12).

The ISTAT data for 1999 show that 96% of Italian families had a colour TV and a washing machine, 78% an automobile, and roughly 64% a videotape recorder, all figures which remained essentially unchanged in 2000.

The spread of personal computers and Hi-Fi systems

Table 2.4.11 - Home appliances: spread and consumption of electricity per application and per user Year of 1999

Home appliance applications	Consumption of electricity				
	Penetration	per application		per user overall	
	%	kwh	kwh	Gwh	%
Refrigerator	97.4	368	358	9,086	16.1
Freezer	28.0	479	134	3,400	6.0
Television	92.4	225	208	5,270	9.4
Video recorder	47.5	119	57	1,433	2.5
Washing machine	88.2	291	257	6,506	11.6
Dishwasher	23.0	442	102	2,577	4.6
Air conditioner	3.0	302	9	230	0.4
Electric kitchen	0.3	374	2	28	0.1
Mixed kitchen	59.6	126	75	1,904	3.4
Microwave oven	11.1	137	15	385	0.7
Electric water heater	33.6	1,054	354	8,977	15.9
Electric stove	16.4	148	24	615	1.1
Iron	96.0	78	75	1,898	3.4
Personal computer	23.7	71	17	427	0.8
Lighting	100.0	295	295	7,478	13.3
Other home applications	-	148	148	3,752	6.7
Non-home applications	-	-	91	2,338	4.2
TOTAL			2,221	**56,305**	**100.0**

Source: ENEA processing of data from the Ministry of Productive Activities

Table 2.4.12 - Families that declare they possess durable goods – Years 1998-1999. Data for 100 families in the same zone.

	Colour TV	Hi-Fi systems	Video recorder	Personal video cameras	Computers	Fax	Telephone answering machines
1998	96.1	47.7	62.0	17.1	18.8	4.5	13.8
1999	96.4	50.1	63.7	18.2	20.9	6.0	14.5
2000	95.7	52.2	64.6	19.1	25.6	6.7	15.0

Source: ISTAT

contributes to increasing the consumption of electricity in the residential sector, and especially consumption for obligatory uses of electricity. In 2000, the percentage of families with Hi-Fi systems was 52%, while almost 26% owned a personal computer and 19% a videogame consol. Nor is can there be any ignoring the fundamental figure according to which 42.3% of families have more than one television.
In the two-year period 1999-2000, the number of families with a subscription to Internet doubled, going from 7.6% to 15.4%, at the same time as the percentage of families with a modem rose (from 9.4% to 16.6%), as well as the percentage owning cell phones (from 55.9% to 64.8%). The spread of fax and telephone answering machines was more limited.

2.4.5 Agriculture
Italian agriculture is highly diversified in terms of its main characteristics, especially between the Alpine and Apennine regions and those of the North, Central and Southern regions of the country. This diversification ranges, for example, from the intensive, high-productivity farming of the northern regions to an extremely marginal situation in the mountain zones and the south of the country.

An updated census of Italian agriculture carried out by the ISTAT (the National Statistical Institute) during the year 2001 is available. Table 2.4.13 summarises the most significant data from the census by type of crop, production and extension of the cultivated areas, while Figure 2.4.12 provides a graphic illustration of the elevate variability of production and surface area utilised in the farming activities practiced in Italy.

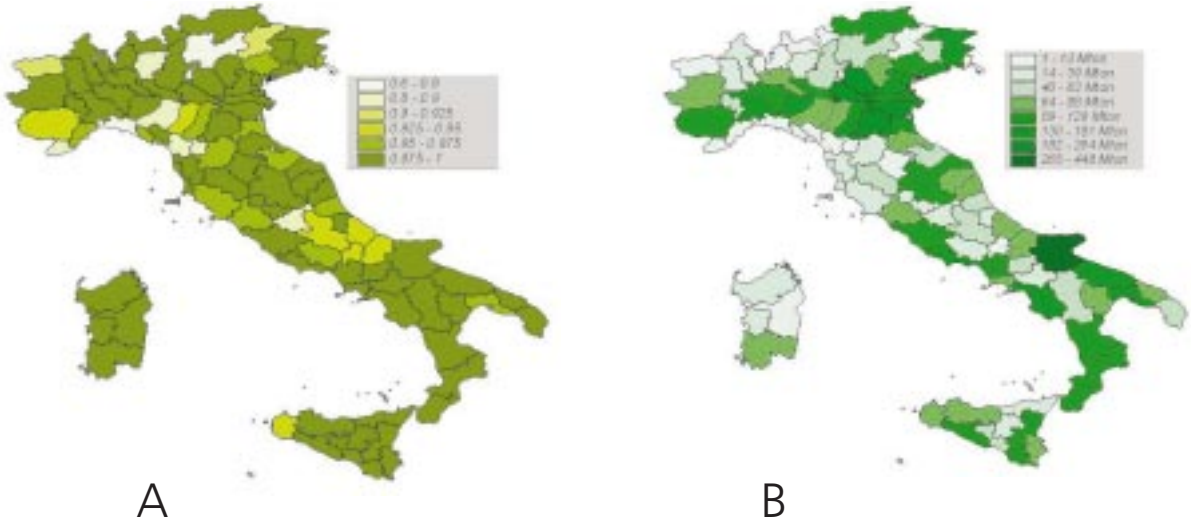
During the period 1990-2000, however, Italian agriculture was characterised by a gradual reduction in the Utilised Agricultural Area (UAA) and by a shrinking of the surface area for planted crops in favour of an increase in permanent crops (ISTAT, 2001). The number of Italian agricultural enterprises fell by an average of 13.4%, but this decrease mainly regarded the northeast portion of the country, where the number of agricultural concerns fell by 39.7%. The utilised agricultural area, on the other hand, fell by only 6%, given that the discontinued operations involved only the smaller enterprises. A further analysis of the data shows that the shrinkage in surface area utilised was greater in areas whose principal activity was not agriculture, especially in marginal area of the country.

Table 2.4.13 - 5th General Agricultural Census of 2000

Type of crop	Total surface area (ha)	Total production (t)
Grassland	5,533,933	5,186,489
Fodder crops	4,905,501	124,038
Wood growing	4,454,584	2,188,075
Total fruit and vegetables	268,258	10,784,109
Greenhouse fruit and vegetables	2,792,500	1,365,486
Total	17,954,776	19,648,196

Source: ISTAT

Figure 2.4.12 – The figure compares the spatial distribution of land intensity (A) and the total agricultural production expressed in Mt (B) for the Italian territory. The figures are grouped by province.



This variation in the use of the land has definitely translated into a net decrease in the emissions of greenhouse gases by the agricultural sector, though the trend proves hard to quantify, given the various overlapping levels on which the different categories of the national censuses are taken. Nevertheless, assuming that the reduction in the area utilised and the use of factors of production and energy are directly proportionate, it can be calculated that the emissions of the agricultural sector have gone from 8.1 Mt of CO_2 in 1990 (Second National Communication, UNFCCC) to 7.6 Mt of CO_2 in 2000.

Together with the overall reduction in the number of enterprises and the area utilised, there has also been a rise in the specialisation of production in areas of traditional activities, with an intensification of grain and animal-husbandry areas in Northern Italy, of grain and foodstuffs in the south, of fruit and produce in the coastal areas and on the islands, and of areas devoted to extensive animal husbandry in the Apennines and in the south.

Into this framework of transformation have been introduced, at times with contrasting effects, the various national and European policies and measures geared towards reclamation of the environment and the countryside (Regulation 2078) and to the promotion of specific agricultural practices (Agenda 2000). The increased introduction of practices of biological agriculture to the overall picture of national agriculture is due precisely to the implementation of these measures and policies.

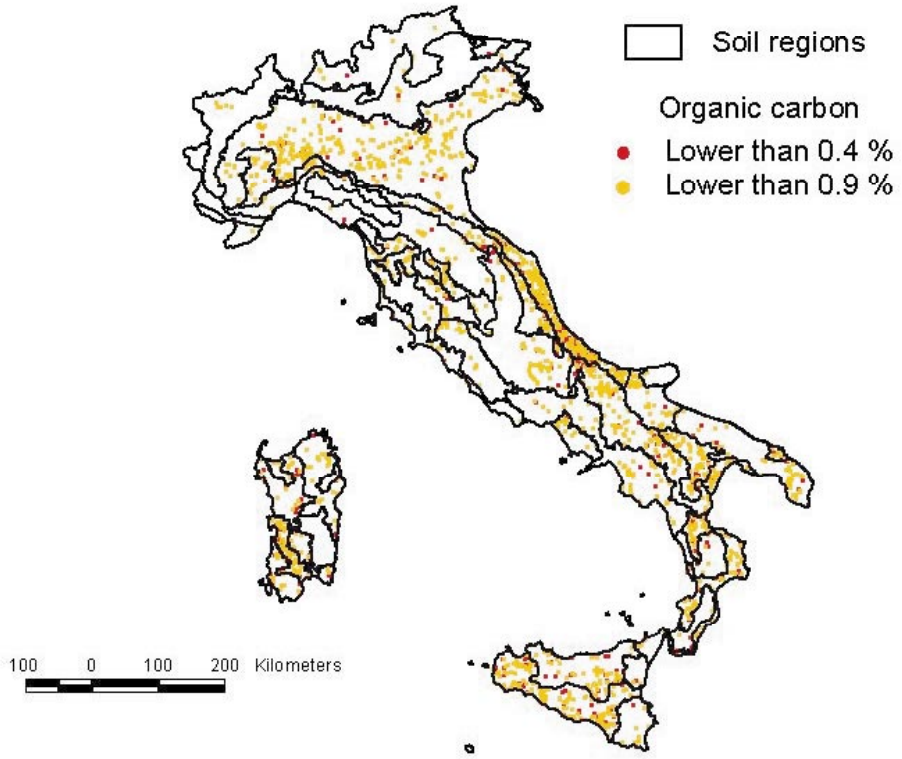
Observations

The production of crop waste in Italy totals more than 80 Mt of organic substances. The great majority of this crop waste, if not the entire amount, is broken down or destroyed, creating a positive flow towards the atmosphere of more than 110 Mt CO_2 per year. An improved, regulated management of crop waste, calling for its recycling for energy purposes or its reintroduction into the soil, could result in a net reduction in emissions. Given that Italian production is concentrated in the areas of the Po Valley and in the irrigated areas of the south, also crop waste is concentrated in the same areas , which means that any measures geared towards reducing net emissions (emissions and absorption) must involve precisely those areas. Traditional Italian agriculture in seeded areas are characterised by the in-depth working of the terrain.

This, together with a management of crop waste that does not stress conservation, plus a rearrangement of land use based essentially on amalgamation, has led, over time, to a sharp reduction in the average contents of organic substances in the soil. This is clearly demonstrated by the data show in Figure 2.4.13, which shows that the great majority of Italian soil contains less than 0.9% of carbon.

The amount of livestock shows a nearly stationary trend, with approximately 7.,362 million head of cattle and 11,016 million head of sheep in 1999 (see Table 2.4.14).

Figure 2.4.13 - Distribution of percentage contents of organic carbon in Italian agricultural soils (source: ICS, Ministry of Agricultural and Forestry Policies, Florence)



Substantial stability was also registered for mineral and organic-mineral fertilisers in 1999. Mineral products showed a slight increase (+0.3%), due to the combined effect of an increase in simple mineral products (+2.0%) and a drop in composite products (-1.8%). Among the simply formulated products, the most noteworthy increases were in miscellaneous nitrogen products (+123.7%), ammonium sulphate (+8.0%), potassium chloride (+7.5%) and urea (+4.7%). In the category of composite mineral fertilisers, an increase in binary products (+1.9%) was offset by a drop in ternary compounds (-3.9%). Organic-mineral fertilisers remained nearly stable, showing only a slight decrease (-0.5%).

2.4.6 Forests

Our country has a rich biological heritage of plant life, plus numerous landscape units of types which are, in some cases, extremely diverse from one another. In

Table 2.4.14 - Amount of livestock (thousands of head)

	1997	1998	1999
Cattle	7,334	7,315	7,362
Sheep	10,893	10,894	11,016
Swine	8,292	8,322	8,414

Source: ISTAT

Table 2.4.15a - Fertilisers distributed for consumption (in thousands of quintals)

	1998	1999
Nitrogen-based	15,100	15,483
Nitrates	*6,111*	*7,512*
Phosphates	3,236	3,230
Perphosphates	*3,092*	*3,115*
Potassium-based	1,664	1,686
Binary compounds	5,189	5,288
Ternary compounds	10,254	9,851
Organic minerals	3,837	3,820

Source: ISTAT

Table 2.4.15b - Fertiliser distributed for consumption per inhabitant (kg)

	1998	1999
Nitrogen-based	26	27
Nitrates	*11*	*13*
Phosphates	6	6
Perphosphates	*5*	*5*
Potassium-based	3	3
Binary compounds	9	9
Ternary compounds	18	17
Organic minerals	7	7

Source: ISTAT

Table 2.4.16 - Surface area of managed forests (Istat) and overall forest areas in Italy (IFN). Figures in millions of hectares

	ISTAT (1)	IFN (2)
coppice	3,623	3,890
high	2,964	2,973
brush and other forest areas	266	2,036
Total	6,853	8,899

(1) Istat data: forests are considered to be wooded terrains with a minimum conventional coverage of 50% and a minimum extension of 0.5 ha. The estimate refers to 1999.
(2) IFN data: forests are considered to be wooded terrains with a minimum conventional coverage of 20%, a minimum extension of 0.2 ha and a minimum width of 20 m. The estimate refers to 1999.

fact, the Italian peninsula constitutes a bridge between the central European environmental settings, including those of the continental type, and the Mediterranean ones.
The diversification can be observed, in terms of forestry resources, in the contrast between the Alpine woods of resinous trees, similar to those of central and northern Europe, and the mixed forests of leave-bearing trees, with the range extending to Mediterranean brush and formations typical of cold, arid climates closely related to those of the North African countries.

Forested surface area
There is no up-to-date estimate of Italian forestry resources based on a full-fledged inventory research effort, given that the National Forestry Inventory (IFN) dates from 1985. The most recent official fig-

ures are those of the Istat, in the case of managed forests, and those of the IFN for non-managed forests (Table 2.4.16).
Approximately 6.5 million hectares consist of forests managed for the supply of lumber and not subject to restrictions of a legal, economic or environmental nature able to have a significant negative impact on the possibilities for forestry utilisation. Approximately fifty sites, the majority located in mountain areas, represent historic or semi-natural woods, for a total surface area of approximately 160,000 hectares. Natural protected areas number more than 700, having been established on various levels: national, regional and local. These areas occupy a surface area of more than 2.5 million hectares (8% of the national territory). It should be noted that the flora of Italy is the richest in all of Europe: vascular plants number 5,463, of which 712 are endemic.
Approximately 53% of the managed woods are run with simple sprout and mixed trees, while 43% operate with high-forest trees; the remaining 4% consists of Mediterranean brush.
High-forest trees of the same age, or with the same age formation, represent almost 60% of the total of high-forest trees: the predominant type (slightly less than two thirds) are trees aged no more than 40 years (TBFRA).
According to ISTAT statistics for 2000, the national forested surface area has increased by 3% during the last decade.
Wood mass and productivity
As of 2000, the wood supply found in managed forests and in other forest areas, according to our calculations, which are based on the ISTAT data and the IFN data, totalled 1,711 Mm^3, of which 1,436 Mm^3 in managed forests (609 Mm^3 in sprout trees and 827 Mm 3 in high-forest); The yearly increase in wood is equal to 49.6 Mm^3.
Utilisation of forestry wood products
The utilisation of wood over the last thirty years has followed a cyclical pattern, with a minimum in 1976 (5.4 Mm^3) and maximums in 1994 and 1999 (more than 9.9 Mm^3).
The Italian woods are largely geared towards products with a low unit value. Indeed, in most Italian regions, the production of wood for fuel is the predominant activity (more than 60% of all wood used). The drop in the demand for wood, which occurred at the end of the 60's and in the 70's, was followed by a significant revival of consumption, which has remained strong through to the present. In 1999 the amount of wood used for work was equal to 3.9 Mm^3, of which almost 75% consisted of wood from leaf-bearing trees whose main utilisation was as round wood for sawing, shearing and plywood (Table 2.4.17). Poplar planting, which covers almost 2% of the wooded surface area, provides an average of roughly half the national production of wood used for work.

The surface area annually subjected to use is less than 2% of the total forested area. The average size of the cutting operations, influenced by the regional or provincial regulations that set limits of the size of cutting operations in continuous and/or contiguous forest areas, is approximately one hectare.
The wood cut and collected involves approximately 22% of the increase in managed forests. The wood waste left in forests following utilisations represents a negligible percentage of the entire mass cut down (4%).

Economic data
Gross sellable production provided by Italian forests is around 1.0 trillion Lire. Italy is the largest exporter of

Table 2.4.17 - Uses of wood in Italy. Figures are for 1999 and are expressed in thousands of cubic metres.

Product	Fir	Leaf-bearing	Total
Wood for fuel	370	5,607	5,977
Round wood for sawing, shearing and plywood	641	1,375	2,016
Wood for railway ties	0	18	18
Wood for hewn boards	48	12	60
Wood for paste and panels	138	797	935
Large and small posts for supporting mines	76	410	486
Other assorted wood for work	161	255	416
TOTAL	1,434	8,475	9,909

Source: ISTAT

Table 2.4.18 - Distribution of forested surface area by altitude

	Surface area (ha x 1,000)			
Year	**mountain**	**hill**	**plain**	**total**
1990	4,048.1	2,376.4	335.6	6,760.1

Source: ISTAT

furniture in the world, with a volume of business of approximately 70 trillion Lire yearly (source: the Federlegno Wood Manufacturers Association).

Observations
A general analysis shows that more than 70% of woods are found on mountains and high hills, while fewer than 25% are found in plains areas, with these being primarily specialised poplars (Table 2.4.18); the bulk of woods consist of sprout trees, which, despite the numerous conversions to high trunk made on publicly owned land, still dominate the Italian forestry sector. Given that Italian woods supply materials of scarce worth (sprout trees), while the woods themselves are founds on surfaces that are hard to reach (mountains), they often have a low brush value, which can make their use unprofitable.

Until such time as a detailed national forestry inventory can be performed, the data presented illustrate only the rough dimensions of the parameters. In particular, the official statistics for the amount of wood collected should be considered underestimates (ISTAT).

2.4.7 Waste

2.4.7.1 Production and collection of municipal waste
Recent estimates [1] show the production of municipalwaste (MW) in Italy to be approximately 28.4 Mt/a (figure for then year 1999), corresponding to daily per-capita production of approximately 1.35 kg (492 kg per capital on an annual basis). Of these, 3.71 Mt/a (13.1 %) are subject to separate collection, making for sizeable increase over previous years, though the level is lower, in terms of absolute value, than the minimum objective of 15% set under Legislative Decree 22/97 (the "Ronchi Decree") for the year in question.
Based on the recorded data available for recent years (1996-1999), a significant growth trend can be observed in both production and in the fraction collected separately, as is illustrated in detail on table 2.4.19.

2.4.7.2 Management of urban waste

Of particular interest are the different approaches to handling MW,
Which can be summarised as follows:
- composting of the selected organic portion;
- mechanical-biological treatment of the fraction collected in an undifferentiated mode (RDF, refuse derived fuel/bio-stabilised production);
- incineration, with or without recovery of energy;
- other forms of recovery (primarily mechanical treatments geared towards the recycling and recovery of materials generated by separate collection);

Table 2.4.19 - Production and collection of MW

Year	*Production*	*Separate Collection*		
	(Mt/a)	**(Mt/a)**	**(%)**	**Objectives of Legislative Decree 22/97**
1996	26.0			
1997	26.6	2.51	9.4	
1998	26.8	3.0	11.2	
1999	28.4	3.7	13.1	15 %
2000	29.0 (1)			
2001				25 %

Source: APAT [1]
(1) Estimated figure

Table 2.4.20 - Management of urban waste

Treatment	1997		1999	
	Mt/a	%	Mt/a	%
Composting	0.60	2.3	0.84	2.9
Mechanical-biological treatments (1)	1.89	7.1	2.37	8.4
Incineration (2)	1.75	6.6	2.13	7.5
Other forms of recovery (3)	0.3	1.2	2.1	7.4
Non calculable	0.8	2.9	—	—
Controlled landfill	21.26	79.9	21.0	73.8
TOTAL	26.6	100	28.4	100

Source: ENEA processing of APAT data [1]

(1) Selection, production RDF/bio-stabilised, other treatments
(2) Source: Federambiente [3](3) Primarily mechanical treatments meant for the recycling of materials

Table 2.4.21 - Production of energy from the combustion of MW

	1997	1998	1999
Operating plants:	38	41	42
with energy recovery	23	26	27
Total waste treated, Mt/a	1.75	1.98	2.13
Waste treated in plants with recovery (1), Mt/a	1.18	1.41	1.77
Installed electrical power, MWe	95	168	175
Electricity produced. MWh	281 911	394 600	421 900
Thermal energy produced, MWh	152 832	166 000	200 000

Source: ENEA processing from various sources [1] [3] [4] [5]
(1) Recovery of electric and/or thermal energy

- disposal at controlled landfills.

Based on the APAT figures [1], the updated situation is summarised on table 2. 4.20[1]

The recovery of energy through the burning of waste

According to the latest, which regarded the situation as of the end of 1999, there were 42 plants for the burning of MW in operation in the national territory, as is shown on table 2.4.21, which also lists the quantities treated and the levels of electric and thermal energy recovered during the period 1997-99.

In 1999, in particular, the electricity produced from MW combustion totalled approximately 422 GWh/y (with an installed electric power of approximately 175 MWe), while the thermal energy recovered (in the form of steam and/or hot water) was slightly more than 200 GWh/y; the corresponding overall recovery was estimated at approximately 11% of the energy content of the MWtreated through incineration.

The recovery of energy from the combustion of biogas

The capture of the biogas that is released from controlled landfillsf or organic waste, required under the law for environmental reasons, has favoured the recovery of energy from biogas in recent years, partly thanks to the economic incentives[2] provided for the production of electricity from alternative sources.

The majority of biogas, in fact, is used for the production of electricity (mainly by means of endothermic motors with a variable power of from 30 kW to 1 MW) and, to a lesser extent, for thermal uses involving the heating of buildings, greenhouses or other facilities.

[1] These data were derived from the quantities treated in the individual types of plants and do not necessarily coincide with the data on production, which often comes from different sources.

[2] In the past, Deliberation no. 6/92 of the CIP (valid through December of 1996); at present, the "green certificates ".

Table 2.4.22 - Production of energy from biogas at landfills

	1997	1998
Plants installed	58	79
Installed electric power, MWe	90	116
Electricity produced, MWh (1)	320 040	478 800

Source: ENEA [5]

Production with generator units connected with Diesel units makes it possible to obtain, especially in medium-large size installations, systems of exploitation with the characteristics of modular design and flexibility needed to handle the variations in the production of biogas over time while guaranteeing greater availability in the event of breakdowns or maintenance.
It should be emphasised that almost all (approximately 97%) of the energy production is the result of biogas captured at MWlandfills, while other applications (sludges from water treatment, animal detritus, residues from the agro-food industry etc.) play a very marginal role.
In terms of the energy recovered from MWlandfills, the main data available (number of plants, installed power and gross production of electricity) are summarised on table 2.4.22.

2.4.7.3 Production of special waste
The data on the production of special waste (SW) for the year 1998 were provided by APAT [1], essentially on the basis of the declarations (MUD) made under the provisions of Law 70/94, appropriately upgraded to guarantee greater reliability of the data, in this way reducing, to as great an extent as possible, the use of supplementary estimates.

In defining the quantity of wastes produced, there is a large margin of uncertainty regarding the actual magnitude of the inert waste, the production of which is calculated at 6.3 Mt, according to the MUD data, a figure a good deal lower than that arrived at using the method adopted on the European level, which produced an estimate of 20 Mt..

Given that the second figure appears to be more realistic, it can be used as a reference, with the result that the production of SW in Italy for the year 1998 is that shown in abbreviated form on Table 2.4.23, which also contains the figures for the year 1997.

2.4.7.4 Management of special waste
Significant discrepancies can be observed between the data for production and those for management, based on the contents of the last report by the APAT [1]. This is due to a whole series of reasons, among which, without going into detail, mention should be made of the uncertainty regarding the quantities of waste subjected to recovery and/or disposal abroad,

Table 2.4.23 - Production of special waste (Mt/a)

	1997	1998
Non-dangerous special waste (RSNP)	36.7	43.76
Dangerous special waste (RP)	3.4	4.06
Inert special waste (RI)	20.4[1]	20.0
Non-determined special waste (RSND)	0.41	0.21
TOTAL	60.9	68.0

Source: ENEA processing of APAT data [1] [6]
(1) Figure for wastes from construction and demolition

Table 2.4.24 - Management of special waste (Mt/a)

Treatment	1997[2]		1999	
	Mt/a	%	Mt/a	%
Composting	0.94	2	3.44	6.1
Recovery of materials	12.2[1]	26[1]	19.25	34
Recovery of energy	—	—	1.06	2.0
Incineration	0.94	2	0.82	1.5
Other treatments	11.7	25	9.4	16.7
Controlled landfills	21.0	45	22.4	39.7
TOTAL	46.8	100	56.4	100

Source: ENEA processing of APAT data [1]

(1) Overall figure for recovery of matter and energy
(2) Estimated figures

the scarce standardisation of management operations other than incineration and disposal into landfills (i.e. placement in reserve, preliminary deposit etc.) and the introduction of simplified procedures for waste recovery (Ministerial Decree of 5 February 1998), all factors that result in a situation where the recording of the quantities of waste managed leads to lower figures than those for waste produced.
The different forms of management of special wastes are summarised in the list that follows, which includes the respective operations of recovery and disposal for reference, as these are identified in appendices IIA and IIB of Directive 91/156 on waste[3]:
- composting of biodegradable organic matrixes (R3)
- recovery of materials (from R2 to R11);
- recovery of energy (R1);
- incineration, with or without the recovery of energy[4] (D10);
- other forms of recovery (biological treatments (D8), chemical-physical treatment (D9), etc.);
- disposal at a controlled landfills(D1, D5, D12).

The available for the abovementioned forms of data, taken from the last report by APAT [1], are summarised on table 2.5.24[5].

Looking at the year 1998, there was total management, at the treatment and disposal installations, of 56.4 Mt of MW, making for a difference of 11.6 Mt compared to total production (68.0 Mt)[6], the equivalent of a "correspondence" percentage of 83%.

2.5 Figures on national greenhouse gas emissions and international comparisons

2.5.1 The slow improvement in energy efficiency

The most comforting figure in the Italian energy outlook is the low ratio between the consumption of energy and the gross national product, equal in 1999 to 71.6 toe/MldLit at 1995 prices. This figure is slightly higher (3%) than the average for the member countries of the European Union. Nevertheless, it should be pointed out that Italy's energy efficiency is only in part the result of direct policies for investments in technology and the rationalisation of energy uses. The key factors in Italian energy intensity are structural in nature: the historic lack of energy, which has favoured the establishment of forms of behaviour and infrastructures that are parsimonious in the use of energy, together with a production structure that is not an omnivorous consumer of energy; then there is the high level of taxation, which, in the past, has consistently raised the cost of energy sources to the final user well beyond the figures typically found in other countries; plus the low per-capita income, the relatively mild climate and the high population density, which tends to shorten the average length of travel.
The drop in intensity which took place in the years immediately following the peak figure, which was reached in 1973, after strong growth in the 50's and 60's, was, on the whole, more pronounced

[3] Definitions employed, in the national level, by Legislative Decree 22/97 (appendices B and C).
[4] No data are available on the actual magnitude of energy recovery, which, in any event, proves to be quite limited.
[5] These data were arrived at on the basis of the quantities treated under the specific form of management, and they do not necessarily coincide with the data for production, given that the latter often come from a different source.
[6] It should also be remembered that this overall production figure includes a fairly significant estimated value (20 Mt) for the production of inert special waste.

Table 2.5.1 - Total final consumption of energy per unit of GNP

	Index 1995=100					*toe/1000 $USA*
	1995	**1996**	**1997**	**1998**	**1999**	**1995**
Austria	100	103	103	102	100	0.09
Belgium	100	109	105	105	102	0.13
Denmark	100	102	96	93	91	0.09
Finland	100	98	96	95	92	0.18
France	100	102	100	101	99	0.10
Germany	100	103	100	98	95	0.10
Greece	100	107	106	109	105	0.14
Ireland	100	97	93	91	88	0.13
Italy	100	100	99	100	101	0.11
Norway	100	97	92	94	94	0.13
Netherlands	100	101	96	92	89	0.14
Portugal	100	101	103	107	108	0.13
United Kingdom	100	103	97	95	94	0.12
Spain	100	98	100	102	101	0.15
Sweden	100	102	98	94	91	0.07
Switzerland	100	102	99	100	100	0.14
USA	100	100	96	91	91	0.19
Japan	100	99	98	98	99	0.06
UE 15	100	104	102	101	99	0.11

Source: OECD

than the decrease in other industrial countries, being accelerated by the expulsion of production cycles with high levels of energy intensity.
The subsequent downward trend was less evident than in other countries, especially in the 80'. From 1985 onward, energy intensity remained almost constant (a decrease of less than 2%), as opposed to a decrease of 7% in the OECD as a whole and of 8% on the European level. Compared to the leading industrialised countries, Italy has margin for improving its energy efficiency.
What is more, the norms have proven to be difficult to apply, in what is a fairly unreceptive context. Law no. 308, designed to improve energy efficiency and the development of renewable sources, was not passed until 1982, and it was applied with significant delay compared to the actual needs, obtaining results that fell below expectations. The subsequent Law no.

Table 2.5.2 - Surface area, population and density of a number of countries –1999
(surface area in thousands of km²; population in thousands of inhabitants)

COUNTRIES			
	Surface area	**Population**	**Density**
France	552	60,156	109
Germany	356	82,087	231
Italy	301	57,646	192
United Kingdom	244	59,501	244
Spain	505	39,326	78
Canada	9,976	30,493	3
United States	9,363	272,996	29
Australia	7,713	18,937	2

Source: OECD

[7] The break-down of emissions into significant factors is performed on the basis of an extension of the Kaya formula (IPCC, SAR, vol. III, chap. 1, par. 1.3.3.1).

Table 2.5.3 - Per-capita emissions of CO2 and per-capita income in a number of countries (1995 and 1999)

COUNTRIES	Per-capita GNP ($1995)		Per-capita CO2 (kg)	
	1995	1999	1995	1999
Austria	29.228	31.896	8.428	8.156
Belgium	27.217	29.720	11.819	11.446
Denmark	34.508	37.343	13.064	10.712
Finland	25.313	30.358	16.355	12.391
France	26.179	28.220	6.918	6.719
Germany	30.104	31.713	10.770	10.472
Greece	11.249	12.597	7.511	9.398
Ireland	18.439	25.207	9.598	11.215
Italy	19.148	20.175	7.351	7.930
Holland	26.831	30.128	11.457	11.007
Portugal	10.830	12.312	5.607	5.812
Spain	14.894	17.032	6.612	7.129
Sweden	27.212	29.860	9.300	6.322
United Kingdom	19.223	21.079	9.567	9.008
UE 15	23.050	24.985	8.867	8.643
USA	27.895	31.457	20.948	19.996 *
Japan	40.913	42.279	9.587	8.918 *
OECD	23.207	25.103	11.823	11.505 *

Source: OECD; EEA; * For 1998.

10 of 1991 did not produce the forecast outcome on account of a lack of financing.

Looking at each of these economic sectors in detail it is possible to evaluate the contribution of national emissions of greenhouse gases resulting from the leading factors for each sector, distinguishing the latter from the global-type factors, such as population and income[7]. The national emissions figures, their past levels and possible developments for the future can be distinguished from those of other countries because the different values are shown by the factors which, more or less directly, are tied to the emissions or are capable of "explaining" them.

The position of Italy, in this respect, compared to the other member countries, can best be understood if two factors are separated: one of them extensive (the population and the income) and the other intensive (the emission intensities per-capita and by income).

2.5.2 A specific emissions

National CO_2 emissions accounted for 1.9% of worldwide emissions, with emissions of the three major greenhouse gases representing 1.6% of the total. Italy's percentage weight out of total world greenhouse gas emissions, therefore, is relatively low. What is more, the percentage weight of the emissions of the European Union out of the worldwide total (14.6% for CO_2 alone) is lower than that of the United States (above 20%). In other words, the efforts of the European Union to reduce emissions, and even more so national efforts, shall have little effect on the world level unless they are part of a coordinated effort on a broader, international scale enlarged to include developing nations as well (IPCC, TP4, 1997).

The weight of Italian emissions of carbon dioxide are more limited compared to those of other developed countries with equal levels of income and population (see Table 2.5.3): specifically, per-capita yearly emissions of CO_2 in Italy for 1999 were almost 8 tons, while the average value for the EU was approximately 8.6, that of the OECD approximately 11.5 and the United States approximately 20.

Italian CO_2 emissions represent 14.0% of the total for the European Union; if the three leading greenhouse gases are considered, then national emissions account for 12.3%. As can be seen in Figure 2.5.1, taken from chapter 3 of the Second National Communication, the percentage weight of total emissions in 1995 was lower than that of the population and of income, because the carbon intensity of the income and the per-capita emissions were lower than the average figures for the European Union, and in particular lower than those for the leading countries, meaning Germany and the United Kingdom. The situation remained fairly constant in subsequent years.

Figure 2.5.1 - Percentage weight and level of emissions of member countries per-capita and per carbon intensity of income.

Figure 2.5.1 a: Level of CO2 per-capita emissions and percentage weight of member countries (EU-15, 1990)

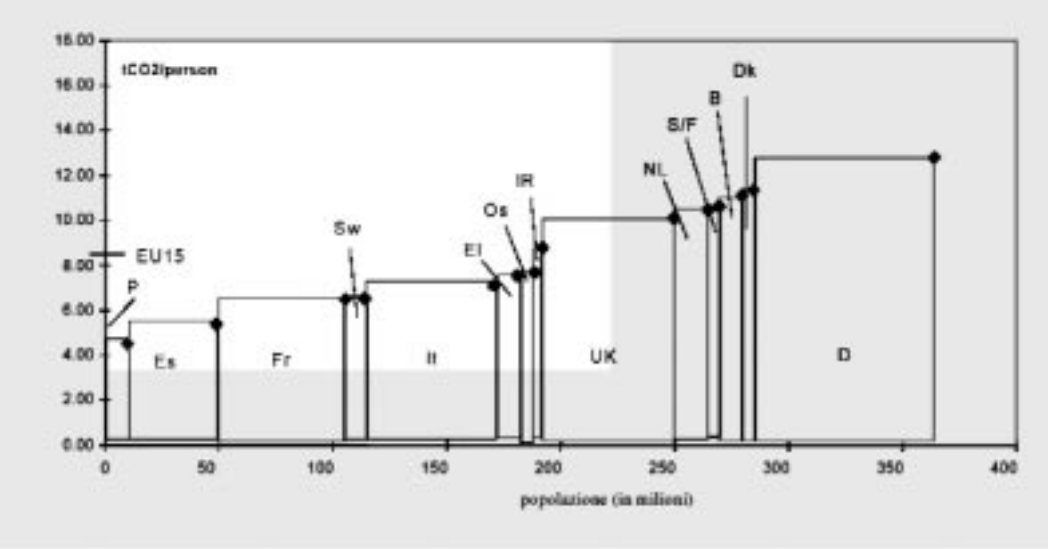
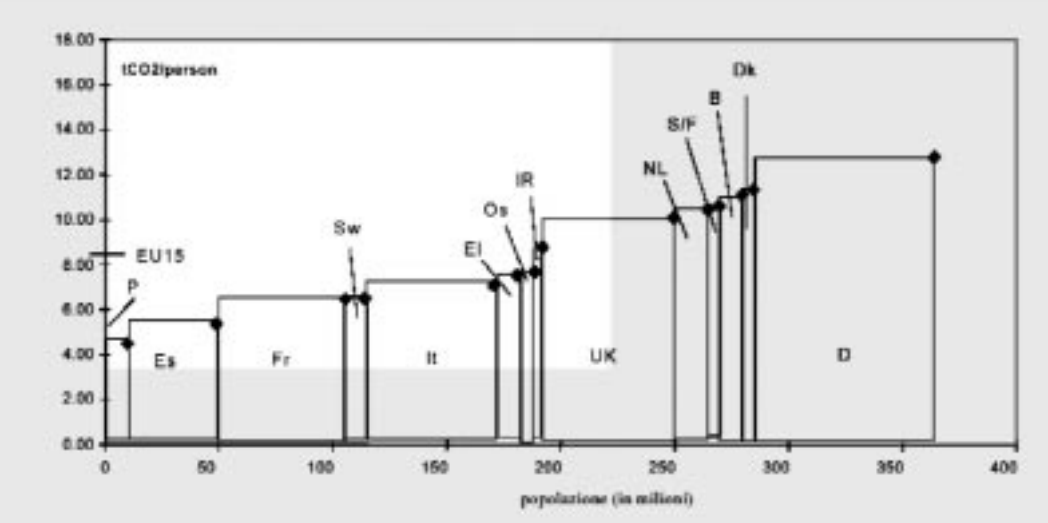


Figure 2.5.1 b: Weight and level of carbon intensity of income (EU-15, 1990)



2.5.3 Historic development of CO_2 emissions in the European Union

In 1999 the overall emissions of carbon dioxide on the part of the 15 member countries of the European Union – and the same holds for Italy – had fallen by 10% compared to the peaked levels registered in the early seventies, while the per-capita emissions dropped by 13% during the same period, and the carbon intensity of income fell by more than 40% (see Figure 2.5.2). In order to reduce the cost of energy, the dependency of their energy systems on petroleum and the risk of having supplies interrupted in the wake of the oil crises of 1973 and 1981, all the European countries made choices which resulted in a reduction of emissions, together with investments in a series of different technological options (energy efficiency, use of methane, nuclear power). In the most

Table 2.5.4 - Commitments of the member countries in accordance with article 4 of the Kyoto Protocol, based on the agreements reached by the Council of Ministers ("*EU burden sharing*", June 1998)

Member Country	Commitment (% change in emissions in the sampling of 6 greenhous gases for 2008-2012 compared to the base year)
Austria	-13
Belgium	-7.5
Denmark	-21
Finland	0
France	0
Germany	-21
Greece	+25
Ireland	+13
Italy	-6.5
Luxembourg	-28
Netherlands	-6
Portugal	+27
Spain	+15
Sweden	+4
United Kingdom	-12.5

Table 2.5.5 - Evolution of emissions of greenhouse gases expressed as CO_2 equivalent tons (excluding changes in uses of soil and forests) and the objectives of the Kyoto Protocol for 2008-2012

	1990 ($MtCO^2$ eq.)	1999 ($MtCO^2$)	change 1998 1999 %	change 1990 1999[1] %	Target 2008-20 under Kyoto Protocol and burden sharing %	Distance-to target indicato (ITI) index points %
Austria	76.9	79.2	0.0%	2.6%	-13.0%	8.5
Belgium	136.7	140.4	-3.4%	2.8%	-7.5%	6.1
Denmark	70.0	73.0	-4.6%	4%	-21.0%	13.5
Finland	77.1	76.2	-0.8%	-1.1%	0%	-1.1
France	545.7	544.5	-2.2%	-0.2%	0%	-0.2
Germany	1206.6	982.4	-3.7%	-18.7%	-21%	-9.3
Greece	105.4	123.3	-0.7%	16.9%	25%	5.7
Ireland	53.5	65.4	2.5%	22.1%	13%	16.3
Italy	518.3	541.1	0.9%	4.4%	-6.5%	7.3
Luxembourg	10.8	6.1	4.6%	-43.3%	-28%	-30.7
Netherlands	215.8	230.1	-2.9%	6.1%	-6%	8.8
Portugal	64.6	79.3	2.9%	22.4%	27%	10.2
Spain	305.8	380.2	6.1%	23.2%	15%	16.5
Sweden	69.5	70.7	-2.6%	1.5%	4%	-0.3
United Kingdom	741.9	637.9	-6.5%	-14.0%	-12.5%	-8.4
EU Total	4198.6	4029.8	-2.0%	-4.0%	-8.0%	-0.4

1) In the case of chlorofluorocarbons, the majority of the member countries chose a base year other than 1990 (specifically 1995), as was permitted under the Kyoto Protocol, In this report, however, the 1990 emissions were used for all the gases,

Source: EEA (2001)

Figure 2.5.2 a - EU15, emissions of greenhouse gas compared with the objectives for 2000 and 2008-2012 (excluding LUCF)

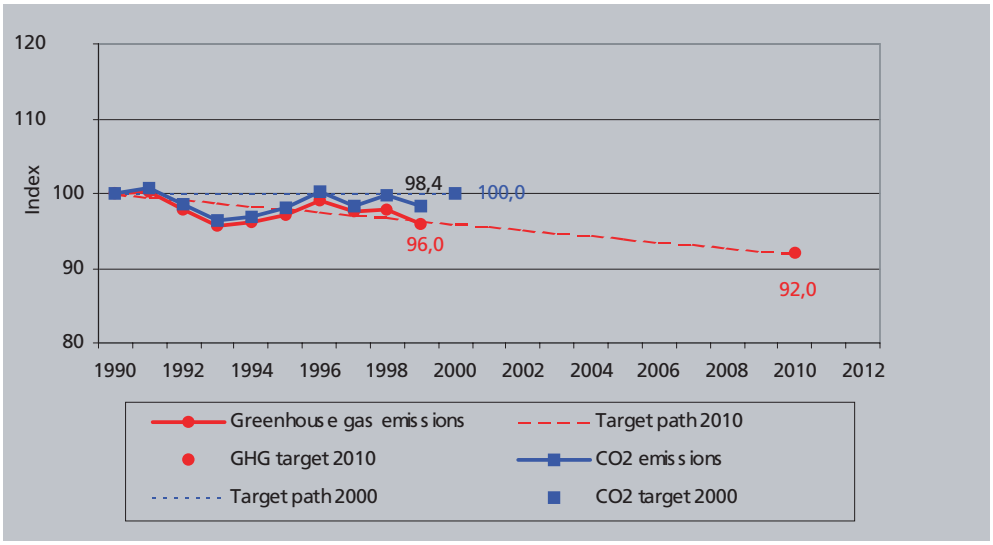
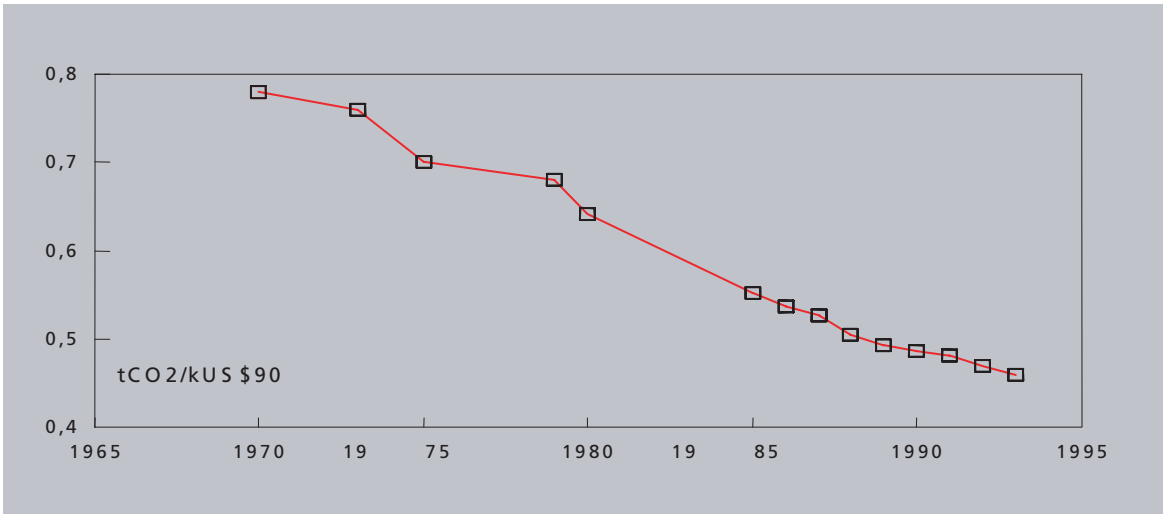


Figure 2.5.2 b - Carbon intensity of income: EU-15 average



recent years, the period of 1990-1999, carbon dioxide have decreased by 1.4% while total emissions of greenhouse gases have fallen by 4%.

With regard to the commitments made under the Kyoto Protocol by the individual European countries – see table 2.5.4 – the figures for emissions during the period of 1990-1999 are shown on table 2.5.5. The overall picture is multifaceted, with the situations of the different countries compared to their objectives varying from one nation to the next. The DTI, or Distance To Target Indicator, photographs the situation as of 1999, compared to the level at which emissions should have been in 1999, assuming they had followed a linear course from 1990 to 2010. The majority of the countries, including Italy, are fairly distant from reaching their objectives.

2.5.4 Evolution of specific CO2 emissions for a number of primary indicators in the European Union

The different countries of the European Union present highly diversified specific national characteristics in terms of industry and agriculture. In particular, the industrial structures can be considered reasonably complete only in the major states: France, Germany, Italy, the United Kingdom and Spain. Listed below are a number of national indicators of energy efficiency and some examples of the same indicator converted into emissions, though solely with regard to these five countries, in order to illustrate the Italian situation on the sector level. These indicators are drawn from a common databank, ODYSSEE, that is shared on the European level and operated in Italy by ENEA.

Though it is not easy to reach general conclusions from these comparisons, it is possible to identify with greater precision the sectors in which to act in order to implement the policies and measures, as well as the type of action to be taken. The indicators of a general nature are included for the sake of information, while those regarding the individual sectors are useful for organising the work to be done on the policies and measures. What is not always clear to the international analysts and negotiators, however, is that those countries which have invested in the reduction options no longer have that choice as a possibility, meaning that, in order to achieve further reductions, they must resort to more costly operations of mitigation.

2.5.4.1 General indicators

Primary energy intensity in Italy, calculated at constant 1995 prices, is located in an intermediate category: above France, Germany and the European average, but below countries such as Spain and the United Kingdom. This is a relatively new situation for Italy, which has historically had the lowest intensity of the European countries. It should be explained that this change in the country's relative position is due to a change on the year of reference for the calculation of the GNP at constant prices. In fact, the appreciation or depreciation of the different nationals currencies against the ECU during the period of 1990-1995 has led to changes in the rankings of the different countries in terms of primary or final energy intensity, without these changes being traceable to improvements or setbacks in energy efficiency (understood as technical efficiency, or the reduction of energy consumption per physical unit of product). Considering that the Italian Lira has depreciated by 40%, in terms of face value, against the ECU during the period of 1990-1995 (2,130 Lit/ECU in 1995, compared to 1,522 Lit/ECU in 1990), the Italian GNP expressed in ECU showed a drop (in other words, a loss in the economic value of Italian production), which was reflected in the performance of the indicator of intensity calculated per unit of GNP. Vice versa, other countries, such as France and Germany, have seen their exchange rates with the ECU appreciate, with the result being a better energy-intensity performance than other countries. The introduction of the Euro, with its fixed exchange rate of 1,936.27 Lire, will make these relative performance patterns, in the near future, rather similar to those presented. Naturally the differences between one year and the next for the same country are not affected by this factor.
The primary energy intensity in Italy has proven to be relatively stable, showing a slight rise in the last two years, growth which can also be observed in Spain. France and the United Kingdom, on the other hand, reduced their intensities by a yearly rate of approximately 2% during the period of 1996-1999, while the Germany registered a decrease of nearly 2.5%. The European Union followed a similar trend, showing a reduction of approximately 2% yearly.

The indicator of primary energy intensity for the European Union decreased by 2.2% in 1999, compared to 1998, showing a trend that clearly ran contrary to that followed by the national indicator (+0.5%). Since 1990, the primary energy intensity of the European Union has fallen by 13.6%, at an annual rate of –1.5%.
The plan of action for improvement of the energy efficiency of the European Community, presented in 2000, set the goal of reducing primary energy intensity at a yearly rate of 1% through 2010, with the intention being to contribute in this way to reducing emissions of CO_2. Italy still appears to have a long way to go before reaching its goal, as shown by the annual rate of decrease of –0.1% registered from 1990 to 1999.
Underlying the variations in the indicators of energy efficiency are differences in the production structures of the various countries (greater or less percentage weight of an energy-intensive industrial sector, the relative weight of the transport sector) and the differences in the types of structures used to generate electricity. The differences in the relative percentage weights of the various industrial and service sectors in the makeup of the GNP of each country translate into variations in the indicators of final intensity, while differences in the structure used to generate electricity (greater or lesser percentage weight of hydroelectric generation and of renewable sources, as well as the question of whether or not there is nuclear power) are reflected in variations of the indicators of primary intensity. A number of countries, such as the United Kingdom, Spain, Greece, Germany and Denmark, produce more than 30% of their respective electricity with coal-fuelled thermoelectric plants, which present a lower average yield than plants that utilise other sources. The use of natural gas in combined-cycle plants can raise the average yield to 51%, compared to a yield of 35/36% for a coal plant. Even a greater or lesser use of natural resources for the generation of electricity (primarily hydroelectric, though also geothermal, wind-powered etc.) can lead to the differences observed from one country to the next.
In Italy the process of reducing primary intensity has also been slowed by the fact that, in the 90's, the price of oil was, on the average, lower than it was in the 80's, in addition to which impact of the oil crisis of the 70's had diminished over time.

To eliminate, at least in part, the effect of the exchange rate on the calculation of the indicators, the so-called indicators of energy intensity at purchasing power parity are calculated (constant 1995 prices);

Table 2.5.6 - Primary energy intensity (kep/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.205	0.210	0.216	0.209	0.208	0.204
Germany	-	0.204	0.209	0.205	0.199	0.194
Italy	0.215	0.214	0.212	0.211	0.212	0.213
Spain	0.229	0.236	0.231	0.236	0.242	0.243
United Kingdom	0.269	0.255	0.263	0.262	0.258	0.252
UE	0.235	0.211	0.215	0.210	0.208	0.203

Source: ODYSSEE

Table 2.5.7 - Primary energy intensity at purchasing power parity (kep/ECU95p).

	1990	1995	1996	1997	1998	1999
France	0.224	0.229	0.236	0.228	0.227	0.223
Germany	-	0.242	0.248	0.243	0.236	0.230
Italy	0.172	0.171	0.170	0.169	0.170	0.171
Spain	0.189	0.195	0.191	0.195	0.200	0.201
United Kingdom	0.234	0.222	0.228	0.228	0.225	0.219
EU	0.235	0.211	0.215	0.210	0.208	0.203

Source: ODYSSEE

Table 2.5.8 - Final energy intensity (kep/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.126	0.125	0.125	0.125	0.123	0.120
Germany	-	0.118	0.122	0.119	0.115	0.111
Italy	0.138	0.137	0.137	0.135	0.137	0.139
Spain	0.145	0.149	0.149	0.147	0.150	0.149
United Kingdom	0.179	0.172	0.178	0.167	0.166	0.164
EU	0.151	0.136	0.140	0.136	0.134	0.132

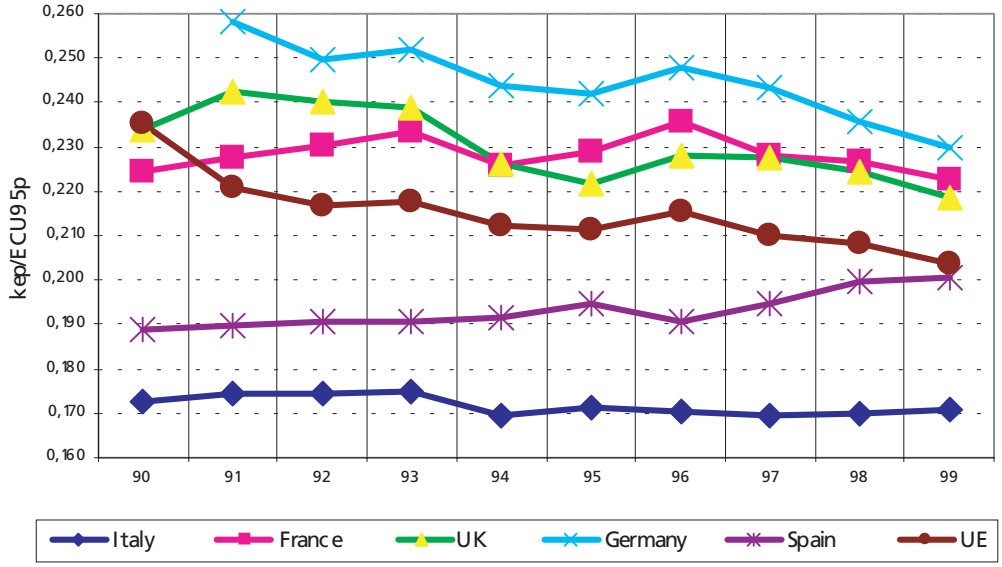
Source: ODYSSEE

Table 2.5.9 - Final energy intensity at purchasing power parity. (kep/ECU95p).

	1990	1995	1996	1997	1998	1999
France	0.138	0.136	0.136	0.136	0.134	0.131
Germany	-	0.140	0.145	0.141	0.137	0.132
Italy	0.111	0.110	0.110	0.108	0.110	0.111
Spain	0.120	0.123	0.123	0.122	0.124	0.123
United Kingdom	0.156	0.149	0.154	0.145	0.144	0.142
EU	0.151	0.136	0.140	0.136	0.134	0.132

Source: ODYSSEE

Figure 2.5.3 - Primary energy intensity at purchasing parity



these prove better suited to carry out a comparative analysis of the countries, given that they more effectively reflect the value of goods and the services of the individual nations. Seen in this perspective, the primary intensity of Italy, with purchasing power being equal, proves to be the lowest of the countries of the EU, raking below those of France and England by an average of 30%.

Final intensity fell throughout Europe during the 80's and 90's as a result of the noted structural changes that took place in the economies of the different countries, traceable to abandonment of industries with high levels of energy intensity in favour of other less intensive ones, as well as the shifting of the focus of the economy in the direction of the service industries and the reduction of the percentage weight of basic industries, plus dematerialisation of the economy. In the case of Italy, these developments have been counterbalanced by the relative growth of the transport sector.

Looking at the final energy intensity with purchasing power parity, on table 2.5.9 and figure 2.5.4, Italy presents the lowest values, which are 20% below those of France and Germany in 1999.

Figure 2.5.4 - Final energy intensity at purchasing power parity

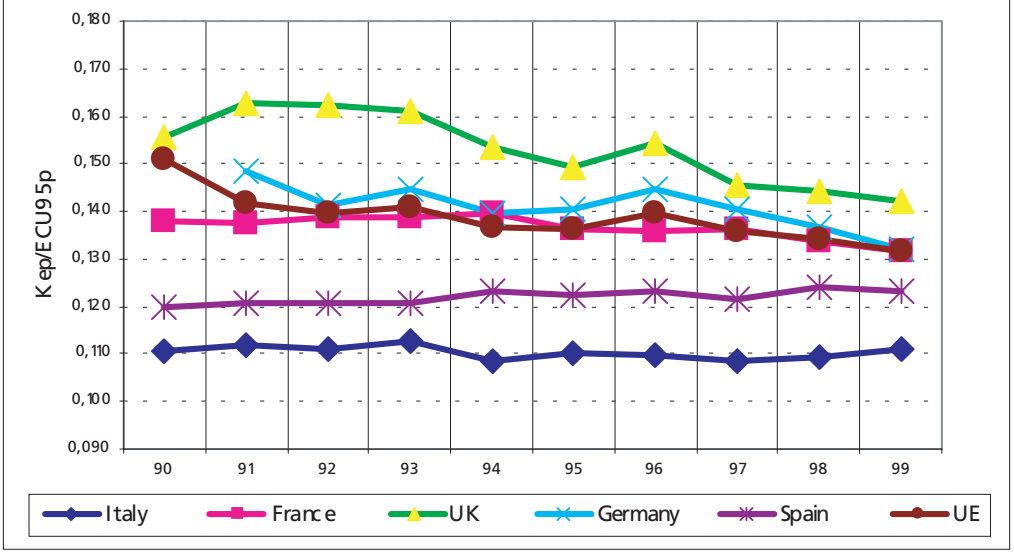


Table 2.5.10 - Energy intensity of industry (koe/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.162	0.162	0.165	0.169	0.170	0.168
Germany	-	0.109	0.110	0.109	0.107	0.106
Italy	0.162	0.156	0.153	0.156	0.155	0.153
Spain	0.149	0.144	0.140	0.144	0.138	0.128
United Kingdom	0.144	0.136	0.129	0.123	0.123	0.126
EU	0.139	0.137	0.135	0.136	0.131	0.135

Source: ODYSSEE

2.5.4.2 Indicators for the industrial sector

Two types of indicators can be found in this sector: that for energy consumption compared to value added (energy intensity, directly proportionate to the emissions of greenhouse gases) and the technological indicator of specific consumption for the levels for the production of certain materials.

The first type of indicator is calculated for the industry as a whole and for the sectors of steel, non-ferrous metals, chemicals and paper. These data accurately reflect the overall performance of the area to which they refer; in recent years they have presented a generally downward trend, being tied to the monetary values of the merchandise, in addition to incorporating any changes in production (fore example, a switch from basic chemistry to "refined" chemistry with a higher value added and lower levels of energy consumption).The indicators for the individual sectors reflect the structure of the industrial area to which they refer, meaning that they also signal whether or not energy-intensive operations are carried out. In terms of the international comparison of these indicators, their performance over time is more important than their absolute value.

The second indicator refers to the physical results of production, calculated for the sectors of steel, cement, steel production and paper. Ongoing developments in specific consumption are tied to changes in the production process and in the energy efficiency of the procedures. In this second case, the international comparison is much easier and mote direct.

The energy intensity of the industrial sector in Italy shows a constant reduction throughout the 1990's: -5.4% during the period 1990-1999 (for an average annual rate of –0.6%), with the decrease concentrated in the first five years of the period, followed by essential stability in the years 1995-1999.

This noteworthy performance by Italian industry follows the general trend towards an improvement in energy efficiency registered by all the EU countries in the 1980's. In those years, countries such as France, Italy and Austria registered improvements of more than 30%. In the 1990's, on the other hand, the reductions were more limited (-2.7% for the EU in the period 1990-1995), with a number of countries actually showing growth (+3.5% in the case of France).

In Italy, the reduction in the energy intensity of industry as a whole was the result of a variety of performance results within the sub-sectors during the period 1990-1999:

- reduction of 20% for the metallurgy industry
- reduction of 17% for the chemical industry
- reduction of 11% for the industry of non-metal minerals, meaning bricks, cement, mortar, plaster etc..
- reduction of 15% for the paper industry (but with figures to be confirmed) and with a variation of -9% in 1999 compared to 1998.

Judging from this overview, together with the international comparison, there is little likelihood of a significant further reduction in energy intensity in Italy. A plausible forecast points to a decrease that essentially follows the performance of the GNP, which means that the physical consumption of fuels would remain more or less stable.

In terms of specific consumption (quantities of energy for tons of product), the official statistics have historically presented extremely competitive figures for Italy. The data show a decrease in the specific consumption in the production of steel and in the metallurgy industry following the major investments made in the 1990's, together with a situation of essential stability in the production of cement and paper. Comparisons on the international level following a differentiated pattern, showing levels of consumption that are fairly limited in the sectors of steel and metallurgy, while those for paper and cement would still appear to hold margins for improvement, especially in France.

In any event, notice should be taken of the complete lack of accurate statistical research on specific consumption in our country. The figures shown are taken from the available statistics, while more in-depth research was initiated in 1999: the figures from a

Table 2.5.11 - Energy intensity of the metallurgy industry. (koe/ECU95).

	1990	1995	1996	1997	1998	1999
Germany	-	1.09	1.07	1.07	1.07	1.09
Italy	0.36	0.33	0.30	0.31	0.30	0.29
Spain	2.36	1.88				
EU	1.19	1.08	1.06	1.07	1.01	

Source: ODYSSEE

Table 2.5.12 - Energy intensity of the chemical industry. (koe/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.42	0.37	0.36	0.34	0.36	
Germany	-	0.22	0.23	0.22	0.20	0.20
Italy	0.38	0.35	0.33	0.33	0.31	
Spain	0.53	0.68	0.62	0.80	0.67	0.46
United Kingdom	0.36	0.31	0.31	0.34	0.33	0.35
EU	0.30	0.23	0.22	0.21	0.20	

Source: ODYSSEE

Table 2.5.13 - Energy intensity of the non-metallic minerals industry. (koe/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.48	0.41	0.41	0.41	0.43	0.48
Germany	-	0.41	0.44	0.44	0.43	
Italy	0.53	0.48	0.46	0.47	0.48	0.53
Spain	0.86	0.69	0.77	0.83	0.84	0.86
United Kingdom	0.53	0.47	0.50	0.42	0.41	0.53
EU	0.52	0.46	0.47	0.46	0.44	0.52

Source: ODYSSEE

1999 ENEA-MAP-ISTAT survey on energy consumption were cross-analysed ISTAT data on production, generating results that contrasted to a significant extent with what had been known up to that point: it appeared that 20% more toe were needed to produce a ton of cement than was the case in other countries. It should be noted that the so-called non-conventional fuels were taken into consideration in the case of Italy, though they had not been calculated for the other countries. All the same, that indicator, when recalculated for Italy, shows a reduction for the 1990's (approximately -2%).

In conclusion, the industrial has shown, both taken as a whole and in many sub-sectors, improvements in energy efficiency over the last ten years, while there should also be small but relevant possibilities for improvement in the processes of a number of sub-sectors.

2.5.4.3 Indicators for the transport sector

The energy intensity of the transport sector, calculated in terms of the GNP, rose by no less than 6.5% in the period 1990-1999, making for an average annual

Table 2.5.14 - Energy intensity of the paper industry. (koe/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.22	0.25	0.25	0.23	0.24	
Germany	-	0.15	0.14	0.14	0.15	0.15
Italy	0.18	0.21	0.22	0.23	0.22	0.20
Spain	0.28	0.36	0.34	0.35	0.35	0.33
United Kingdom	0.12	0.12	0.12	0.12	0.12	0.12
EU	0.19	0.17	0.17	0.17	0.17	

Source: ODYSSEE

Table 2.5.15 - Energy unit consumption for the production of steel.
(toe/tons of steel produced).

	1990	1995	1996	1997	1998	1999
France	0.42	0.40	0.38	0.36	0.35	
Germany	-	0.36	0.37	0.34	0.35	0.35
Italy	0.29	0.28	0.29	0.28	0.27	0.26
Spain	0.38	0.27	0.27	0.22	0.19	0.18
United Kingdom	0.46	0.48	0.48	0.48	0.50	0.50
EU	0.36	0.35	0.35	0.34	0.33	

Source: ODYSSEE

Table 2.5.16 - Energy unit consumption for the production of cement.
(toe/tons of cement produced).

	1990	1995	1996	1997	1998	1999
France	0.08	0.08	0.09	0.09	0.09	0.09
Germany	-	0.08	0.08	0.08	0.07	0.06
Italy	0.10	0.11	0.10	0.10	0.10	0.10
Spain	0.09	0.08	0.09	0.08	0.08	

Source: ODYSSEE

rate of +0.7%. This positive performance in Italy for the 1990's contrasted with the way the indicator evolved in other countries, such as the United Kingdom (-8%), Denmark and the EU as a whole (-5%), where an average annual reduction of 1% was recorded. It should be specified, however, that the indicator for the energy intensity of the transport sector, calculated in terms of the GNP, would not appear to be the most suitable indicator for analysing improvements or deteriorations in the energy efficiency of the sector, given that the annual variation in the GNP is the result of a large number of factors, above and beyond those related to increased traffic.

In analysing the specific characteristics of the different countries, consideration should be given to the fact that, as is commonly known, there is a direct relationship between increased economic activity in the fundamental production sectors (agriculture and industry) and increased freight and cargo traffic. What is more, the Italian economy has shown itself to be

Table 2.5.17 - Energy unit consumption for the production of paper.
(toe/tons of paper produced).

	1990	1995	1996	1997	1998	1999
France	0.28	0.26	0.27	0.25	0.26	–
Germany	-	0.31	0.30	0.28	0.28	0.28
Italy	0.32	0.35	0.36	0.35	0.33	0.31
Spain	0.42	0.50	0.49	0.51	0.50	0.47
EU	0.30	0.30	0.30	0.29	0.28	–

Source: ODYSSEE

increasingly open towards the EU, the problem being that Italy, in addition to a geographic and topographical layout that differs from the rest of the European countries, finds itself, together with a number of other nations, such as Spain and Greece, in an outlying geographic position compared to the centre of gravity of Europe, placing it at a disadvantage in terms of the trading of products on the European market, compared to countries such as Denmark, Belgium, France and Germany, in addition to increasing traffic and creating a situation in which the merchandise is forced to travel longer average distances.
The increase in energy intensity, however, is not due solely to freight traffic, but is the result of the combined effect of this factor with the marked, and as yet unchecked, increase in the pool of circulating motor vehicles (from 27.4 million in 1990 to 32.0 million in 1999), together with the parallel rise in the average annual distance travelled by the vehicles (from 11,040 km in 1990 to 12,985 km in 1999). When these elements are taken together, they more than offset the improvements and reductions in specific consumption, both that of cars and of heavy vehicles.

Additional information that helps explain the ongoing development of the energy efficiency of the sector emerges from special indicators of energy consumption by vehicles, such as the consumption per motor vehicle or consumption per ton or merchandise transported.
Taking, for example, the average specific consumption of new cars sold in a given country (calculated as the weighted average of vehicles fuelled by gasoline and those operated with diesel fuel), in the case of Italy a reduction of approximately 4% for the period 1990-1999 is observed (the indicator goes from 7 l/100 km to 6.7 l/100 km; with this last figure representing the average of 6.9 l/100 km for new gasoline vehicles and 6.3 l/100 km for new diesel vehicles). When this indicator is compared with the figures for the other countries of the EU, Italy shows the lowest levels for the entire period, with the average consumption of new vehicles sold in Italy during the 1990's proving to be roughly 5% less than the EU average. This is due to the fact that newly registered cars in Italy have smaller engine displacements and reduced levels of specific consumption compared to those of other countries as well as to the EU average. This difference can also be observed in terms of the specific consumption of the current stock of motor vehicles, which, though it is moving towards a higher average engine displacement, still presents the lowest levels (7.1 l/100 km in 1999, compared to the EU average of 7.8 l/100 km).

Table 2.5.18 - Energy intensity of transport. (kep/ECU95).

	1990	1995	1996	1997	1998	1999
France	0.037	0.038	0.038	0.038	0.038	0.038
Germany	-	0.033	0.033	0.033	0.033	0.033
Italy	0.044	0.046	0.046	0.046	0.047	0.047
Spain	0.056	0.061	0.063	0.061	0.065	0.065
United Kingdom	0.061	0.059	0.060	0.058	0.057	0.056
EU	0.044	0.042	0.042	0.042	0.042	0.042

Source: ODYSSEE

Table 2.5.19 - Specific energy consumption of new cars (test values). (litres/100 km).

	1990	1995	1996	1997	1998	1999
France	6.52	7.13	7.06	7.05	6.88	–
Germany	–	7.42	7.84	7.77	7.54	7.41
Italy	7.00	6.80	6.70	6.78	6.74	6.74
United Kingdom	7.62	–	–	–	–	–
EU	7.59	7.60	7.49	7.39	7.26	7.05

Source: ODYSSEE

Table 2.5.20 - Specific energy consumption of cars (figures for overall stock). (litres/100 km).

	1990	1995	1996	1997	1998	1999
France	8.25	7.79	7.70	7.63	7.61	7.55
Germany	–	8.98	8.89	8.81	8.72	8.73
Italy	7.40	7.20	7.20	7.20	7.13	7.13
Spain	7.94	8.05	8.00	7.95	7.91	7.86
United Kingdom	9.28	9.20	8.80	8.78	8.52	8.75
EU	8.59	8.04	8.02	7.90	7.83	–

Source: ODYSSEE

Table 2.5.21 - Energy unit consumption of roadway transport of freight. (kep/tkm).

	1990	1995	1996	1997	1998	1999
France	0.085	0.085	0.084	0.086	0.086	0.087
Germany	–	0.052	0.053	0.050	0.051	0.048
Italy	0.056	0.056	0.056	0.056	0.051	0.049
Spain	0.051	0.050	0.051	0.051	0.050	0.052
United Kingdom	0.065	0.065	0.067	0.068	0.067	0.069
EU						

Source: ODYSSEE

The level of efficiency is also good in terms of the quantity of energy consumed for the freight transported, with the results proving to be in line with those of Germany and Spain.

To conclude, an analysis of the indicators shows that our country combines a relatively good level of energy efficiency with a growth rate in the demand for mobility which is exceptionally high, representing an anomaly compared to the other European countries.

In formulating a strategy to limit the emissions of freight transport, our country, given that the margins for improving the efficiency of the vehicles are fairly limited, and considering the need to compensate for the "geographic gap" with the other countries of Europe, should make significant investments in more efficient modes of transport. In the area of passenger transport, In the area of passenger transport, the prospects for expansion of the rail mode are equally noteworthy, especially in the case of systematic mobility in urban centres. In this case, there are also signifi-

Table 2.5.22 - Energy unit consumption of dwellings, corrected for the average European climate.

	1990	1995	1996	1997	1998	1999
France	2.26	2.19	2.15	2.14	2.15	2.16
Germany	–	1.49	1.45	1.60	1.55	1.51
Italy	1.87	1.79	1.83	1.82	1.88	1.84
Spain	0.89	1.02	0.99	1.04	0.99	1.01
United Kingdom	2.19	2.05	2.16	2.18	2.21	–
EU	1.80	1.71	1.72	1.75	1.76	1.76

Source: ODYSSEE

Table 2.5.23 - Energy unit consumption for heating by square meter, with climate corrections. (kep/m 2).

	1990	1995	1996	1997	1998	1999
France	15.1	14.5	14.2	13.7	13.6	–
Germany	–	17.8	16.7	17.4	17.8	–
Italy	10.9	9.7	10.0	9.9	10.2	9.8
United Kingdom	15.8	13.8	–	–	–	–

Source: ODYSSEE

Table 2.5.24 - Energy unit consumption for heating by square meter, corrected for average European climate. (kep/m 2).

	1990	1995	1996	1997	1998
France	16.6	16.3	16.0	15.3	15.2
Germany	–	12.7	12.0	12.4	12.7
Italy	15.3	14.5	15.2	14.8	15.3
United Kingdom	17.4	15.6	–	–	–

Source: ODYSSEE

cant margins for improvements in vehicle efficiency. Demand grows at such a quick pace that the only hope for limiting or reducing the increase in emissions in this sector over the long term is to use both options.

2.5.4.4 Indicators for the residential sector

Average energy consumption per dwelling in Italy usually ranks below the European average. This is largely due to the Mediterranean climate, which features higher average winter temperatures, meaning that homes have less need for heating. In fact, this indicator, on the average, falls roughly 20% below the EU average, near the levels of Spain and Greece. In order to compare the indicators for the different countries, the climatic differences must be eliminated by calculating indicators of energy intensity corrected for the average European climate, meaning that a calculation is made of the theoretical consumption which would occur in the different countries if they each had the temperatures registered as the average for the EU.

This corrected indicator shows that Italy has a level of consumption per dwelling similar to the average for the EU and higher that some much colder countries, such as Germany. In other words, there is room for further efforts at improving the energy efficiency of

Table 2.5.25 - Unit consumption of dwellings for lighting and electric appliances (kWh/dwelling).

	1990	1995	1996	1997	1998	1999
France	2,221	2,405	2,496	2,681	2,858	–
Germany	–	2,058	2,063	2,065	–	–
Italy	2,005	2,102	2,074	2,072	2,090	2,200
Spain	2,123	2,285	2,295	2,354	2,346	2,427
United Kingdom	2,727	2,662	2,659	2,661	2,781	2,427
EU	2,216	2,315	2,331	2,372	–	–

Source: ODYSSEE

Table 2.5.26 - CO_2 emissions in terms of gross thermoelectric production (grams of CO_2/kWh)

	1997	1998	1999
France	700	904	783
Germany	932	940	890
Italy	656	612	617
United Kingdom	745	705	658
EU	801	783	765
Canada	870	756	783
USA	939	995	925
Japan	644	495	630
World	957	951	905

Source: ENEL / GRTN

Note: the data differ slightly from those on table 2.4.3, where the methodologies used to estimate the emissions were those based on the national inventory, whereas tab. 2.5.26 was prepared with methodologies agreed to by the different electricity companies. The results on this table were left unaltered to facilitate the international comparison.

our homes.
During the 1990's, growth trends continued in terms of the average surface area of homes (from 93.1 m2 in 1990 to 97.5 m2 in 1998), the greater ambient comfort requested (resulting in higher average temperatures for winter heating - 20-22 °C instead of 18-20 °C – and more hours of heating), the development of air conditioning in the summer (often using heat pumps) - a trend which, in certain respects, undermines the advantage afforded by the milder winter climate compared to the countries of Northern Europe - and the growing number of home appliances used in dwellings, together with the more intensive use of these devices (two televisions turned on continuously, home computers, play-stations, cell phone recharging devices etc.). The factors in question lead the figure for the average consumption of electricity per dwelling in Italy from 2,005 kWh in 1990 to 2,200 kWh in 1999, for an increase of 10%. The peculiar nature of the price system blunted the thrust towards growth, which, without such restrictions, would have risen even higher. In fact, during the same period, countries such as France and the United Kingdom figures, in kWh/dwelling for lighting and for home appliances, that were roughly 30% higher than in Italy.

2.5.4.5 Indicators for the generation of electricity

Thermoelectric operations accounted for 78.7% of the electricity produced in Italy in 1999, while 19.6% came from hydroelectric plants or renewable sources and 1.7% from geo-thermoelectric sources. This makes Italy one of the EU countries that made the greatest use of thermoelectric production. As a result, CO_2 emissions in Italy for the production of electricity were fairly high: 486 gCO_2/kWh in 1999, compared to 398 gCO_2/kWh for the EU and 79 gCO_2/kWh for France (higher by approximately 22% and 515% respectively). This indicator does not give clear picture

Table 2.5.27 - CO2 emissions in terms of total gross production (grams of CO2/kWh)

	1997	1998	1999
France	58	96	79
Germany	598	617	571
Italy	524	489	486
United Kingdom	520	488	469
EU	406	405	398
Canada	198	214	214
USA	681	709	663
Japan	382	285	384
World	611	609	583

Source: ENEL / GRTN

Note: see the commentary on Table 2.5.26

of the current situation, however, in as much as it fails to take into account the structure of the generation of electricity in the individual countries.

The reason France shows such low levels of CO_2 per kWh is that 75% of its electricity is generated by nuclear plants and only 10% by thermoelectric operations. It is more appropriate, therefore, to establish the comparisons by using the indicator of CO_2 emissions calculated on the basis of thermoelectric production. Seen in this perspective, Italy presents a level of energy efficiency higher than that of other countries: it emits -21% less gCO_2/kWh than France, -31% less than Germany and -19% less than the EU. Proof of Italy's high level of energy efficiency is the fact that, even though countries such as Germany and Great Britain draw on nuclear power to generate, respectively, 31% and 26% of their electricity, Italy presents a better emissions/production ratio, even in terms of total production.

In terms of thermoelectric efficiency, Italy outperforms the leading non-European countries as well, though the same cannot be said for total production.

In light of the underlying conditions, further reduction of these figures would appear to be a very difficult task, though a great deal of progress has been made in this direction. The most important step has been the signing of a voluntary agreement on 20 July 2000 by the Ministry of the Environment, the Ministry of Production Activities and ENEL, with the latter, Italy's leading producer of electricity, voluntarily committing itself to reduce its emissions of CO_2 (by -20% within 2006). The main initiatives planned for the future point towards improvements in the energy efficiency and environmental efficiency of thermoelectric production, ongoing development of production from renewable sources, reductions in energy loss on the distribution network and increased energy efficiency in final uses. Other points in the agreement call for the organisation of international projects and exchanges of emissions rights (Emissions Trading).

Projects can be undertaken regarding the make-up of the primary sources used for thermoelectric generation: natural gas produces a lower quantity of CO_2, meaning that an increase in its percentage within the mix of fuels, with a corresponding decrease in oil products and coal, would have positive consequences (as was mentioned earlier in the text, in 1999 natural gas became the main source of primary energy for the production of electricity, though any further increase would seem to be restricted by structural obstacles).

Another area in which initiatives can be taken is the production of electricity from renewable sources. In 1999 there was an increase of 9.7% in production from renewable sources compared to 1999. Article 11 of Legislative Decree no. 79 of 16 March 1999 on the liberalisation of the electricity industry stipulates that, starting in 2002, producers and importers are required to supply to the national electricity system quantities of energy produced by new plants operated with renewable sources and equal to at least 2% of the thermoelectricity produced or imported in the course of the previous year. This requirement, which is not present in the other countries of the European Union, can also be met by purchasing from other operators the "green certificates" issued by the Manager of the National Transmission Network (GRTN) to certify production from renewable sources.

A number of elements on individual sectors were taken from the REA2001 – ENEA, which should be consulted for more in-depth information.

CHAPTER III
Greenhouse gas inventory information

3.1 Summary

National emissions of carbon dioxide (CO_2), which account for 84.7% of all greenhouse gas emissions in CO_2-equivalent, show an increase of 5.4% between 1990 and 2000. In the energy sector, in particular, emissions in 2000 were 6.7% greater than in 1990.
Emissions of methane (CH_4) and nitrous oxide (N_2O) account for 6.9% and 7.9% of the total CO_2-equivalent greenhouse gas emissions respectively. CH_4 emissions fell by 4% from 1990 to 2000, while those of N_2O increased by 5.9%.
Other greenhouse gases, including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), accounted for less than 0.5% of total CO_2 equivalent emissions; their contribution to overall GHG emissions is therefore still negligible, despite their increase from 1995 to 2000 (+78.4%).
In 2000, total greenhouse gas emissions, in CO_2-equivalent, were 5% above the base year levels, while the national target, in the frame of the European Union commitment, is a reduction of 6.5% by the period 2008-2012. Italy has decided to use 1990 as the base year for CO_2, CH_4 and N_2O, and 1995 for the fluorinated gases.

3.2 National System for preparing the Italian Greenhouse Gas Inventory

The Italian greenhouse gas inventory is compiled and updated annually by the National Environmental Protection Agency (APAT). The basic data needed to draw up the inventory are the energy statistics published in the National Energy Balance by the Ministry of Production Activities, industrial and agricultural production data published by the National Statistical Institute (ISTAT), statistics on transportation provided by the Ministry of Transportation, and data supplied directly by the relevant industrial associations.
Italy has not yet established a national system that provides the collection and transmission of the basic data needed for the inventory compilation within the time scheduled as well as determining and assigning roles and responsibilities to the various institutes that take part in the preparatory phases of the national greenhouse gases inventory.

3.3 Greenhouse gas emission trends

The emission figures presented in the Third National Communication are those reported to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and to the European Commission in the frame of the Monitoring Mechanism of greenhouse gas emissions. Emission trends are reported in the Appendix; more details are available on the web site www.sinanet.apat.it.
In agreement with the Convention on Climate Change, the National Greenhouse Gas Inventory is communicated through compilation of the Common Reporting Format.
This format provides more detailed information on emission estimates, including all basic data as well as estimation procedures to carry out the final emission values.
In 2000, the emission time series, from the year 1990 onwards, was updated. Such a revision is necessary on an annual basis in order to meet the requirements of transparency, consistency, comparability, completeness and accuracy explicitly set by the Convention. It should be noted that the emissions of the base year have changed from those reported in the Second Italian National Communication.
Regarding CO_2, the most significant changes were the result of a revision in the consumption statistics of maritime transport, with a shifting of consumption originally considered to be international

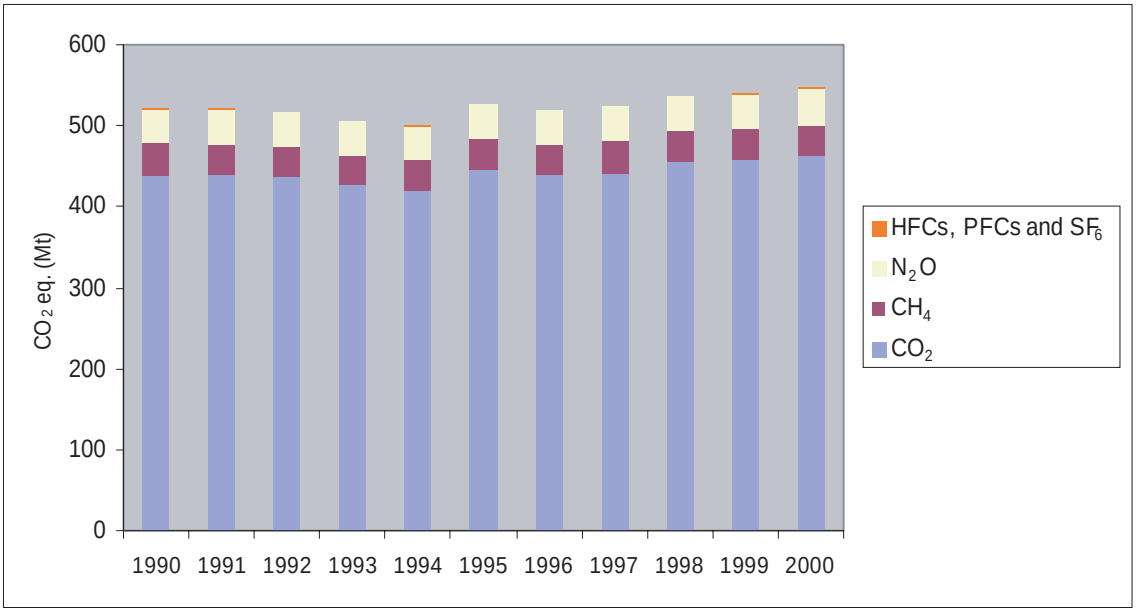
edited by: R. De Lauretis and D. Romano (APAT) - For § 3.4, S. Federici and R. Valentini (University of Tuscia), A. Lumicisi (Ministry For The Environment and Territory).

bunkers to the category of domestic shipping. Moreover, emissions from the production of geothermal energy have been revised on the basis of new documentation in which the current CO_2 emissions are estimated equal to the natural flows in those areas. For CH_4, the emissions factors previously utilised for compost production were revised. In the case of N_2O, the emission factors for electric power plants were corrected.

Further modifications in the time series concerned the updating of activity data and the use of the IPCC Good Practice Guidance. These revisions particularly had a significant effect on CO_2 emissions from lime production.

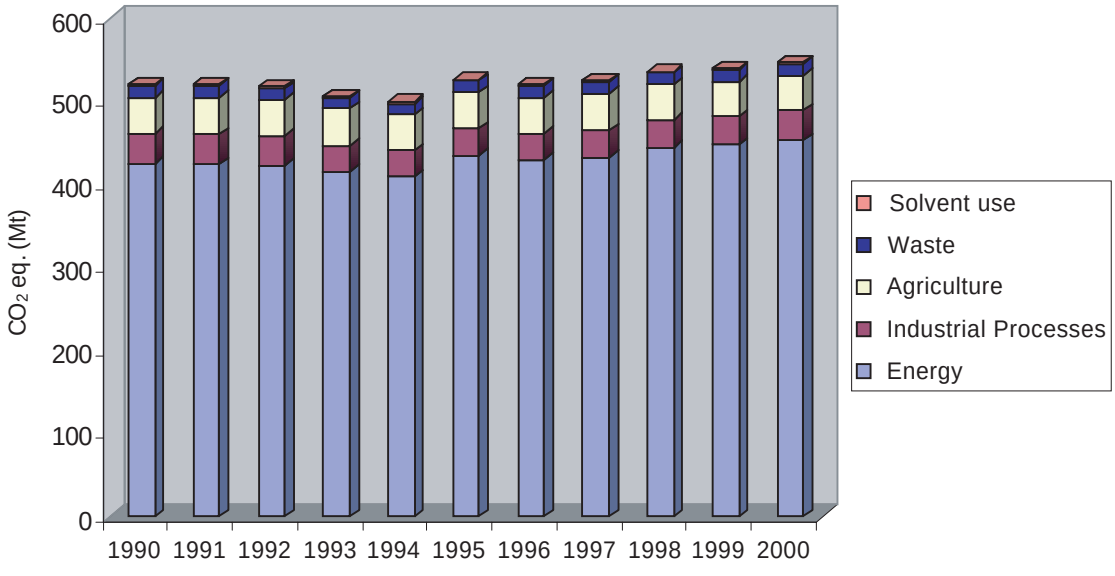
Total greenhouse gas emissions, in CO_2-equivalent, excluding CO_2 emissions and removals from land use change and forestry, showed an increase of approximately 5% between 1990 and 2000, vary-

Figure 3.1 - National greenhouse gas emissions from 1990 to 2000



Source: APAT

Figure 3.2 - Greenhouse gas emissions from 1990 to 2000 by sector



Source: APAT

ing from 521 to 547 million tons (Mt) of CO_2-equivalent, while the national commitment for reducing emissions by the period 2008-2012 is 6.5% compared to the base year levels.
The most important greenhouse gas is CO_2, accounting approximately for 84% of the national total over the whole period 1990-2000; the relative weight of CH_4 and N_2O, approximately 15% altogether, showed a slight decrease in recent years, while fluorinated gases increased from 0.3% to 0.5% of the total.
Figure 3.1 shows the national trend of greenhouse gases for 1990-2000, in Mt CO_2-equivalent by substance; CO_2 emissions do not include emissions and removals from land use change and forestry.
Figure 3.2 shows the total greenhouse gas emissions by the sectors considered in the Common Reporting Format.
The percentage distribution of the different sectors is unvaried for the whole period. Energy sector is responsible for the largest part of the total greenhouse gas emissions (83%), followed by agriculture (8%), industrial processes (7%), waste and solvent use.

3.3.1 Carbon dioxide emissions

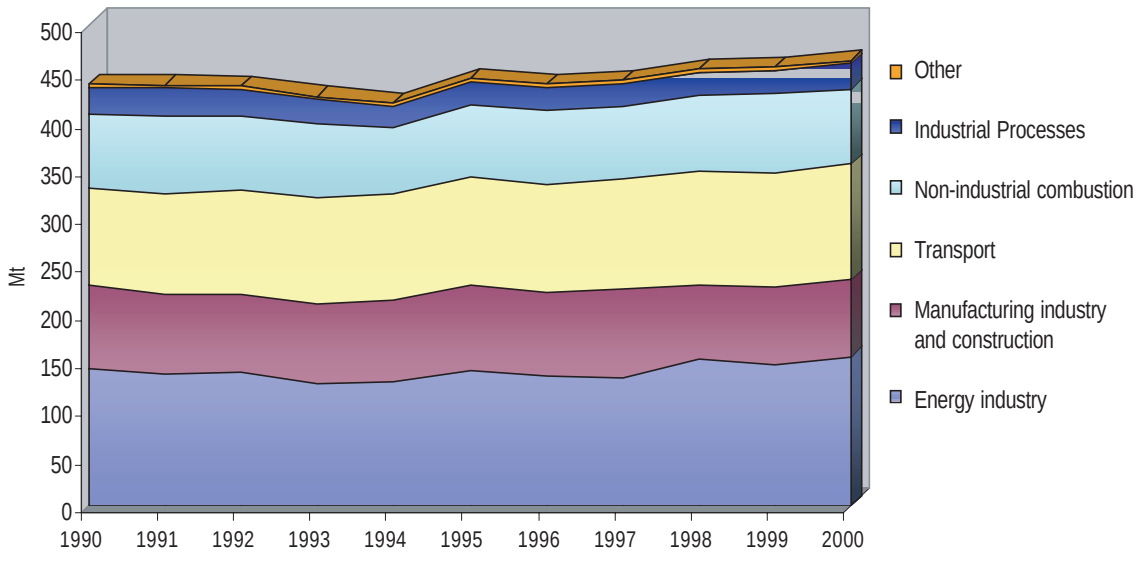
CO_2 emissions, excluding emissions and removals from land use change and forestry, increased by approximately 5.4% between 1990 and 2000, going from 439.5 to 463.4 Mt. Energy industries (33%) and transport (26%) were the most relevant sources of emissions. The manufacturing and construction industries and non-industrial combustion each accounted for 17%, while the remaining emissions came from industrial processes (6%) and other sectors (1%). Emission trends by sector are shown in figure 3.3.
Figure 3.4 shows the trends of the following economic and energy indicators:
- Gross National Product (GNP) at 1990 market prices published by ISTAT in the National Statistics Yearbook;
- Total Energy Consumption published by Ministry of Production Activities in the National Energy Balance;
- CO_2 emissions, excluding emissions and removals from land use change and forestry, published by APAT;
- CO_2 *intensity*, which represents CO_2 emissions per unit of total energy consumption.

The figures show that CO_2 emissions in the 1990's essentially mirrored energy consumption, with a discrepancy between the curves only in recent years, primarily as a result of the substitution of fuels with high carbon contents by methane gas in the production of electric energy and in industry.

3.3.2 Methane emissions

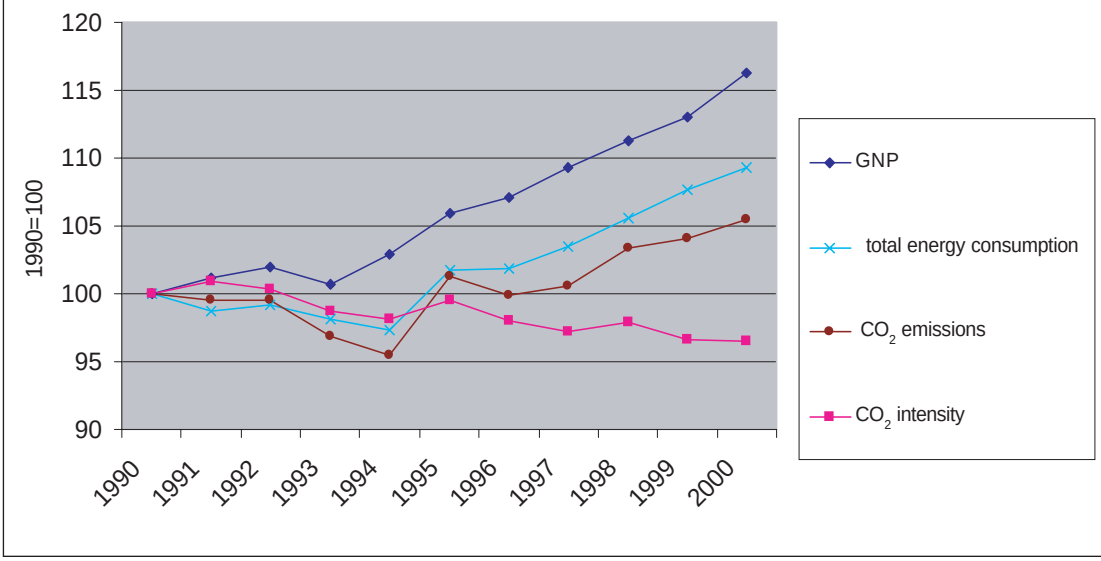
Methane emissions in 2000 represented 6.9% of total greenhouse gases, equal to 37.8 CO_2-equivalent Mt, showing a decrease of approximately 1.5 Mt compared to 1990.
The major sources of CH_4 emissions are agriculture, which accounts for 48% of total emissions, waste (32%) and energy (20%).
Emissions in the agricultural sector refer mainly to

Figure 3.3 - CO_2 emissions by sector from 1990 to 2000



Source: APAT

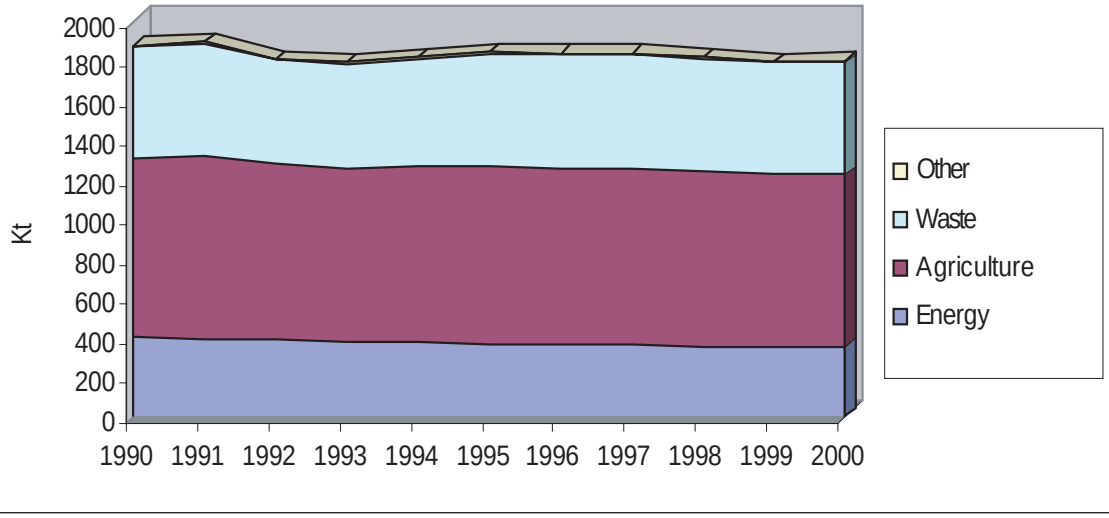
Figure 3.4 - Energy and economic indicators and CO_2 emissions



Source: APAT, ISTAT, MAP

manure management. These emissions where constant over the period, being related to the number of animals, especially cattle and swine.
Activities typically leading to emissions on the waste management sector are landfills and industrial waste-water handling. The waste sector shows an increase in emissions (+2.5% compared to 1990) due to industrial waste-water handling.
Concerning CH_4 emissions in the energy sector, the reduction (-11%) is the result of two contrasting factors; on the one hand there has been a considerable reduction in emissions caused by leakages from fossil fuels extraction and distribution (-18%), thanks to the gradual replacement of natu-ral gas distribution networks; at the same time, combustion emissions in the road transport sector have increased on account of the overall rise in consumption and, in the residential and tertiary sector, as the result of increased use of natural gas in heating systems. Figure 3.5 shows the

Figure 3.5 - CH_4 emissions by sector from 1990 to 2000



Source: APAT

emission trends by sector in thousands of tonnes (kt).

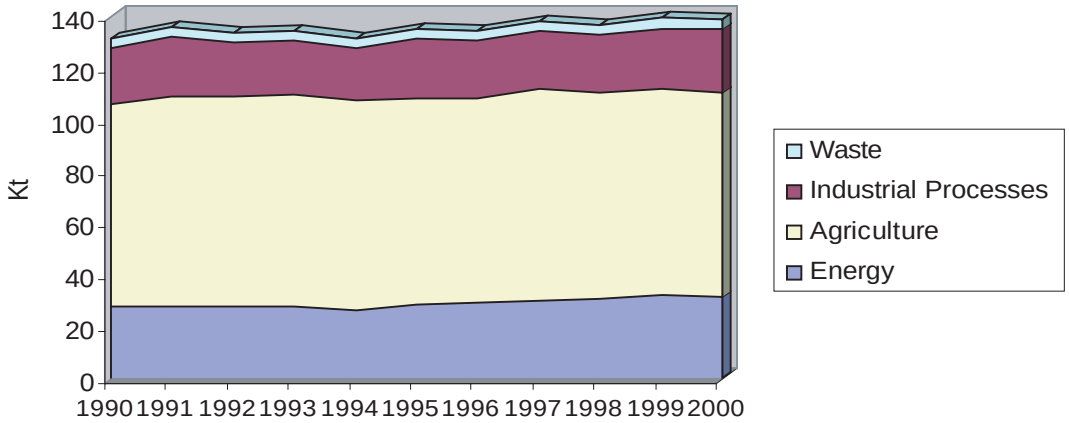
3.3.3 Nitrous oxide emissions

In 2000 nitrous oxide emissions represented 7.9% of total greenhouse gases, with an increase of 5.9% between 1990 and 2000, from 40.8 to 43.2 CO_2-equivalent Mt.
The major source of N_2O emissions was the agricultural sector (56.5%), due to the use of both chemical and organic fertilisers in agriculture, as well as the manure management. These emissions were constant during the period of 1990-2000.
Emissions in the energy-use sector (23% of the total) showed an increase by approximately 12% in the period 1990-2000; this growth can be attributed primarily to the road transport sector and is related to the introduction of three-way catalyst converters. It should be noted, however, that a high degree of uncertainty still exists with regard to the emission factors of catalysed passenger cars.
The production of nitric acid, which has decreased in recent years, and the production of adipic acid, whose levels have grown, account overall for 18% of total emissions.
N_2O emissions from waste regard mainly domestic and industrial waste-water handling. Figure 3.6 shows the emission trends by sector in thousands of tonnes (kt).

3.3.4 Fluorinated gases emissions

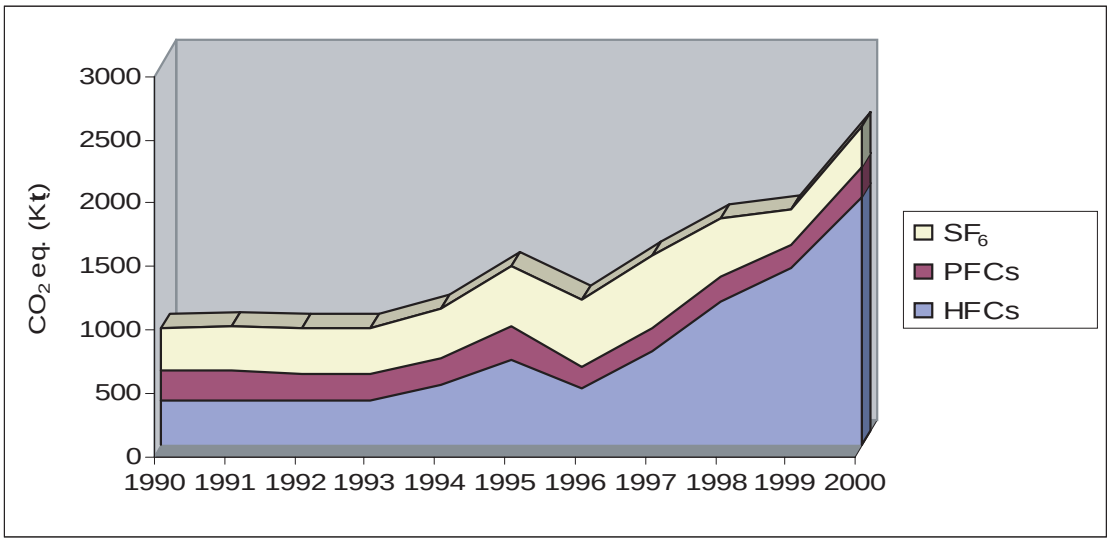
Italy has decided 1995 as the base year for the fluorinated gases covered by the Kyoto Protocol (HFCs, PFCs and SF_6). Altogether, fluorinated gases emissions represent 0.5% of total greenhouse gases, and they increased of 78% between 1995 and 2000. This increase is the result of different features for different gases.
HFCs, for instance, increased considerably from 1995 to 2000, going from 0.7 to 2 CO_2 equivalent Mt. The main sources of emissions are the consumption of HFC-134a, HFC-125, HFC-32 and HFC-143a in refrigeration and air-conditioning equipments, plus the use of HFC-134a in pharmaceutical aerosols. Increases during this period were due both to the use of these substances as replacements for ozone depleting substances and to the use of air conditioners in automobiles.
PFCs emissions decreased by approximately 15% from 1995 to 2000. The quantity of these emissions in 2000 was 0.2 CO_2-equivalent Mt, and they can be attributed to the use of these gases in aluminium and semiconductors production. The decreasing trend is due to the reduction of PFCs production, almost close to zero in Italy.
SF_6 emissions were equal to 0.3 CO_2 equivalent Mt in the year 2000, decreasing by 30% compared to 1995. Out of the SF_6 emissions, 65% are due to the gas contained in electrical equipment. Other emissions come from the use of these gases in the semiconductors production and in magnesium foundries. This use has been rising in recent years, unlike emissions from electrical equipment, which have fallen.
The National Inventory of fluorinated gases, though complete in terms of the sources and the gases identified, requires further in-depth analy-

Figure 3.6 - N_2O emissions by sector from 1990 to 2000



Source: APAT

Figure 3.7 - Fluorinated gases emissions by gas from 1990 to 2000



Source: APAT

sis, eventually throught the use of different methodologies, as contemplated under the "Good Practice Guidance" of the IPCC. The main difficulty is collecting data, which are considered to be of strategic importance and are therefore kept confidential. Figure 3.7 shows the emission trends by gas in CO_2-equivalent thousands of tonnes.

3.4 Carbon dioxide emissions and removals by forests

Until the IPCC draws up "Good Practice Guidance" for land use, land use change and forestry emissions and removals inventory, preliminary estimation of Italian emission, removals and carbon stocks as well as changes in carbon stocks resulting from

Table 3.1 - Emissions, gross and net removals and organic carbon stocks for the total Italian managed forested land (based on ISTAT and IFN data)

year	emissions Mt CO_2	gross removals Mt CO_2	net removals Mt CO_2	total stocks Mt CO_2
1990	13.2	74.5	61.3	3,863.4
1991	13.8	74.0	60.2	3,959.3
1992	15.5	73.7	58.2	4,056.8
1993	14.9	73.2	58.3	4,122.0
1994	16.3	72.9	56.6	4,214.3
1995	16.1	72.6	56.5	4,315.3
1996	15.4	72.2	56.8	4,418.3
1997	15.5	71.6	56.1	4,504.8
1998	16.7	70.9	54.2	4,576.2
1999	16.8	70.3	53.5	4,659.6
2000	16.3	69.8	53.5	4,734.6

Source: University of Tuscia

activities under art. 3.3 and art. 3.4 of the Kyoto Protocol have been calculated.

3.4.1 Emissions, removals and carbon stocks inventory

Census data of the National Forestry Inventory (IFN) for the year 1986 have been updated on a yearly basis considering figures on the use of forests and increases in forest areas supplied by ISTAT, as well as figures on fires provided by the National Forestry Office (CFS). The methodology is described in details in: "Stima degli assorbimenti di CO_2 atmosferica delle foreste italiane" (S. Federici & R. Valentini, 2002).
Emissions, removals and carbon stocks inventory has been therefore compiled for the total Italian managed forested land in the period 1990-2000 (table 3.1). These figures differ from those included in the national greenhouse gas inventory, which were based exclusively on the forest area recorded by ISTAT, until more up-to-date inventory data could be obtained.

3.4.2 Changes in carbon stocks resulting from activities under art. 3.3

Estimates in table 3.2 were obtained by applying the growth curves, calculated from Federici and Valentini (2002), to the surfaces reforested/afforested in the decade 1991-2000 under specific legislative measures.
In addition to the surfaces directly reforested/afforested by man through planting, there are areas where man has let the forest regrow naturally (see chapter 4).
In Italy, this surface area (from 1990 until now) can be estimated as a value variable from data supplied by ISTAT and the difference between the IFN surface-area data updated to 1990 (8,737 million ha) and the Temperate and Boreal Forest Resources Assessment (TBFRA) of the Food and Agriculture Organisation (FAO) of 2000 (10,842 million ha), with the result, in this case, being approximately 2 million hectares of new forest areas. Such areas, direct consequence of past policies for the territorial protection and agriculture areas reduction, could be correctly evaluated by a new forest inven-

Table 3.2 - Surfaces and carbon stored through activities of afforestation and reforestation carried out under subsidised initiatives (Regulations 2080/92 and others)

year	area (ha)	total carbon stored (Mt CO_2)
1990	3,104	0.0008
1991	6,061	0.0026
1992	10,344	0.0056
1993	13,286	0.0099
1994	30,485	0.0192
1995	44, 498	0.0334
1996	55,974	0.0524
1997	65,873	0.0762
1998	83,058	0.1075
1999	100,243	0.1471
2000	117,428	0.1960

Source: University of Tuscia

Table 3.3 – Carbon stored in area with natural forest regrowth

year	area (ha)		total carbon stored Mt (CO_2)	
	ISTAT	FAO	ISTAT	FAO
1990	4,558	191, 364	0.0012	0.0512
1991	8,412	382,728	0.0024	0.1086
1992	16,086	574,092	0.0047	0.1728
1993	20,883	765,456	0.0066	0.2447
1994	53,865	956,820	0.0162	0.3251
1995	65,745	1,148,184	0.0123	0.4150
1996	81,640	1,339,548	0.0281	0.5154
1997	87,099	1,530,912	0.0329	0.6276
1998	91,951	1,722,276	0.0381	0.7528
1999	97,573	1,913,640	0.0441	0.8923
2000	108,638	2,105,004	0.0522	1.0478

Source: University of Tuscia

Table 3.4 - Emissions and removals by managed forests for the period 1990-2000

year	increments Mt CO_2	utilizations Mt CO_2	net removals Mt CO_2
1990	38.8	6.7	32.0
1991	38.5	7.0	31.5
1992	38.3	7.9	30.4
1993	37.9	7.6	30.3
1994	37.7	8.3	29.4
1995	37.6	8.2	29.4
1996	37.2	7.8	29.4
1997	36.8	7.8	29.0
1998	36.3	8.5	27.9
1999	36.0	8.5	27.5
2000	35.7	8.3	27.5

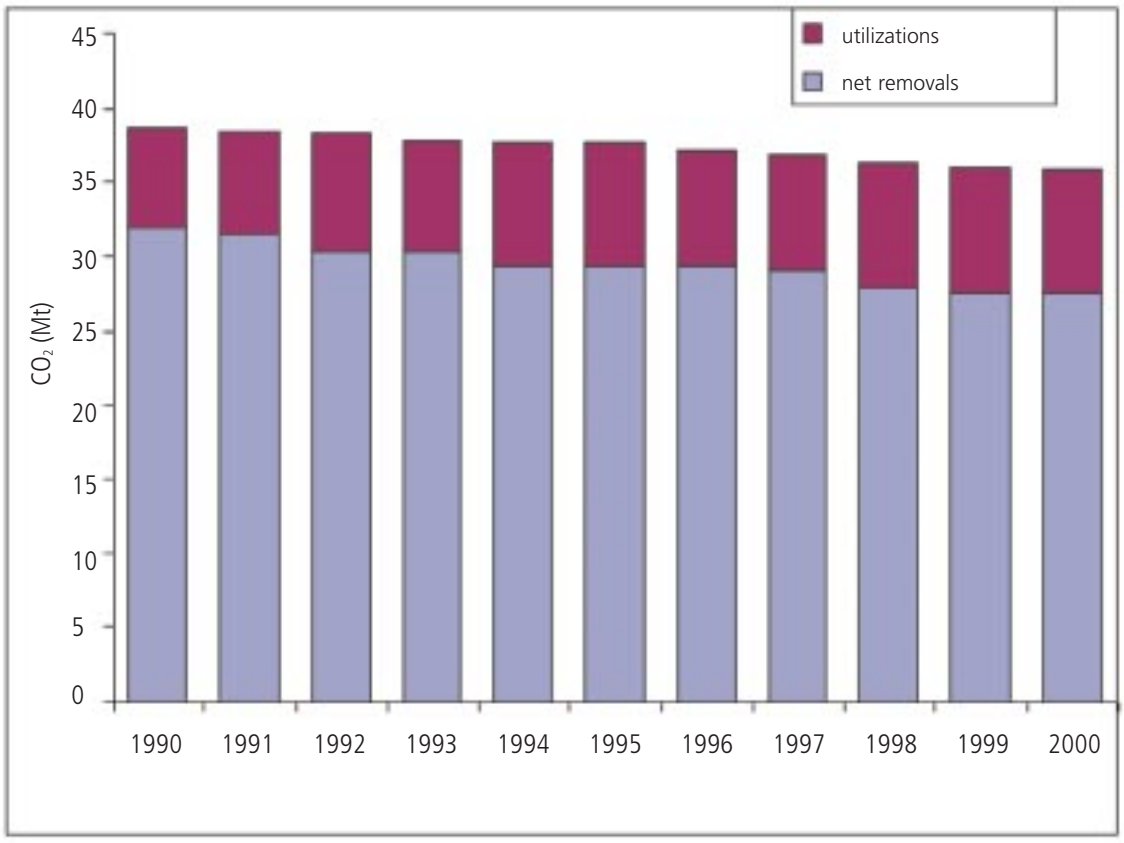
Source: University of Tuscia

tory in terms of specific composition, forest stands and growth rates.
In table 3.3 an estimate of the carbon stock amount in these areas is reported.

3.4.3 Changes in carbon stocks resulting from activities under art. 3.4

For the period 1990-2000 emissions, removals, and carbon stocks of managed forests have been estimated. To the ISTAT data on surfaces, forest fires and biomass in commercial harvest of coppice and high forests, and IFN data on specific compositions, forest stands and biomass growth rates coppice and high forest growth curves were applied (S. Federici & R. Valentini, 2002). Results are reported in table 3.4 and in figure 3.8.
These estimates are affected by different sources of error whose combination lead to an underestimation of total net removal:

Figure 3.8 - Removals of Italian managed forests in the period 1990 – 2000



Source: University of Tuscia

- according to other data sources (FAO, Regional Forest Inventory) the actual managed Italian forest area is at least 3 million hectares greater than the official ISTAT figures;
- these estimations include only carbon stored in the above-ground woody biomass, while, according to the Bonn agreement on sinks, carbon stored in roots, in leaves, in dead wood, in the litter and in the soil should also be included;
- data on biomass removed in commercial harvest published by ISTAT are lower than the actual data, particularly concerning fuelwood consumption.

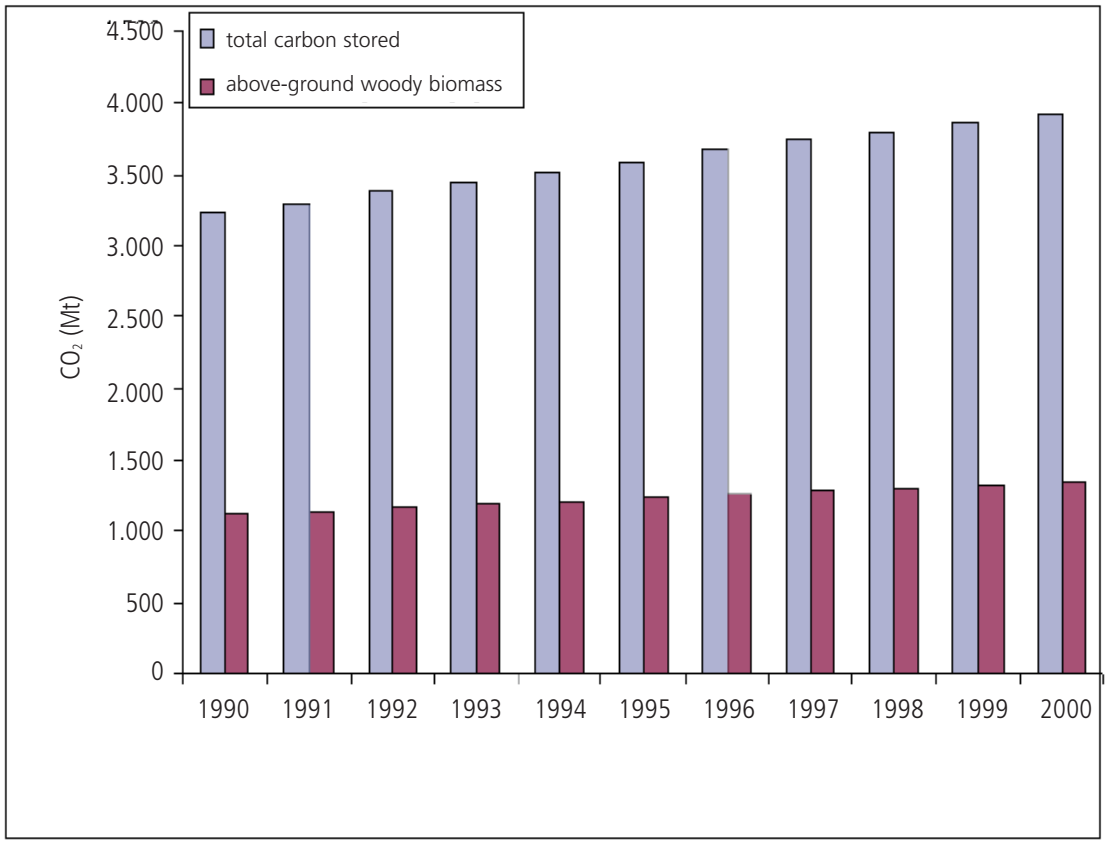
It should be noted that the above-ground woody biomass represents only a third of the organic carbon stored in the entire forest system (table 3.5 and figure 3.9).

Table 3.5: Carbon stock in managed forests for the period 1990-2000

year	Above ground woody biomass $MtCO_2$	total Mt CO_2
1990	1,119.1	3,246.5
1991	1,142.3	3,313.3
1992	1,169.7	3,392.8
1993	1,188.1	3,446.6
1994	1,210.7	3,511.8
1995	1,238.9	3,593.8
1996	1,267.8	3,677.5
1997	1,292.5	3,749.1
1998	1,311.3	3,803.5
1999	1,333.0	3,866.1
2000	1,354.2	3,927.5

Source: University of Tuscia

Figure 3.9 – Organic carbon stored in managed Italian forests



Source: University of Tuscia

APPENDIX

TABLE 10 EMISSION TRENDS (SUMMARY)
(Sheet 5 of 5)

Italy
2000
Submission 2002

GREENHOUSE GAS EMISSIONS	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	CO_2 equivalent (Gg)											
Net CO_2 emissions/removals	415.945,64	415.945,64	414.501,36	415.475,44	405.237,17	400.227,06	425.411,33	418.843,21	424.351,95	436.925,74	439.484,95	446.937,01
CO_2 emissions (without LUCF)[1]	439.478,11	439.478,11	437.677,47	437.292,77	425.929,09	419.673,09	445.009,19	439.065,54	442.115,89	454.351,89	457.201,90	463.381,26
CH_4	39.387,33	39.387,33	39.780,43	38.019,22	37.612,11	38.110,11	38.739,30	38.567,74	38.639,11	38.135,25	37.743,10	37.825,91
N_2O	40.783,39	40.783,39	42.165,77	41.483,99	41.744,55	40.754,45	42.016,17	41.656,55	42.859,01	42.433,87	43.213,51	43.176,52
HFCs	671,29	351,00	355,43	358,78	355,42	481,90	671,29	448,64	750,79	1.138,30	1.400,29	1.961,68
PFCs	272,46	237,50	231,35	205,84	203,57	212,48	272,46	176,79	184,26	201,37	190,02	231,66
SF_6	469,80	333,56	357,85	360,49	373,38	387,67	469,80	527,26	562,06	454,79	273,97	327,72
Total (with net CO_2 emissions/removals)	497.529,91	497.038,41	497.392,20	495.903,76	485.526,20	480.173,66	507.580,35	500.220,18	507.347,18	519.289,32	522.305,84	530.460,50
Total (without CO_2 from LUCF)[1][3]	521.062,38	520.570,88	520.568,30	517.721,08	506.218,12	499.619,70	527.178,20	520.442,51	525.111,11	536.715,48	540.022,80	546.904,75

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	CO_2 equivalent (Gg)											
1. Energy	425.200,98	425.200,98	423.613,04	422.673,80	415.553,14	409.984,97	435.209,04	430.075,06	433.112,55	444.647,29	447.694,29	452.520,09
2. Industrial Processes	37.089,95	36.598,45	36.689,74	36.516,19	32.065,41	30.733,21	32.609,72	31.533,22	32.014,02	33.238,32	33.984,14	36.241,67
3. Solvent and Other Product use	1.679,72	1.679,72	1.675,29	1.581,28	1.514,46	1.459,60	1.425,19	1.378,38	1.366,19	1.307,78	1.298,60	1.293,02
4. Agriculture	43.354,53	43.354,53	44.477,07	43.859,44	43.854,71	43.767,08	43.663,97	43.223,27	44.263,17	43.266,80	42.895,49	42.638,57
5. Land-Use Change and Forestry[2]	-23.532,48	-23.532,48	-23.176,10	-21.817,32	-20.691,92	-19.446,03	-19.597,85	-20.222,33	-17.763,94	-17.426,15	-17.716,96	-16.444,25
6. Waste	13.737,20	13.737,20	14.113,16	13.090,37	13.230,40	13.674,83	14.270,29	14.232,57	14.355,19	14.255,29	14.150,28	14.211,39
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

(1) The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

(2) Net emissions.

(3) The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry. Note that these totals will differ from the totals reported in Table Summary 2 if Parties report non-CO2 emissions from LUCF.

TABLE 10 EMISSIONS TRENDS (CO_2)
(Sheet 1 of 5)

Italy
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)											
1. Energy	408.073,32	408.073,32	406.592,42	405.902,87	399.032,59	393.872,37	418.552,32	413.300,41	416.296,76	427.691,50	430.139,34	435.275,55
A. Fuel Combustion (Sectoral Approach)	407.074,22	407.074,22	405.838,66	405.102,61	398.106,86	392.814,58	417.499,70	412.246,07	415.188,77	426.487,90	428.937,05	433.984,28
1. Energy Industries	142.926,92	142.926,92	137.488,80	137.591,81	127.476,20	129.069,42	140.299,04	134.548,94	133.463,47	151.975,20	146.563,10	155.052,13
2. Manufacturing Industries and Construction	85.946,32	85.946,32	82.372,24	81.907,31	82.453,48	84.420,16	89.368,95	87.121,27	91.961,07	77.811,40	80.483,85	79.752,46
3. Transport	101.490,15	101.490,15	103.984,21	108.297,73	110.022,04	109.905,35	111.626,24	112.695,80	114.424,07	118.212,34	119.223,49	121.024,37
4. Other Sectors	75.669,63	75.669,63	80.801,34	76.222,71	76.711,66	67.964,14	74.769,65	76.702,21	73.807,31	77.452,75	81.559,53	77.349,00
5. Other	1.041,21	1.041,21	1.192,07	1.083,06	1.443,49	1.455,52	1.435,81	1.177,85	1.532,86	1.036,21	1.107,07	806,32
B. Fugitive Emissions from Fuels	999,10	999,10	753,76	800,26	925,73	1.057,79	1.052,62	1.054,34	1.107,99	1.203,60	1.202,28	1.291,27
1. Solid Fuels												
2. Oil and Natural Gas	999,10	999,10	753,76	800,26	925,73	1.057,79	1.052,62	1.054,34	1.107,99	1.203,60	1.202,28	1.291,27
2. Industrial Processes	28.813,36	28.813,36	28.506,89	28.888,04	24.393,07	23.310,00	23.926,41	23.369,69	23.451,14	24.269,59	24.741,58	25.802,16
A. Mineral Products	24.192,97	24.192,97	24.095,23	24.553,56	20.849,97	20.205,24	20.744,59	20.262,07	20.386,42	21.164,65	21.853,25	22.722,14
B. Chemical Industry	2.257,61	2.257,61	2.137,19	2.149,76	1.372,98	975,67	955,84	848,71	893,38	905,24	823,19	941,47
C. Metal Production	1.804,19	1.804,19	1.672,17	1.497,57	1.541,66	1.532,88	1.659,67	1.668,51	1.659,12	1.626,66	1.480,90	1.592,12
D. Other Production	558,59	558,59	602,30	687,14	628,45	596,20	566,31	590,41	512,22	573,04	584,25	546,42
E. Production of Halocarbons and SF_6												
F. Consumption of Halocarbons and SF_6												
G. Other												
3. Solvent and Other Product Use	1.679,72	1.679,72	1.675,29	1.581,28	1.514,46	1.459,60	1.425,19	1.378,38	1.366,19	1.307,78	1.298,60	1.293,02
4. Agriculture	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
A. Enteric Fermentation												
B. Manure Management												
C. Rice Cultivation												
D. Agricultural Soils												
E. Prescribed Burning of Savannas												
F. Field Burning of Agricultural Residues												
G. Other												
5. Land-Use Change and Forestry	-23.532,48	-23.532,48	-23.176,10	-21.817,32	-20.691,92	-19.446,03	-19.597,85	-20.222,33	-17.763,94	-17.426,15	-17.716,96	-16.444,25
A. Changes in Forest and Other Woody Biomass Stocks	-28.605,24	-28.605,24	-28.955,32	-28.311,96	-27.424,72	-26.976,17	-27.315,56	-27.886,27	-27.255,27	-25.745,11	-25.667,98	-25.698,76
B. Forest and Grassland Conversion												
C. Abandonment of Managed Lands	-102,01	-102,01	-103,73	-119,25	-131,77	-141,82	-148,26	-151,17	-153,41	-153,52	-158,52	-160,27
D. CO_2 Emissions and Removals from Soil	5.174,77	5.174,77	5.882,95	6.613,88	6.864,57	7.671,95	7.865,97	7.815,11	9.644,75	8.472,48	8.109,54	9.414,78
E. Other												
6. Waste	911,72	911,72	902,86	920,58	988,97	1.031,13	1.105,27	1.017,05	1.001,80	1.083,02	1.022,39	1.010,53
A. Solid Waste Disposal on Land												
B. Waste-water Handling												
C. Waste Incineration	911,72	911,72	902,86	920,58	988,97	1.031,13	1.105,27	1.017,05	1.001,80	1.083,02	1.022,39	1.010,53
D. Other												
7. Other (please specify)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total Emissions/Removals with LUCF	415.945,64	415.945,64	414.501,36	415.475,44	405.237,17	400.227,06	425.411,33	418.843,21	424.351,95	436.925,74	439.484,95	446.937,01
Total Emissions without LUCF	439.478,11	439.478,11	437.677,47	437.292,77	425.929,09	419.673,09	445.009,19	439.065,54	442.115,89	454.351,89	457.201,90	463.381,26
Memo Items:												
International Bunkers	8.591,03	8.591,03	7.846,94	8.171,30	8.659,80	8.935,46	9.897,23	9.441,35	9.710,25	10.528,00	10.800,65	11.635,00
Aviation	4.194,66	4.194,66	4.247,16	4.709,73	4.973,95	5.262,92	5.853,78	6.435,43	6.647,76	7.189,12	7.711,55	7.778,00
Marine	4.396,37	4.396,37	3.599,77	3.461,57	3.685,85	3.672,54	4.043,44	3.005,92	3.062,49	3.338,87	3.089,11	3.857,00
Multilateral Operations												
CO_2 Emissions from Biomass	5.756,17	5.756,17	6.022,59	6.423,12	6.249,74	7.295,21	7.892,12	7.586,88	8.332,91	7.574,50	8.946,89	9.272,52

TABLE 10 EMISSIONS TRENDS (CH_4)
(Sheet 2 of 5)

Italy
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)											
Total Emissions	1.875,59	1.875,59	1.894,31	1.810,44	1.791,05	1.814,77	1.844,73	1.836,56	1.839,96	1.815,96	1.797,29	1.801,23
1. Energy	398,19	398,19	393,73	389,03	375,67	373,52	364,75	361,90	359,70	355,05	354,29	354,84
A. Fuel Combustion (Sectoral Approach)	75,22	75,22	78,08	81,23	81,31	84,06	87,30	88,14	89,96	86,15	88,60	89,29
1. Energy Industries	15,41	15,41	14,99	14,58	14,61	14,37	16,36	16,66	17,44	8,63	8,25	9,26
2. Manufacturing Industries and Construction	7,62	7,62	7,04	6,97	6,87	7,14	6,87	6,82	6,88	13,06	13,20	15,67
3. Transport	36,76	36,76	38,97	41,98	42,97	44,10	45,03	45,81	44,77	43,42	43,50	40,00
4. Other Sectors	15,23	15,23	16,86	17,49	16,61	18,21	18,79	18,63	20,48	20,85	23,45	24,23
5. Other	0,21	0,21	0,22	0,21	0,26	0,25	0,25	0,21	0,38	0,18	0,19	0,14
B. Fugitive Emissions from Fuels	322,97	322,97	315,65	307,80	294,36	289,46	277,44	273,76	269,74	268,90	265,70	265,54
1. Solid uels F	5,58	5,58	5,25	4,91	3,86	3,39	3,07	2,88	2,85	2,63	2,52	3,05
2. Oil and Natural Gas	317,39	317,39	310,40	302,89	290,50	286,07	274,37	270,88	266,89	266,27	263,17	262,49
2. Industrial Processes	5,46	5,46	5,26	5,13	5,15	5,39	5,72	5,25	5,53	5,55	5,44	5,43
A. Mineral Products												
B. Chemical Industry	3,05	3,05	3,04	2,99	2,86	3,11	3,34	3,14	3,21	3,34	3,26	3,14
C. etal roductionM	2,41	2,41	2,22	2,15	2,29	2,27	2,38	2,11	2,31	2,21	2,18	2,29
D. Other Production												
E. Production of Halocarbons and SF_6												
F. Consumption of Halocarbons and SF_6												
G. Other												
3. Solvent and Other Product Use												
4. Agriculture	912,72	912,72	920,76	890,21	881,35	888,06	902,52	894,32	894,48	883,36	868,73	867,85
A. Enteric Fermentation	648,81	648,81	660,72	632,29	620,02	628,62	636,05	628,34	627,05	618,97	606,50	606,86
B. Manure Management	190,02	190,02	189,19	183,68	181,89	178,56	184,49	184,56	187,61	187,91	186,53	185,49
C. Rice Cultivation	73,26	73,26	70,17	73,58	78,81	80,24	81,36	80,78	79,24	75,83	75,08	74,93
D. Agricultural Soils												
E. Prescribed Burning of Savannas												
F. Field Burning of Agricultural Residues	0,62	0,62	0,68	0,66	0,64	0,64	0,62	0,64	0,57	0,64	0,62	0,58
G. Other												
5. Land-Use Change and Forestry	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
A. Changes in Forest and Other Woody Biomass Stocks												
B. Forest and Grassland Conversion												
C. Abandonment of Managed Lands												
D. CO_2 Emissions and Removals from Soil												
E. Other												
6. Waste	559,22	559,22	574,55	526,07	528,88	547,80	571,74	575,08	580,25	572,01	568,83	573,11
A. Solid Waste Disposal on Land	453,64	453,64	461,26	415,16	419,26	435,35	455,08	459,98	460,54	452,76	444,53	449,25
B. Waste-water Handling	97,97	97,97	98,54	99,33	97,03	100,65	103,77	104,23	106,46	107,47	109,88	111,87
C. Waste Incineration	7,60	7,60	14,73	11,56	12,57	11,77	12,87	10,86	13,20	11,72	14,35	11,92
D. Other	0,01	0,01	0,01	0,01	0,02	0,02	0,02	0,02	0,05	0,06	0,07	0,07
7. Other (please specify)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Memo Items:												
International unkersB	0,54	0,54	0,47	0,47	0,50	0,50	0,56	0,47	0,49	0,53	0,52	0,61
Aviation	0,12	0,12	0,12	0,14	0,14	0,15	0,17	0,19	0,19	0,21	0,22	0,25
Marine	0,42	0,42	0,34	0,33	0,35	0,35	0,39	0,29	0,29	0,32	0,29	0,36
Multilateral Operations												
CO_2 Emissions from Biomass												

TABLE 10 EMISSIONS TRENDS (N_2O)
(Sheet 3 of 5)

Italy
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)											
Total Emissions	131,56	131,56	136,02	133,82	134,66	131,47	135,54	134,38	138,25	136,88	139,40	139,28
1. Energy	28,28	28,28	28,23	27,75	27,84	26,67	29,02	29,60	29,88	30,64	32,63	31,59
A. Fuel Combustion (Sectoral Approach)	28,28	28,28	28,23	27,75	27,84	26,67	29,02	29,60	29,88	30,64	32,63	31,59
1. Energy Industries	7,05	7,05	6,92	6,73	6,90	6,72	7,45	7,47	7,49	7,44	7,36	7,11
2. Manufacturing Industries and Construction	4,56	4,56	4,48	4,53	4,25	4,01	4,29	4,25	4,28	4,38	4,50	3,84
3. Transport	5,58	5,58	5,63	5,81	6,05	6,46	7,03	7,58	8,13	9,18	9,91	10,35
4. Other Sectors	11,04	11,04	11,16	10,62	10,58	9,41	10,18	10,24	9,92	9,59	10,79	10,25
5. Other	0,04	0,04	0,06	0,06	0,07	0,08	0,08	0,06	0,07	0,05	0,06	0,04
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels												
2. Oil and Natural Gas												
2. Industrial Processes	21,77	21,77	22,99	21,28	21,39	20,09	23,06	22,26	22,42	22,77	23,43	25,18
A. Mineral Products												
B. Chemical Industry	21,77	21,77	22,99	21,28	21,39	20,09	23,06	22,26	22,42	22,77	23,43	25,18
C. Metal Production												
D. Other Production												
E. Production of Halocarbons and SF_6												
F. Consumption of Halocarbons and SF_6												
G. Other												
3. Solvent and Other Product Use												
4. Agriculture	78,02	78,02	81,10	81,18	81,76	81,03	79,71	78,85	82,19	79,73	79,52	78,75
A. Enteric Fermentation												
B. Manure Management	12,41	12,41	12,87	12,40	12,08	12,37	12,79	12,85	12,94	12,96	12,76	12,44
C. Rice Cultivation												
D. Agricultural Soils	65,60	65,60	68,22	68,77	69,67	68,64	66,91	65,99	69,24	66,75	66,75	66,30
E. Prescribed Burning of Savannas												
F. Field Burning of Agricultural Residues	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
G. Other												
5. Land-Use Change and Forestry	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
A. Changes in Forest and Other Woody Biomass Stocks												
B. Forest and Grassland Conversion												
C. Abandonment of Managed Lands												
D. CO_2 Emissions and Removals from Soil												
E. Other												
6. Waste	3,49	3,49	3,69	3,62	3,66	3,68	3,74	3,67	3,77	3,74	3,81	3,76
A. Solid Waste Disposal on Land												
B. Waste-water Handling	3,18	3,18	3,18	3,20	3,20	3,23	3,24	3,25	3,27	3,28	3,30	3,31
C. Waste Incineration	0,31	0,31	0,51	0,42	0,46	0,45	0,49	0,42	0,50	0,46	0,52	0,45
D. Other												
7. Other (please specify)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Memo Items:												
International Bunkers	0,17	0,17	0,15	0,15	0,16	0,16	0,18	0,16	0,17	0,18	0,18	0,21
Aviation	0,06	0,06	0,06	0,06	0,07	0,07	0,08	0,09	0,09	0,10	0,10	0,11
Marine	0,11	0,11	0,09	0,09	0,09	0,09	0,10	0,08	0,08	0,08	0,08	0,09
Multilateral Operations												
CO_2 Emissions from Biomass												

TABLE 10 EMISSION TRENDS (HFCs, PFCs and SF_6)
(Sheet 4 of5)

Italy
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)											
Emissions of HFCs - CO_2 equivalent (Gg)	**671,29**	**351,00**	**355,43**	**358,78**	**355,42**	**481,90**	**671,29**	**448,64**	**750,79**	**1.138,30**	**1.400,29**	**1.961,68**
HFC-23	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,00	0,00	0,00	0,00	0,00
HFC-32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,03	0,08
HFC-41												
HFC-43-10mee												
HFC-125	0,01	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,04	0,05	0,07	0,14
HFC-134												
HFC-134a	0,20	0,00	0,00	0,00	0,00	0,10	0,20	0,29	0,43	0,65	0,80	0,98
HFC-152a												
HFC-143												
HFC-143a	0,01	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,02	0,03	0,03	0,06
HFC-227ea	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HFC-236fa												
HFC-245ca												
Emissions of PFCs - CO_2 equivalent (Gg)	**272,46**	**237,50**	**231,35**	**205,84**	**203,57**	**212,48**	**272,46**	**176,79**	**184,26**	**201,37**	**190,02**	**231,66**
CF_4	0,03	0,03	0,03	0,02	0,02	0,03	0,03	0,02	0,02	0,02	0,02	0,02
C_2F_6	0,01	0,01	0,01	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01
C_3F_8												
C_4F_{10}												
c-C_4F_8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C_5F_{12}												
C_6F_{14}												
Emissions of SF_6 - CO_2 equivalent (Gg)	**469,80**	**333,56**	**357,85**	**360,49**	**373,38**	**387,67**	**469,80**	**527,26**	**562,06**	**454,79**	**273,97**	**327,72**
SF_6	0,02	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,01

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10mee	1300
HFC-125	2800
HFC-134	1000
HFC-134a	1300
HFC-152a	140
HFC-143	300
HFC-143a	3800
HFC-227ea	2900
HFC-236fa	6300
HFC-245ca	560
PFCs	
CF_4	6500
C_2F_6	9200
C_3F_8	7000
C_4F_{10}	7000
c-C_4F_8	8700
C_5F_{12}	7500
C_6F_{14}	7400
SF_6	23900

CHAPTER IV
Policies and Measures

This chapter summarises the strategies, the measures and the interventions implemented or to be implemented by the Italian Government in order to achieve the objective of mitigating climate change. A detailed description of the existing measures, the measures already established or to be re-formulated or adopted ex-novo is given in this chapter. This chapter synthesises the information contained in the background papers used to prepare the CIPE deliberation "Revised guidelines for national policies and measures regarding the reduction of greenhouse gas emissions" (see Annex I).

In order to help the reading of this document, the mitigation objectives, options and strategies and any additional measure have been divided by sector: energy production and distribution, industry, residential and tertiary, transportation, agriculture, forestry and waste.

There are many subjects responsible for preparing the implementation measures, and they are scattered in many administrative offices; moreover in this document we underline the role of the Regions and other local administrations but it is not possible to define the leadership of all the described measures.

The mitigation potential of the implemented policies and measures is evaluated together with the forecasted impact on emissions of other measures already decided or still under discussion.

4.1 Summary of planned aimed measures almed at of achieving the objectives of the Kyoto Protocol

Law no. 120 of 1 June 2002, passed in ratification of the Kyoto Protocol, adopted on 10 December 1997 in Kyoto at the Third Conference of the Parties of the Convention on Climate Change, namely, article 2, paragraph 1, establishes that the Ministry for the Environment and Territoryshall present within 30 September 2002 to the Interministerial Committee for Economic Planning, a national action plan for the reduction of greenhouse gas emission levels and increase of their removals.

These additional policies have been arranged after a study on the emission trends quantified the surplus of emissions compared to the Kyoto targets – see chapter 5. Part of these policies, listed in table 4.1, have already been approved and they are included in the reference scenario. Another set of policies, still under discussion, is listed in table 4.2. They are mainly domestic policies and, together with sinks and flexible mechanisms, they will fill the the gap with the Kyoto target.

The achievement of the Kyoto target, in terms of size of necessary effort and extension of the sectors involved, requires the simultaneous implementation of more general policies, not necessarily of environmental nature. These policies deal mainly with:

- the country's upgrade with additional infrastructures : in the transportation sector they are badly needed to achieve the mobility shift to rail and to streamline road traffic;
- the construction of new combined-cycle plants and new import lines for natural gas and electricity, which may favour new operators, increase energy efficiency and create the necessary conditions to cut electricity and gas prices in the frame of the liberalisation of energy markets.
- the integrated management of territory and environment for the exploitation of renewable energy sources, through the establishment and efficient management of integrated industrial system; this mainly concerns the exploitation of wind energy

Edited by: Mario Contaldi (APAT), Alessandro Bianchi and Davide Tabarelli (Fondazione Alma Mater) for § 4.1; Alessandro Bianchi, Massimiliano Piacentini and Davide Tabarelli (Fondazione Alma Mater) for § 4.2; Mario Contaldi and Davide Tabarelli (Fondazione Alma Mater) for § 4.3; Alessandro Bianchi and Giuseppe De Bellis (Fondazione Alma Mater) for § 4.4; Mario Contaldi (APAT) Arturo Lorenzoni and Alessandro Vaglio (Fondazione Alma Mater) for § 4.5; Alessandro Bianchi (Fondazione Alma Mater) for § 4.6; Domenico Gaudioso (APAT) for § 4.7; Riccardo De Lauretis (APAT) for §§ 4.7.2 and 4.7.3; Antonella Trisorio and Annalisa Zezza (INEA) for § 4.7.2; Pasquale De Stefanis (ENEA) for § 4.7.3; Antonio Lumicisi (Ministry for Environment and Territory), Sandro Federici and Riccardo Valentini (University of Tuscia) for § 4.8

TABLE 4.1 – Policies approved or established, included in the reference scenario

Use of energy sources	Regulatory tool	Monitoring tool	Emission reduction (2008-2012) ($MtCO_2$ eq.)	Investment (Mill. Euro)	NAV (when negative net cost) (1) (Mill. Euro)	Net cost (Mill. Euro/Mt CO_2) (2)
Electric industry			26.00			
Expansion of the CC for 3200 MW	Bill of Ministry of Productive Activities "Reorganisation of the energy sector", July 2002	GRTN data monitored by APAT	8.9	1,984	<0	<0
Expansion of import capacity for 2300 MW	GRTN Plan of 2002, Bill of MPA "Reorganisation of the energy sector", July 2002	Manager of the National Transmission Network (GRTN)	10.6	85.2	0 (2)	<0
Further increase of electricity generation from renewables of2800 MW	White Paper, Directive 2001/77/CE, Bill of MPA "Reorganisation of the energy sector"	GRTN data monitored by APAT and ENEA	6.5	4,950	<0	<0
Residential and tertiary			6.3			
Decrees on the efficiency of end use	Decrees of Ministry of Industry, Commerce and Craft 24/4/01	Authority for Electricity and Gas	6.3	6.3	<0	<0
Transportations			7.5			
Buses and private cars with low-carbon fuels (LPG, methane)	Protocols of the Ministry of Environment – Fiat–Oil Union, Ministry of Industry – Fiat – Consortium for LPG, Decree no. 256 of 17 July 1998, Decree of 27 March 1998	Data by the Ministry of Transport (CNT) elaborated by APAT,ENEA	1.5	880	-880	39
- Optimisation and collectivisation systems for private transportation (*car pooling, car sharing, jitneys)* -Reformulation of taxes on oils and realisation of computer-telematic systems	Decrees of Ministry of Environment Guidelines by the Commission of MPA, Ministry of Treasury	Data by the Ministry of Transport (CNT) elaborated by APAT ,ENEA	2.1	60	-60	3
Development of domestic infrastructures	Deliberation of 21 December 2001 Interministerial Committee for Economic Planning, "Target Law", PGT	Data by the Ministry of Transport (CNT) elaborated by APAT, ENEA	3.9	(not imputable to GHG reduction)	(not imputable to GHG reduction)	
Carbon credits from JI and CDM			12	920-2,650	230-663	1-3
TOTAL			51.8	7,994 - 8,224		

TABLE 4.2A - ADDITIONAL MEASURES (NOT ESTABLISHED)

Additional measures on the use of energy sources	Regulatory tool	Monitoring tool	Emission reduction (2008-2012) ($MtCO_2eq.$)	Investment (Mill. Euro)	ANV (when negative net cost) (1) (Mill. Euro)	Net cost (Mill. Euro/Mt CO_2)
Industry			**6.9-13**	**6,367-10,606**	**3,047-5,412**	
Replacement of industrial engines with high-efficiency engines with saving from 2-7,2 TWh, high-efficiency industrial engines	Integration of resolution AEEG 228/2001, extension of regulation l.79/99 and following articles for green certificates, extension of regulations under Ministerial Decree 24/4/01 on white certificates	Ministry of Productive Activities	1-3.6	666-2,400	<0	<0
Implementation of COSFI standard with saving of 1TWh			0.5	<0	<0	<0
Replacement of transformers			1.0	900	<0	<0
Small/medium size cogeneration with production between 10-20 TWh			0.8-1.5	1,100-2,100	48-90	3
Energy production from municipal waste and biogas, also with combined combustion in cement works equal to 750 – 1.300 MW			1.8-3.0	1,800-2,900	<0	<0
Increase of electricity generation from renewables 500-1200 MW			1.5-3.1	884-2,121	<0	<0
Diffusion of solar heating			0.2	800	160	40
Research and development in the photovoltaic sector with "niche" uses			0.1	1,125	220	110
Residential and tertiary			3.8-6.5	19-33	<0	
Extension decrees on the efficiency of the end use sector (MITC 24/4/01) and regional measures with savings between 1.5. - 2.9 Mtoe/year	MToe/year, extension regulation of Ministerial Decree 24/4/01	Regions/AEEG	3.8-6.5	19-33	<0	<0
Agriculture			0.28 – 0.34	0		
CO_2 reduction from energy consumption			0.28 – 0.34	0	<0	<0

TABLE 4.2B - ADDITIONAL MEASURES (NOT ESTABLISHED)

Additional measures from the use of energy sources	Regulatory tool	Monitoring tool	Emission reduction (2008-2012) ($MtCO_2eq.$)	Investment (Mill. Euro)	ANV (when negative net cost) (1) (Mill. Euro)	Net cost (Mill. Euro/Mt CO_2) (2)
Total transportation			11.3-15.6	2,855-5,155	655-4,855	
Transportation: technological/tax measures			9.1-12.1	1,415-2,415	15	
Replacement of circulating cars with cars at 120 g/KmCO2 with savings between 1,5-2,5 Mtoe	Programme agreement	Ministry of Transport Information processing by ENEA on CED data	3.5-6	1,400-2,400	<0	<0
Improvement of energy efficiency of heavy-transport means with savings between 0,1-0,3Mtoe	European Directives	Information processing by ENEA on CED data	0.3-0.8	0	<0	<0
Use of diesel-bio-diesel up to 5% of transportation grade diesel	Ministry of Transport Extension of programme agreement Min. Environment and OU	Data processing from APAT on MAP data	4	15	15	0,2
Revision of calculation method of vehicle property tax and its correlation with periodic tests	Ministerial Decree	Not necessary	1.3	0	0	0
Transportation: infrastructure measures			1.4	640	640	
Reorganisation of urban traffic	National and local regulations and incentives	Min. of Transport	0.8	610	610	38
Promotion of rail transport and connection to interchange parking areas	Programme agreements Financing of research	Min. of Transport	0.6	30	30	3
Urban mobility plans (PUM)			1.5-3	85	85	2.83-1.42
Telematic solution for transports			0.5	30	30	9
Transportation: research (4)			0.8-2.1	800-2,100	1,600-4,200	
Realisation of pilot projects with hydrogen, cell and fuel-propelled systems for transport by rail, road, sea and river			0.1-0.3	100-300	200-600	100
Development and experimental use of materials enabling the reduction of vehicle and train masses			0.2-0.6	200-600	400-1,200	100
Realisation and diffusion of optimised engines using methane as mono-fuel and direct injection LPG as mono-fuel			0.5-1.2	500-1,200	1,000-2400	100
Sum of additional measures from the use of energy sources (a)			22.28-35.44	9,241-15,794	3,702-10,267	

TABLE 4.2C - ADDITIONAL MEASURES (NOT ESTABLISHED)

Additional measures to reduce emissions from other sources	Regulatory tool	Monitoring tools	Emission reduction (2008-2012) ($MtCO_2eq.$)	Investment (Mill. Euro)	NAV (when negative net cost) (1) (Mill. Euro)	Net cost (Mill. Euro/Mt CO_2) (2)
Industry			6.20	0.08	0.08	
Emission reduction from the production of adipic and nitric acid	Programme agreements	APAT from sectorial data	6.20	0.08	0.08	0
Agriculture			0.46	0	<0	
Reduction of CH_4 emissions from manure management	Technical regulations (IPPC) for new plants, regional financing for existing plants	APAT on data from the Ministry of Agricultural Policies	0.15-0.83	6.2-33.2	<0	<0
Reduction of N_2O emissions from agricultural soils	Programme agreements and regulations	APAT on data of the Ministry of Agricultural Policies	0.46	0	<0	<0
Waste		APAT / ENEA	0.64	900	900	70
Stabilization of the organic fraction	Waste regulations		0.64	900	900	70
Others (solvent, fluorinated gases)			0.76	50.4	50.4	
Reduction of PFC emissions through aluminium recycling			0.05	0	0	0
Installation of abatement devices and adoption of low GWP substances in the production of semiconductors			0.02	0	0	0
Reduction of HFC leaks from mobile air conditioners			0.65	50	50	4
Reduction of SF_6 leaks from electrical equipment			0.04	0.4	0.4	0.5
Sum of additional measures from other sources (b)			8.06	950.48	950.48	
TOTAL additional measures (a) + (b)			30.3-43.5	10,191-16,744	4,652-11,217	

(1) Current net value of investment for the duration of the plant updating the cash flows at the rate of 5%. When negative, the CNV indicates the amount of resources to be financed by means of incentives in order to accomplish the investment and, therefore, it is indicated as net cost of the investment.
(2) The ratio is calculated by bearing in mind the reduction of the emissions for the entire duration of the investment. (3) kep=0,22 kWh .

and waste management.
These policies, although they have been worked out several years ago, suffer from significant implementation delays, mainly due to the opposition by the local authorities in approving the industrial and infrastructure projects at basis of these policies. On one hand, the Kyoto target urge local authorities (whose powers have been strengthened still further by law of October 2001) to improve their authorization guidelines and, on the other, they are an opportunity to upgrade the country, cut energy prices through the energy market liberalisation and improve territorial management.

4.1.1 General guidelines on policies and measures
The elaboration of a climate change strategy requires the implementation of many measures in different economic and technological sectors. As a matter of fact, scientific research and technological development have not succeeded in providing economically competitive technologies capable of supplying the goods and services necessary to the economic production and consumption systems without generating greenhouse-gas emissions. It is not certain, moreover, that the technological research and development will succeed in solving the issue in

Table 4.3 - Measures implemented in the energy sector: production, processing and distribution and measures included in the trend scenario

Implemented measures	Description	Estimated reduction in 2010 ($MtCO_2$)
Decrees and various instructions	Supports in stock account aimed at increasing the efficiency of power plants, spread of co-generation plants and promotion of natural-gas use.	19.7
Legislative Decree no. 79 of 16 March 1999 (Bersani)	Liberalisation of the electric sector. Implemented by the Ministry of Productive Activities, Authority for Electricity and Gas and ENEL S.p.A..	-
Ministerial Decree no. 106 of 29 March 2001 Minister of the Environment, resolution no. 224/00 AEEG	"Programme for photovoltaic roofs" realises plants from 1 to 50 kWp connected to low-tension distribution network in Italy, from 2000 to 2002.	0.12
Various decrees	Maintenance of the current progressive structure of domestic electric tariffs	10
Legislative Decree of 24 April 2001	1.6 Mtoe of energy saving from the efficient use of energy 1.3 Mtoe of saving of primary energy from the reduction of gas use	7-8
Voluntary agreement with Enel	The first VA being implemented, signed with Enel in 2000 12	12
Ministerial Decree of 11 November 1999 Minister of Productive Activities and Minister ofthe Environment	Decree supporting the regulation of electricity production from renewable sources (Legislative Decree no. 79 of 16 March 1999, art. 11, par. 1,2,3)	6
Ministerial Decree of 18 March 2002 Ministry of Productive Activities	Modifications and integrations to decree of the Minister of Industry, Trade and Craft in agreement with the Minister of Environment, 11 November 1999, concerning the "directives for the implementation of rules on the subject of the production of electricity from renewable sources as of paragraphs 1, 2 and 3 of art. 11 of Legislative Decree no. 79 of 16 March 1999.	-
Resolution of the Authority for Electricity and Gas no. 42/02	Conditions for the recognition of co-generation of electricity/heat in conformity with art. 2, paragraph 8, of Legislative Decree no. 79 of 16 March 1999	-
Several legislative decrees	Diffusion of the use of natural gas, enlargement and updating of transport lines and distribution	0.5

the short-medium term, even though the UN Agenda 21 and the Fifth Programme of Environmental Action of the EU have set sustainable development as a main objective.
Law no. 120 of 1 June 2002, passed in ratification of the Kyoto Protocol, identifies the following guidelines on policies and measures:
- increase the energy efficiency of the national economic system and foster the use of renewable sources of energy;
- increase carbon dioxide removals deriving from land use, changes of land-use and forestry, as established under article 3 paragraphs 3 and 4 of the Kyoto Protocol;
- full implementation of the JI and CD mechanisms established under the Kyoto Protocol;
- promotion of research and development aiming at introducing hydrogen as a main fuel in energy systems and in the transport sector; promotion of biomass based combined heat and power plants and solar thermal power plants; promotion of wind and photovoltaic power plants and waste and biogas based power plants.

4.2 Energy sector: production, processing and distribution

4.2.1 Measures implemented in the electric sector, including renewable sources
The policies already implemented can be grouped according to four main objectives:
- Upgrading of existing plants;
- Spread of co-generation plants;
- Promotion of renewable sources in the consumption of electricity;
- Reduction of electricity and gas demand.
Some major tools have been used to promote the aforementioned objectives: voluntary agreements with industries, mandatory renewable sources share (renewable obligation) in total electricity production and dispatching priority for energy produced in co-generation plants. Other incentives have been used in the past, particularly those aiming at recognising an additional price for energy produced by means of renewable or assimilated energy sources (CIP6).
The effects of these tools can be hardly evaluated; a summary of major measures adopted and the expected emission reductions is provided in table 4.3.

The ***voluntary agreement with Enel*** has the objective of reducing emissions of 22 $MtCO_2$ by 2006, compared to the emissions of 1990, by:
- increasing the efficiency of existing plants and converting 15.000 MW to combined-cycle plants; of the reduced 12 $MtCO_2$, only 10 $MtCO_2$ are to be attributed to the measures implemented after the Kyoto Protocol;
- increasing the use of renewable sources (2% obligation) capable of reducing emissions by 2 $MtCO_2$;
- reducing leaks from distribution networks by 0.1 $MtCO_2$;
- DSM measures: (Demand Side Management) by quantifying only the effects of the spread of most efficient electric technologies, it is possible to have a net reduction effect of 0.4 $MtCO_2$, which can be added to the effects of fewer leaks from the distribution networks of 0.1 $MtCO_2$;
- DSM measures: by quantifying the effects of the spread of more efficient electric technologies instead of fossil fuels, it is possible to have a net reduction effect of 0.4 $MtCO_2$;
According to the privatisation programme, Enel shall sell part of its production and distribution plants; the net effects of such voluntary agreement can be hardly quantified now, due to the uncertainties of the future ENEL production – distribution capacity.
The resolution establishing the ***2% production obligation from renewable source***, could promote an additional production capacity of 9.000 GWh, with a reduction effect of about 6 $MtCO_2$.
Legislative Decrees of 24 April 2001 provide for the reduction of electricity and gas consumptions through the implementation of measures adopted by distribution companies; these measures are expected to be fully adopted since non-compliance would incur financial penalties. The overall effect of such Decrees is expected to entail a reduction from 7 to 8 $MtCO_2$. Associated to this measure, it is important to mention the current progressive structure of domestic electric tariff, which, together with the 3 KW power limitation, contributes to keep electric domestic consumptions in Italy lower than European average.
The programme of ***10,000 photovoltaic roofs*** is expected to be partially implemented and, according to rough estimates, emission reduction should be around 0.12 $MtCO_2$ year.
As concerns electricity generated from ***waste by*** 2010 it is assumed that the burning capacity of the existing incinerators will increase by 220,000 tonnes every year, entailing a reduction of 1.6 $MtCO_2$.
The replacement of liquid and solid fossil fuels with natural gas is an option aimed at mitigating CO_2 emissions and overall greenhouse-gas emissions, given that the increase in methane leaks from networks, especially the distribution networks, and from end users seems to be negligible. Natural gas will continue to play a major role in the frame of national energy requirements. Its growth will have to occur in a period in which several supply contracts expire and in a climate of increasing competition on the international market determined by the strong resort to natural gas by all major consuming countries.

4.2.2 Measures implemented before and after 1998
Some of the aforementioned measures, were imple-

mented before the Kyoto agreements, and others afterwards. Some of the measures in force, such as the voluntary agreement with Enel, include both pre-Kyoto and post-Kyoto measures. A detailed evaluation of the measures adopted before and after the Kyoto agreements is contained in Ecofys, 2001. A detailed analysis of all measures is also reported in the Second National Communication, chapter 5.

4.2.3 Trend scenario and interventions already established for the electric energy sector

In brief, by 2010 the electric system described in the trend scenario will be characterised by the following developments with reference to year 2000:

• growth electricity demand in the network for about 65 TWh;

• imports will increase to 60 TWh, about 16 more than 2000;

Compared to the trend scenario, the policies already established for the electric sector defining the reference scenario include:

• the construction of 3200 MW of additional combined cycles;

• the expansion of import lines for electricity for about 2300 MW;

• higher growth of renewable source capacity and development, from 3670 MW of the trend scenario to 5900 MW in 2010.

4.2.3.1 Additional combined cycles

An additional generating capacity from combined cycles has been assumed in the trend scenario with 20,000 MW, 14,000 MW of which in place of the existing plants and the remaining 6,000 MW completely new. In the reference scenario, a higher capacity of new combined cycles is assumed for additional 3,200 MW, implying an emission reduction equal to 8.9 Mt.

The hypotheses of an increase exceeding 3,200 MW, in addition to the 20,000 MW already anticipated in the trend scenario, seem to be hardly achievable and not compatible with the equilibrium required by the future electric market The investment analysis presents a positive current net value of investment, implying that such option does not require additional incentives. This measure virtually reflects the implementation of the resolutions foreseen by the bill for the Reorganisation of the Energy Sector, debated in September 2002, integrating the resolutions stipulated under law of 10 April 2002 (the so-called "plant-liberalisation decree"[1]).

4.2.3.2 Realisation of new import capacity

Only a slight increase is assumed in the trend scenario, that is to say, 5500 MW of the import capacity by 2010, aimed toward the completion of the Italy-Greece import line. Another measure included in the reference scenario is the additional expansion of 2.300 MW enabling:

- a remarkable emission reduction of 10.6 Mt, considering that the entire import capacity from abroad, supposedly from under-exploited plants, would cause a reduction in domestic emissions.
- an economic advantage on account of low wholesale prices of electric power abroad .

An import capacity exceeding 2.300 MW can be hardly created, also due to economic reasons linked to the necessary use of expanding national production capacities.

This measure calls for the implementation of part of the plan arranged by the Manager of the National Transmission Network (Transmission System Operator) and announced at the beginning of 2002[2], through the simplification of the authorisation procedures by the local authorities. In order to speed up the realisation of new import lines for electricity, the bill for the reorganisation of the energy sector, introduces a number of directives providing for the creation of several import lines for electricity by private operators as stipulated under article 10, whereas article 13 aims at streamlining the authorization procedures. These directives should be adequate to enable the expansion of the import capacity.

4.2.3.3 Additional expansion of renewable sources

According to the trend scenario to 2010, the increase of 10 TWh in the amount of contributions, which would reach a total amount of 64 TWh, from renewable sources is obtained for about 3 TWh by the expansion of the hydroelectric sector, for 1.6 by the increased wind capacity, for 1.3 by the thermo-valorisation of waste and for the remaining amount by biomass, biogas and photovoltaic energy. This scenario implements the 2% renewable obligation and the completion of the CIP 6/92 projects.

The policy aiming at spurring the expansion of renewable sources still further indicates as feasible an additional expansion by 2010, of 11 TWh, mainly on account of increased biomass, waste and wind contribution. This additional expansion requires an increase of 0.3% each year of the mandatory 2% obligation, from 2005 to 2012..

[1] Law no. 55 of 9 April 2002, "Conversion into law and following modifications of Legislative Decree no. 7 of 7 February 2002, establishing measures for guaranteeing the security of the national electric system", OG no. 84 of 10 April 2002.

[2] "Triennial programme for the development of the national transmission network", approved by the Manager of the National Transmission Network (GRTN) on 31 March 2002.

Moreover, the prospected scenario is in line with the terms of the White Paper aimed at valorising renewable sources, approved by the Interministerial Committee for Economic Planning on 6 August 1999.
The result of approximately 75 TWh anticipated in the reference scenario is also the objective indicated by the Italian Government upon approval of Directive 2001/77/CE on Renewable Sources. The table 4.4 shows the hypotheses of expansion for each renewable source.

The expansion of renewable obligation is not sufficient and it would require other side support policies. They are mainly norms aimed toward the integrated management of the waste cycle and the definition of new policies in the agricultural sector in order to supply, in a regular and inexpensive way, biomass energy both for electric and heat generation.
At the same time, it is necessary to foster the involvement of the Regions to simplify the authorization procedures through the definition of a series of policies aimed at strengthening renewable sources at local level. The exploitation of renewable sources compared to other sources mainly involves territorial management through the direct involvement of local authorities. The definition of policies for the achievement of the Kyoto targets should be seen as an occasion to work out and adopt local policies.

As far as biomasses are concerned, which, according to the reference scenario, are supposed to increase significantly, the creation of integrated industrial system – an objective which had already been sanctioned by article 23 of the Legislative Decree for the Reorganisation of the Energy Sector – calls for the application of the guidelines identified in the White Paper of 1999, approved by the Interministerial Committee for Economic Planning of 6 August 1999. Many projects based on the exploitation of biomass energy, authorised in the nineties, have never been realised due to a number of difficulties arisen during the fuel acquisition, selection and stocking stages.
In particular, the Ministry of Agricultural Policies and the Regions should take steps to:
• identify the districts that carry out wood processing activities capable of providing abundant amounts of rejects to be used as biomass energy;
• plan actions aimed toward the maintenance of wooded areas which may give rise to abundant amounts of biomass energy;
• start dedicated cultivations, also to the end of improving the exploitation of agricultural areas;
• foster the technological development in support of small-size plants;
• integrate projects for the production of electric power from biomass energy using heat through district heating;
• speed up the resort to biomass energies (particularly pellets), especially in mountain areas for heat generation in place of diesel oil and other fuels.
An important measure to aim to achieve such an objective is the promotion of simplified authorization procedures for plants with power capacity inferior to 10 MW, already proposed by some regional administrations. The second fundamental aspect is the availability of correct information. On one hand, today's investors find it difficult to know their obligations and rights on a recently instituted market; on the other, several administrations have not the adequate technical tools to evaluate properly the credibility and feasibility of

Table 4.4 - Capacity of renewable sources

SOURCE		Installed power by 2010 MW	Increase compared to 2000 MW	Annual production in 2010 GWh
hydroelectric	>10 MW	14,800	355	37,000
hydroelectric	<10 MW	3,100	903	12,400
wind		2,500	2,137	5,500
biogas		300	120	1,350
geothermal		700	74	4,900
biomass		1,500	1,282	9,000
waste		800	513	4,800
photovoltaic		100	94	130
		23,800	5,478	75,080

the investments proposed, forcing the proponents of the projects to start difficult negotiations.
The agricultural world seems willing to nourish a new market in the energy sector, but it requires continuity and clarity of intents to undertake adequate investments.
If adequate measures are adopted, the 75 TWh target is not a prohibitive goal and it represents an interesting opportunity for the Italian industrial system.

4.2.4 Additional measures for the electric energy sector

Increase in the production of energy from renewable sources for 500-1.200 MW
This is an option which, in any case, must take into account the strong development already hypothesised in the reference scenario, where the achievement of 75 TWh of renewable energy by 2010 is taken for granted, as indicated in the White Paper of 1999. Sectorial studies shows further projects with positive Net Present Value (NPV) of investment thanks to the inclusion in the valorisation of transferred electric energy of the green certificate, which is supposed to be at 5 cents of Euro/kWh. .

Research and development in the photovoltaic sector
This is a more expensive option than other renewable sources since it entails higher investment costs, that is to say, in the order of 7500 Euro/kW. The possibility of an additional expansion of about 150 MW with an investment of 1.125 million Euros and a negative NPV of 220 million Euros is identified. The unit cost is therefore equal to a 110 Mill. Euros/Mt.

4.3 Industry sector

4.3.1 Measures implemented in the industry sector
The measures implemented in the industry sector can be grouped into two typologies: voluntary agreements and direct or indirect financing in several specific sectors. A list of the measures and expected effects on emissions is shown in table 4.7.
The two most important voluntary agreements are contracted with Montedison and Assovetro.
The ***voluntary agreement with Montedison,*** unfortunately, will not produce the expected effects, estimated at 10 MtCO2; some of these projects proposed a series of options for the production of electric energy and their potential have been already estimated in paragraph 4.2. Although the development of detergents for low temperatures to reduce CO_2 emissions has been estimated in the voluntary agreement, it is not reasonable to forecast a reduction of 4 $MtCO_2$. The effect of the new measure is therefore estimated between 0 and 0.3MtCO2 (Ecofys, 2001).
The realisation of a marine stocking terminal will certainly support the growth of gas demand in Italy and will help its expansion; but the terminal alone will not be adequate to produce such an increase in the use of natural gas as to entail 3 MtCO2 reduction in emissions.

4.3.2 Measures implemented before and after the Kyoto agreements
Some of the measures described and/or summarised in the previous paragraph have been put into operation before the Kyoto agreements, others have been implemented afterwards. A detailed evaluation of the measures adopted before and after the Kyoto agreements is contained in Ecofys, 2001. A detailed analysis of all measures is also reported in chapter 5 of the Second National Communication.

4.3.3 Additional interventions for the industry sector
The suggested interventions had been assumed following the indications and the documentation offered by the operating agents. They mainly concern the increase in the efficiency of electric motors, transformers and condensers, as well as cogeneration and the use of wastes.

4.3.3.1 Increase in the efficiency of electric motors
To the end of the application of this policy the following measures are necessary:
- co-financing for research and re-conversation activities for the production of last-generation engines (F1, high efficiency, including a total amount of investment of about 300-350 million Euros), to be determined in the voluntary agreement with ANIE;
- regulations establishing that all electric engines introduced on the market are of the F1 (high efficiency) type as from 2007
- decreasing incentive to the replacement of the existing engines with F1 engines (tax credit) toward a more rapid substitution of the stock, with tax credit equal to the amount of the investment relating to the anticipated substitution, which will decrease in the course of the years up to 2007, i.e. the last incentive year;
- a parallel information campaign in all businesses, through the application of the voluntary agreement with ANIE.
These measures are associated to energy savings between 2 and 7.2 TWh and to CO_2 emission reductions in a range between 1 and 3.6 Mt.

4.3.3.2 Increase in the efficiency of the transformers stock

In order to increase the average efficiency of the Italian stock of transformers currently in operation (about 430,000), it is expected that, as from 2008, all transformers with leaks exceeding the standard indicated in the rules CEI 14.13. will not be allowed to be sold. It must be noted that the additional investment return of a substitution producing efficiency recovery is of about 2 years, with evident advantages for end users.
The expected abatement to 2010 is negligible (the almost total market saturation with high efficiency transformers would have a reduction effect of 1 Mt of CO_2) also on account of the long life cycle of the transformers (20-40 years according to models).

4.3.3.3 Raising of the COSφ standard
The raising of the COSφ standard is envisaged from 0.9 to 0.95 (the same as the European average), with an aggravation of the tariff component connection to the reactive power.
The time-response of this measure for the interested subjects is of 6-10 months. The CO_2 abatement is 0.5 Mt and energy saving is 1 TWh.

4.3.3.4 Cogeneration in the industrial sector
Cogeneration has largely developed in Italy as a result of the CIP6 resolution of 1992, especially following the realisation of large-size plants. The thermal basin of the Italian industry sector, however, is represented by relatively small plants, which found it difficult to obtain an economic advantage from the ongoing market conditions.
With the new policy started in the electric sector under decree 79/99, the incentives for cogeneration plants have been reduced with respect to the previous situation under CIP 6/92. The advantages envisaged for cogeneration plants are dispatch priority and the exclusion from the obligation of covering 2% - production of the demand through renewable sources. Moreover, the plants connected in medium and low tension to the distribution network can benefit from the reduction of the transmission costs in virtue of the less amount of leaks caused on the network, according to the terms of Resolution no. 228/2001 of the Authority for Electricity and Gas.
A potential additional expansion of medium-size cogeneration plants in the industrial sector is estimated in the range of 10-20 TWh with a reduction in CO_2 emissions between 0.8 and 1.5 Mt.
The evaluation of the investments, between 1,100-2,100 million Euros, assumes that the transfer of electric power should be carried out taking into account wholesale prices, estimated around 5 eurocents/kWh; this implies a negative NPV in a range between 48 and 90 million Euros. This value also provides an estimate of the necessary additional incentives for the entire duration of the investments, which are supposed to last 20 years. Considering the overall emission reductions along the 20-year period, the unit cost ranges around 3 mill. Euro/Mt CO_2. Incentives to cogeneration shoud

Table 4.7 – List of measures implemented in the industry sector

Implemented measures	Description	Estimated reduction in 2010 ($MtCO_2$)
VA with Montedison (1998)	Voluntary agreement between the Italian Government and Montedison: different projects supported by means of subsidies. Reduction objective of 10 MtCO2 for 2010, but unclear annual target and geographical localisation.	0-0.3
VA with the glass industry	Voluntary agreement with the glass industry, programme of 10% emission reduction to 2005; potential reduction of 0.4 MtCO2eq/a	–
Public allocation	Allocation by the Italian Government of _ 7 millions for the adaptation of 4 steel plants to the EU standards.	_
Various	Increase in the use of methane in the industry	3.0
Law no. 10/91 Art. 19	Compulsory appointment of an energy manager in industrial plants consuming more than 10 000 tep year of primary energy and in the services companies consuming more than 1000 tep/ year. In 1997, about 2500 industries and 1000 service companies had appointed a manager.	_
VA between Enel (2000) and the Ministry of Productive Activities, Ministry of Environment.	Campaigns to increase the use of efficient light-bulbs and to reduce the size of electric engines. (It is estimated that if the size of all electric engines was adequate, a 2% saving in electric consumptions would be achieved).	_

be actuated through the following alternative options:
· the definition of a tariff scheme for the transfer of surplus amounts to distributors, for cogeneration plants with capacity lower than 50 MW - for instance, according to the size, similarly to the terms established under resolution 82/99 for small hydroelectric plants;
· extension to cogeneration plants with capacity lower than 50 MW of green certificates, for the part of energy saving defined under Resolution 42/02 of the Authority for Electricity and Gas;
· extension to the industrial users of regulations of Ministerial Decree issued by the Ministry of Industry, Trade and Crafts on 24 April 2001 on end use of energy: white papers from the production of energy for civil uses by cogeneration plants.
4.3.3.5 Production of energy from waste
An important reform of the waste sector has been started in Italy under decree no. 22 of 5 February 1997 (Ronchi Decree). The reform aims at decreasing the amount of waste which is landfilled and at increasing energy recovery through the combustion of dry fraction or through the transformation in Waste-Derived Fuels. Several regulatory impediments, especially at local level, however, have prevented the efficient spread of such projects to date. A solution to these problems at local level and the integration of a set of rules simplifying the realisation of such projects in the regulatory framework currently in force in Italy should imply, in the next future, an increase in energy recovery from the waste industry. Italy is still behind schedule compared to other European countries with regard to the use of waste for electricity generation, with a total use of waste lower than 7%, against the 20% European average, and the 50% peaks reached by several countries.

In particular, as far as the industrial sector is concerned, there is the case of the unsuccessful use of wastes in the cement sector, which, in Italy, suffers from extremely severe restrictions compared to other countries. The wastes used in the production of cement, the cost of which is often null or negative, would be withdrawn from the incineration or dumping processes, and would replace conventional and more expensive fuels.
In order to undertake the investments necessary to achieve this objective, a series of adequate resolutions, authorizing the employment of wastes in cement works, should be established to overcome the difficulties arising at local level. This measure does not require additional incentives.

Altogether, the investments on the use of heat from wastes both in the industry sector and for the production of electric energy are estimated in a range between 1.100 and 2.400 million Euros, with a NPV near to zero, proportionate to the tariffs of waste disposal which should be established in order to enable the investment return. Potential emission savings are estimated between 1.8 and 3 Mt.

4.4 Transport and mobility sector

4.4.1 Measures implemented in the transport sector
This sector is characterised by the number of initiatives undertaken and by the relatively moderate impact on emissions. From the administrative point of view, the jurisdiction falls under a large number of institutional entities and businesses, and, consequently initiatives need to be extremely specific. A list of all measures and estimated effects on emissions is referred to in table 4.8. The most significant measures are described in chapter 5 of the Second National Communication and they are briefly summarised hereafter.
The ***voluntary agreement with Fiat*** (integrated with agreement between the European Commis-sion and the car producers) foresee a reduction in specific car emissions from 164 gCO_2/Km to 145 gCO_2/km. This measure is estimated to enable a reduction of 6.8 $MtCO_2$ by 2010.
The increasing diffusion of ***methane, LPG and biodiesel vehicles*** will enable an additional reduction of 1 $MtCO_2$.
The direct effects of the measures promoting the use of ***collective transport means*** is limited to 0.5 $MtCO_2$.
A series of measures aim at increasing the **efficiency of goods transport**: the reduction achievable through the shift of 12 Gt/km from road to rail/sea traffic, is of about 1 $MtCO_2$; assuming that all other anticipated measures are achieved, the emission reduction will be in the range of 2.6 and 3.2 $MtCO_2$.
The panorama of the measures proposed in the ***General Plan for Transports*** could produce a reduction effect from 20 to 24 $MtCO_2$(including all measures described above) The actual implementation of these measures depends also on the decisions taken by the European Commission on the increase in the efficiency of cars, lorries and urban mobility. The anticipated measures are:
- use of low-carbon fuels;
- Increase in transport infrastructures in urban areas;
- Reduction/restrictions of car use in cities;
- Freight traffic from road to rail and sea.

4.4.2 Measures implemented before and after the Kyoto agreements
On the whole, most of the measures for this sector have been implemented before the Kyoto agreements, but some of them have been implemented afterwards. A detailed evaluation of the measures

adopted before and after the Kyoto agreements is contained in Ecofys, 2001.

4.4.3 New initiatives already established for the transport sector

A great number of actions are foreseen for this sector, on account of the difficulty to carry out the necessary initiatives in a context characterised by a strong increase in consumptions and by the presence of more than 40 millions subjects, the owners of the vehicles, and a large number of businesses and institutional bodies whose relative jurisdiction falls under specific aspect of this sector.

The established measures incorporated in the reference scenario are described and classified into three categories as follows:

- measures aimed toward the shift to low-carbon fuels;
- optimisation of private transport systems and car pooling;
- infrastructures.

The Ministry of Transport shall provide to monitor the measures to the aim of estimating the expected greenhouse gas reduction.

4.4.3.1 Shift to low-carbon fuels (lpg, methane)

These measures should enable a reduction of 1.5 Mt of CO_2 by 2010 (standard value 2,0 Mt), and total investment up to 880 million Euros, 530 of which charged to the public sector.

The duration of the investment is supposed to be 15 years, implying a unit cost of 39 Euro/t.

Promotion of natural gas use. Protocol of the Ministry of Environment – Fiat – Oil Industries board

The Protocol potentialities are only partly exploited for the time being. The development of natural gas – which, in any case, gives positive results since it reduces CO_2 emissions – will produce the best results when "dedicated" engines will be available, that is to say, engines purposely devised and optimised for fuelling vehicles with natural gases. Natural gas, which is available in large quantities and which is expected to play a major role in the transport sector, is capable to fuel a fleet of 1÷1.5 million vehicles if adequate interventions are implemented. The actual fleet is strong of about 0.4 vehicles. The greatest difficulties concern the development of a more extensive and updated distribution network of natural gas with refuelling time in line with other fuels. Despite the number of difficulties, the potentialities of a greater development of methane-driven vehicles are still high, due to the fact that Italy is a leading country in this sector in terms of availability of methane-fuelled car fleet.

Natural gas-driven buses

Having considered the reassuring results of Law no.194/98 and following developments (MD 25 May 1999), a proposal is made to spur the local transport companies to replace, by means of Programme Agreements and local regulations, their outdated buses (registered more than 10 years before) with gas-driven buses or hybrids.

Promotion of LPG use Protocol of the Ministry of Industry– Fiat – LPG Consortium

The protocol was signed recently and it includes a series of financial incentives for the acquisition of LPG-fuelled vehicles or in favour of those subject who are willing to convert their vehicles into LPG-fuelled cars within 36 months from the registration date. A series of mutual commitments are also foreseen to the aim of improving the diffusion of this fuel. At the moment, the LPG-driven fleet amounts to 1.4 million vehicles.

The current distribution system of LPG would allow supporting a fleet of 3.5÷4 million vehicles without remarkable interventions. The availability of dedicated engines will act as a booster of the existing advantages offered by LPG fuelling. The cost of the intervention is 40 million Euros.

4.4.3.2 Systems aimed toward the optimisation of the private transport sector

These measures should enable a reduction of 2.1 Mt of CO_2 by 2010 (4.6 Mt when completed), energy saving equal to 0.8 Mtoe (2 at completion) and total investments amounting up to 60 million Euros, 49 of which charged to the public sector. The unit cost for the reduction of emissions is estimated around 3 euro/t.

Car pooling

Established under Decrees of Environment M. of 17 February 2000 and of 20 December 2000, the sharing of private means of transport among several users, co-ordinated by local mobility managers for the formation of car crews, could be implemented also through the signing of voluntary agreements with businesses with a number of employees exceeding a given threshold.

Car sharing

Established under Decree of Environment M. of 20 December 2000, proposes the organisation of operating units within local public transportation enterprises for the purpose of initiating the joint management of a vehicle available to a wide range of users while encouraging the use of vehicles that provide low environmental impact.

Collective taxis

Already contemplated Decree of Environment M. of 20 December 2000, proposes a transport offering that represents a middle road between public

Table 4.8 – List of measures implemented in the transport sector

Implemented measures	Description	Estimated reduction in 2010 ($MtCO_2$)
MD of 17 February 2000 Minister of the Environment	Financing plan called "Ecological Sundays" aimed at: realising, integrating or completing public means of transport producing zero or low emissions; regulations and restrictions to the access to central areas in several major cities through automatic control systems or implementation of a "road pricing" system; promotion of the use of low-impact fuels.	–
VA with FIAT (1988)	Reduction at 145g CO_2/km of control on CO_2 emissions from cars	6.8
Law no. 140 of 11 May 1999.	Rules concerning production activities: Art. 6: regulations on the re-financing and extension of incentives (for the acquisition of motorcycles and motor vehicles)	
Resolutions of the Interministerial Committee for Economic Planning of 20 November 1995 and 21 April 1999, l. no. 448/99, no. 488/99 and no. 388/00	3 series of financing decrees: a. 52 projects, total investment amounting to _7.3 billions, approved in 1999 b. 23 projects, total investment amounting to _2.2 billions, approved in 2000 c. 32 projects, total investment amounting to _1.9 billions, estimated but not approved yet.	2.6-3.2
MD 6.6.00 (financing deriving from Law no. 194 of 18 June 1998. art. 2, par. 5) Minister of Environment	Financing to the Regions for the replacement of buses for public transport in operation for more than 15 years.	
MD of 28 May 1999 Ministers of Environment, Transport and Treasury	Financial incentives to local authorities and private businesses for the acquisition of vehicles with zero or low emissions (hybrids, electric, methane, LPG cars) in urban areas with more than 150,000 inhabitants. (Law no. 426 of 9 December 1998)	1.0
MD of 20 December 2000 Minister of Environment	Incentives for the conversion to natural gas or LPG of non-catalysed vehicles.	
VA of 6 April 2001 Ministers of Environment, Productive Activities, Finance, Agricul-ture, ENEA, ANCI, Regions.	Promotion of "Bio-diesel" in the distribution networks and public means of transport.	
Law no. 403 of 14 October 1999 Minister of Foreign Affairs	Ratification and implementation of the Convention for the Protection of Alps of 1991; programme of measures in the sector of freight traffic from road to rail/sea	1.0
Law no. 27 of 18 February 2000 (conversion of Legislative Decree no. 484 of 20 December 1999, with modifications to Law no. 454 of 23 December 1997) Minister of Transport	Actions aimed toward the development of intra-modality systems, according to EU regulations, 1	
MD of 7 June 2000 (Ministers of Transport and Public Works)	Allocation to a Fund promoting the use of bicycles under Law no. 366/1998 and self-governing Regions and Provinces.	–
Resolution of the Interministerial Committee for Economic Planning no. 113 of 2 November 2000.	General Transport Plan including stabilisation proposals - on emissions to 2010 compared to 1990 levels.	–

Implemented measures	Description	Estimated reduction in 2010 ($MtCO_2$)
MD 20 December 2000 Minister of the Environment	Promotion of "Car sharing" – MD 20 December 2000	–
Minister of the Environment	Incentives for the planning of "mobility managers" in businesses, for the transport of passengers and goods.	–
MD 25 January 2000 Minister of the Environment	"Ecological Sundays"; co-financing of projects aimed at promoting public awareness to sustainable transport.	–
Circular no. 2708 of 30 June 1999. Ministry of Environment	Support to Ministerial Decree no. 163 of 21 April 1999 for the identification of health and environmental criteria according to which the Major must take steps aimed toward the reduction of urban traffic.	–
EU Directives	in application of Directive 2001/1/CE of the European Parliament and the Council of 22 January 2001, modifying Directive 70/220/CEE of the Council, concerning measures to be adopted against atmospheric pollution from motor-vehicle emissions. O.G. no.103 of 5 May 2001.	–
MD 1 June 2001 Ministry of Transport	Application of Directive 1999/96/CE of the European Parliament and the Council of 13 December 1999 concerning the rapprochement of the legislations of the Member States about the measures to be adopted against the emission of gaseous pollutants and polluting particulates generated by self-ignition engines for vehicle propulsion and against the emission of gaseous pollutants produced by spark-ignition engines fuelled by means of natural gas or liquefied petroleum gas for vehicle propulsion, modifying Directive 88/77/CEE of the Council.	–
MD 1 June 2001 Ministry of Transport	Application of modifications to Directive 1997/68/CE of the European Parliament and the Council of 16 December 1997 concerning the measures to be adopted against the emission of gaseous pollutants and polluting particulates generated by internal-combustion engines to be installed on non-road movable machines.	–
MD 25 July 2001 Ministry of Environment	Campaign "Ecological Days 2001" –	–
MD 2 April 2002 Ministry of Environment	Application of Directive 1999/30/CE of the Council of 22 April 1999 concerning limit values of ambient air quality for sulphur dioxide, nitrogen dioxide, particles and lead and of Directive 2000/69/CE concerning limit values of ambient air quality for benzene and carbon monoxide	–

buses and private taxis and contributes to lessening the congestion of routes where the demand for transport is high; this segment of transportation supply could be launched by incentives/tenders aimed at both public and private transport companies.

Informatic-telematic systems for freight transport

As has already been proposed in the PGT, given that considerable portion of the kilometres travelled by vehicles of heavy transport without working loads (10% - 25%), it is recommended that a voluntary agreement be reached with the Federtrasporto (industry board), providing incentives for the creation of one or more centres of coordination that can establish synergy among the initiatives already undertaken while assisting an increasingly large number of transporters to cover their "empty trips".

Reformulation of taxes on fuels

By the end of 2004 the Ministry of Finance should reformulate the excise taxes on fuels in such a way that, with the revenue flow remaining equal, fuels that cause less damage to human health and to the environment, as well as lower emissions of CO2, are promoted.

4.4.3.3 Infrastructures

The measures in question, already contemplated, and on a priority basis, under the "objective law" of 21 December 2001, should permit by 2010, when considered altogether, reductions of 3.6 Mt of CO2 (17.6 Mt at full operation), for energy savings of 1.1 Mtep (at full operation 2.0). The optimisation of the country's infrastructures is the primary justification for the investments.

Maritime transport. Implementation of the "Highway of the Sea" project

In light of Law no. 27/2000, as well as the voluntary agreement with the Confitarma, plus the impetus in this direction on the European-Community level, the investments made for the restructuring and modernisation of port structures will prepare Italy (which sits at the centre of the transport flows in the Mediterranean basin) to meet the growing demand for coastal shipping, making that mode of transport competitive even for voyages of less than 500 km .

Maritime transport. Reactivation and development of inland waterways.

The implementation of inland naval transport may be accomplished in a relatively brief period of time, and with significant levels of positive fall-out, with the investment priority being placed on the areas that lead to the market of Rome, to the "petrochemical rectangle" of Mantua – Marghera – Ferrara – Ravenna, as well as the Mestre – Treviso basin.

Completion of high-speed railway lines. Railway transportation – Extension of the local railway network.

Extension of the network is a measure needed to ensure balanced and sustained development. Particular attention is paid to the rail/road and rail/ship inter-modal connections, as well as to the reinforcement of passenger transportation on the commuter routes.

- New lines and the extension of existing lines: subways and bus transport on dedicated lanes (urban).

Among the European countries, ours is the least equipped with public transport structures using dedicated (single occupancy) lanes. The programs approved and currently being implemented have made possible improvements in the structural facilities of a number of cities, but the overall needs would appear to be significantly greater than the initiatives undertaken.

- Development of interconnectors and regional hubs

The projects to improve interconnectors and regional hubs prove to be a strategic tool for the entire national transportation system (freight and passenger); thanks to the reduction in traffic congestion, there will also be positive side-effects in terms of emissions.

Work on medium and long-range roadway infrastructures.

Though it can be assumed that significant amounts of transport (passengers and, to an even greater degree, freight) shall be transferred from the roadway mode to rail and ship, the demand for roadway transport is bound to continue rising. The national roadway network, plus its interconnections with other European networks, have, for some time now, shown themselves to be inadequate. The development of the infrastructures will make possible shorter routes and improved criteria for the utilisation of vehicles, with positive consequences for emissions as well.

4.4.4 Additional initiatives planned for the transport sector

The additional measures regarding the transport sector have been grouped into three main categories:

- technological/tax-related
- infrastructure work
- research.

Technological/tax-related

These are measures designed to limit consumption and emissions of pollutants (not only CO_2) by improving the average efficiency of the vehicles in circulation and instilling in users, through taxation, environmentally beneficial forms of behaviour.

- supplement to the Fiat-Acea agreement for the development of vehicles producing lower emissions

of CO_2 and incentives in the form of subsidies for the replacement of existing automobiles with new vehicles providing consumption rates lower than 5 lt/100 km (average CO_2 emissions equal to or lower than 120 g/Km); it is expected that a directive on the subject will be issued before the end of this year. Estimates show that this measure, should lead to reductions in CO_2 from 3.5 to 6 Mt, with energy savings of between 1.5 and 2.5 Mtoe following investments of from 1.4 billion and 2.4 billion euro and a decrease in external costs of approximately 1 billion euro.

- *Improvement in the energy efficiency of heavy transport vehicles*. The measure would make registration of vehicles used for transport dependent on compliance with more restrictive rules in terms of both consumption and emissions. At the same time, a voluntary agreement is to be reached with the industry involved. It is estimated that the measure would lead to reductions in CO_2 from 0.3 to 0.8 Mt, with energy savings between 0.1 and 0.3 Mtoe; there would be no cost, while a reduction of approximately 1 billion euro would be obtained in terms of external costs.

- *Bio-fuels.* There are plans for the blending of diesel fuel used in engines with bio-diesel (produced through the esterification of rape oil) up to a level of 5%. Within 4-6 years, the national industry could be capable of turning out an annual quantity of bio-diesel of between 1 and 1.3 Mt.. It is estimated that the measure in question would reduce CO_2 by 4 Mt, without any energy savings and with an overall cost of 15 million euro. Considering the time needed for the commercialisation of bio-diesel, it can be forecast that blending of the commercial product will begin in 2006 at levels of 1÷1.5%, reaching rates of 4÷5% in the year 2010. A similar measure would simultaneously lead to a annual decrease of approximately 1% in the national demand for oil. Plans call for a voluntary agreement with the companies involved in production and commercialisation, together with rules and regulations on the formulation of diesel oils sold to the public. There is the added possibility of a partial or total tax reduction for the bio-diesel fuel utilised.

- *Revision of the method for calculating the owner's tax on vehicles* so that it no longer reflects only the maximum horsepower of the vehicle, but also: a) the weight of the vehicle, in this way pointing users towards lower-weight vehicles, with significant advantages in terms of CO_2 emissions, lower consumption and less pervasive pollution; b) a return to annual vehicle inspections (see further on). It is estimated that this measure, in combination with the one that follows, would lead to a CO_2 reduction of 1.3 Mt and energy savings of 0.6 Mtoe, with a negligible overall cost and a reduction of 200 million euro in external costs.

- *Annual frequency of vehicle inspections,* including an inspection of the efficiency of the engine and the exhaust reduction devices.

- **Improvement of quality and standardisation of fuels** beginning in 2004:

- *Reduction of the maximum level of sulphur allowed in gasolines:* this measures is an irreplaceable precondition to the development of vehicles with low or extremely low levels of consumption.

- *Setting of Lpg commercial standards:* a normalised product that is free - or almost - of olefins is a precondition to the development of dedicated engine systems, as well as to the continued progress of today's most widely used post-conversion systems.

- *Setting of commercial standards for natural gas:* the "normalisation" of natural gas supplied for motor propulsion would appear to be an indispensable step towards achieving significant development of this fuel.

- **adjustment of excise taxes on fuels and financing of national sinks**. Given the difficulty of reducing emissions in the transport sector, it is proposed that the industry be assigned the absorption potential of the sinks, both domestic and abroad; a reformulation of the increases in excise revenues resulting from the carbon tax could make possible the financing of internal measures of forestation/reforestation and/or other measures relating to the sinks. The increases in the excise tax (or the allocation of a portion of the existing tax) for the financing of these costs amounts to 0.005 euro/unit of sale to the public.

- **promotion of campaigns to heighten awareness regarding methods of driving vehicles**

Given that no small percentage of wasted fuel and excess emissions is the result of the ways in which vehicles of individual transport are driven on a daily basis, campaigns designed to heighten awareness among roadway users would be able, even in relatively brief periods of time, to have extremely positive consequences on emission levels (and not only those of CO_2), as well as on fuel consumption and roadway safety. It is estimated that this measure would reduce CO_2 by 0.2 Mt, with energy savings of 0.1 Mtoe, an overall cost of 36 million euro and a reduction of 15 million euro in external costs.

Measures involving infrastructures

It is estimates that such measures would reduce CO_2 by 0.4 Mt, with energy savings of 0.2 Mtoe, overall costs of 610 million euro and reductions of approximately 80 million euro in external costs.

- **promotion and development of automobile transport on trains**. This service, which has been offered for many years now, offers interesting pos-

sibilities for reducing emissions and contributing to limiting fuel consumption. A measure that will have positive consequences for medium to long-range trips is the functional integration of the parking exchanges with the zones where the vehicles are loaded onto the trains. There are plans for a program agreement with the Trenitalia company. It is estimated that a similar measure would reduce CO_2 by 0.6 Mt, with energy savings of 0.2 Mtoe, overall costs of 30 million euro (of which 20 funded publicly) and a reduction of approximately 40 million euro in external costs.

- **reorganisation of urban traffic** by means of:

• *car pricing*: setting of a fee for entry of vehicles into metropolitan areas;

• *introduction of taxi-buses* into roads with the highest demand for traffic;

• *activation of computerised systems for traffic management and control of traffic lights*, which determine the fuel consumption for the distance travelled, as well as the related emissions;

• *restrictions on access to historic downtown areas* based on the emissions levels of motor vehicles.

Research efforts involving transport

Support for research into vehicles that are intrinsically more efficient and operated with fuels that contain lower levels of carbon is worthy of note among measures designed to reduce emissions of greenhouse gases, in addition to which it could contribute significantly to the modernisation of Italy's transport system as a whole and to roadway safety. The following topics deserve mention:

• Optimised single-fuel natural gas engines.

• Optimised single-fuel lpg direct-injection engines.

• Fuel-cell propulsion system for roadway transport.

• Fuel-cell propulsion systems for rail / maritime transport.

• Development of materials to reduce the mass of vehicles and trains.

• Production/Distribution of hydrogen from hydrocarbons.

It is estimated that the above research efforts can lead, by 2010, to reductions of between 0.8 and 2.1 Mt in CO_2, with energy savings of between 0.4 and 1 Mtoe (though, at full operation, the figures would be 24 Mt CO_2 avoided and 12 Mtoe saved), at overall costs varying from 1.6 billion to 4.2 billion euro, of which 1/3 would e paid by the public sector.

4.5 Residential, commercial and service sectors

4.5.1 Measures implemented in the residential and tertiary sector

The measures implemented can be classified under three categories: use of fuels with a lower carbon content, increased building insulation and promotion of more efficient equipment, both electric and thermal. A list of the measures adopted and their estimated effects on emissions is found on table 4.9.

The ***use of natural gas*** in residential units registered significant increases in the years following 1990 and is expected to continue growing in the years to come; this remains the most economical measure for reducing emissions. Tied to this measure is the increased use of more efficient equipment (boilers and components) to heat buildings.

The legislation developed for the ***implementation of Law 10/91***, and in particular art. 4C, points 1 and 2, has reduced energy consumption in new buildings by 10% within the last two years, compared to the 1990 levels. It has been estimated that annual residential and service-industry emissions, which total to 100 Mt CO_2, could be reduced by 3% through application of this law. Given the nearly 2% growth rate in the number of residential buildings, however, reaching this reduction objective would appear to be a difficult task.

Measures involving the labelling of home appliances, as well as more efficient electrical devices in general, also play an important role in reducing the consumption of electricity in buildings. In technical terms, an estimate of the impact of these measures on emissions is fairly straightforward, though framing the results in this type of study is rather complex, with one of the concerns being to avoid double evaluations of savings:

- in terms of overall trends, the impact of these measures is included in the estimate of growth in the consumption of electricity;
- regarding the current electricity consumption levels, as well as theoretical levels without the measures, reference should be made to chapter 2, indicators for the domestic sector. Establish a comparison with the average levels on other European countries, better than any other calculation, demonstrate the greater efficiency, on a national level, in this sector;
- the impact of further increases in the use of more efficient appliances/components is evaluated in the electricity sector (see paragraph 4.2) and included in an estimate on the potential for reducing emissions of the legislative decrees of 24 April 2001, described in paragraph 4.5.3., on energy efficiency.

4.5.2 Measures implemented before and after 1998

Some of the measures described and/or summarised in the preceding paragraph were implemented before the Kyoto accords and some afterwards. A detailed evaluation of the measures adopted before and after the Kyoto accords can be found in Ecofys, 2001. A detailed analysis of al the measures is also available in the SCN, chapter 5.

4.5.3 New initiatives already approved for the civil sector

4.5.3.1 Decrees on final uses (M. D. 24 April 2001)

As mentioned earlier, these decrees represent the

Table 4.9 – List of measures implemented in the residential and tertiary sector

Implemented measures	Description	Estimated reduction in 2010 ($MtCO_2$)
Various decrees	Increase in the use of natural gas in the residential and service-industry sectors	8.0
Implementation of Law 10/91	Reduction in heat consumption of new residential and service-industry buildings	3.7
Implementation of Law 10/91, Art. 4, Paragraphs 1-2	Reference criteria for the insulation of constructions. As of 1999 reduction of 10% in CO2 for new constructions built in last two years.	
Implementation of Law 10/91	Reduction in consumption of heat in restructured buildings.	2.0
Law 449/97. Art 31	Income tax (IRPEF) deduction allowed for 41% of restructuring expenses. Only in force since 1998 and 1999	
Resolution 137/98 of the Inter-Ministerial Committee on Economic Planning - AV	Introduction of a code of self-regulation in the energy-environmental sector for the buildings of the Public Administration	
AV with ENEL (2000)	Information campaign to increase use of high-energy-efficiency light bulbs, eliminate large-size, inadequate electric motors and promote heat pumps and microwave ovens.	–
EU Dir. EU	Standards for home appliances, labelling	–
MD of 10 July 2001, Ministry of Productive Activities	Endorsement of Directive 98/11/EC, passed by the Commission on 27 January 1998 to set the procedures for application of Directive 92/75/EEC of the Council regarding labels indicating the energy efficiency of light bulbs for use in the home.	–
EU Dir.	Application of Eco-labels in old constructions. Implementation planned for 2002.	–
Implementation Law 10/91	ENEA and FIRE courses and information on energy efficiency. DSM measures: heat pumps and cogeneration	–
		–
3 April 2001 National project	"Solar Town" program. Aimed at local government bodies and regional governments in central-southern Italy that want to install solar-energy systems for the production of hot water in public buildings. Also calls for young people to be trained for employment in the solar-energy sector.	–
3 April 2001 National project	"Solar Thermal" program: municipalities with more than 50,000 inhabitants and municipally owned gas distribution enterprises are able to present, starting from 3 April 2001, applications for financing to back the low-temperature production of heat.	–
June 2001 Inter-Ministerial Agreement Ministries of the Environment and Justice	National Program for Introducing Solar Energy in Italian Penitentiaries: shall result in the installation of 3,000 m2 of collectors in 5 years.	–
MD 26 March 2002 Ministry of Productive Activities	Implementation of Directive 2000/55/EC of the European Parliament and Council on the energy-efficiency prerequisites of the power-feeds for fluorescent lights.	

most important measure already approved for the sector. In terms of the accounting, their contribution has been entered under the electrical sector, paragraph 4.2, but their application is discussed in this context.
The decrees issued by the Ministry of Industry on 24 April 2001 set the national quantitative objectives for energy savings and the development of renewable sources, together with quantitative objectives for increasing the energy efficiency of final uses. The degrees translate into a wide variety of actions: for example, the use of more efficient boilers, of fluorescent lamps, of solar collectors for the production of hot water, of double-paned windows etc.. The objectives of the decrees are indicated in Mtoe of energy saved for each year of the period 2002-2006.
The subjects that must meet the obligations set under the decrees are distributors of electric energy and gas which, as of the end of the year 2001, served at least 100 thousand clients. In practical terms, the group consists of approximately 30 subjects that have been assigned a specific mandatory objective calculated as a part of the national objective, based on the proportion between the energy distributed by the individual distributor and the national total.
The projects are financed with the resources of the parties making the proposals, but also with other resources, such as financing from the State, the European Community or the regions, or from the beneficiaries of the energy savings (the so-called participating clients). Fee-coverage mechanisms can be introduced for the costs not covered by other resources (decision taken by the AEEG).

Based on initial estimates drawn up by a number of important regions in preparing their energy plans, the necessary investments are on the order of 10 euro/t of CO_2 reduction, a cost which results in a NPV of investment that is positive by a clear margin.

The decrees call for sanctions to be levied against distributors that fail to respect their annual objectives.
The projects for the promotion of energy savings consist of initiatives that result in the installation of highly efficient equipment (bulbs, motors, sources of heat and cooling), regulating devices to achieve more efficient final uses of energy or passive casings that decrease energy loss (double-paned glass, insulation).
The results produced by each project are valid for a maximum period of 5 years.

4.5.4 Additional initiatives planned for the residential and tertiary sector

4.5.4.1 Extension of effect of decrees on the efficiency of final uses
There are plans for the ministerial decrees of April 2001 to remain in effect beyond 2006, with the same annual increases as those set for the period 2002-2006: the result would be a further reduction – in addition to that estimated for the year 2006 – of from 3.8 to 6.5 Mt CO_2 from an investment that, as of 2010, would total between 19 and 33 million euro. The instrument of implementation and incentives would be the same as that proposed by the Authority for Electric Energy and Gas for the initial period of 2002-2006.
The presence in many regional energy plans (P.E.R.) of noteworthy measures and objectives for savings in the civil sector by 2010 serves as a guarantee of the effectiveness of this extension; for that matter, a parallel line of initiatives has already been identified on the regional level (see, for example, the provisions of the P.E.R. of Lombardy, Emilia Romagna and Liguria).

4.5.4.2 More extensive use of thermal solar energy
A major basin of energy demand that can be satisfied with renewable sources is represented by low-temperature thermal uses. Today there are a number of different technological opportunities for the use of thermal solar energy that prove worthwhile, in absolute terms, for certain types of consumption. It is important that energy policy initiatives not neglect these opportunities.
Solar energy is definitely better suited to the construction of small-scale plants than to that of large-scale facilities which prove difficult to operate.
It is predicted that investments can be made for potential energy savings of 70,000 t.o.e., which would result in reductions of approximately 0.2 Mt in CO_2 investments. Overall investments are estimated at 800 million euro, with a negative VAN of 160 million euro and a unit cost, assuming the investment will last for 20 years, of 40 million euro. The objective can be reached, given that the market for panels in 2001 showed an order of magnitude of roughly 40,000 m2, with constant growth in the last few years. There are examples of high levels of penetration of thermoelectric solar energy in the domestic sectors of other European countries, with percentages that rise as high as 70% of the homes in certain areas of the Mediterranean.

4.5.4.3 Regional measures in the residential and tertiary sector
Listed below are examples of regional initiatives that contribute to reaching the Kyoto target and are directed at the civil sector. The regional governments and the local government bodies shall

play an increasingly important role in this sector, given that all the initiatives fall under their responsibility from 2002 on. At present there is a lack of sufficient information on the measures and guidelines adopted on the local level.

Lombardy (July 2002)
Lombardy is pursing an "objective scenario", with the aim of fulfilling its portion of the 6.5% reduction assigned to Italy; 1/3 of the efforts towards this objective involve internal measures, while 2/3 consist of flexible mechanisms. The overall estimates for the "objective scenario" point to: a reduction of 2.7 Mt of CO_2 in the residential sector as of 2010 on investments of 27,319,000 Euro (54.238 billion Lire); a reduction of 0.76 Mt of CO_2 in the sector of the services industries and the Public Administration on investments of 7,711,000 Euro (15.267 billion Lire).
Measures of implementation:
• Energy certification of buildings: supported by Law 10/91, Legislative Decree 112/98, transformed into regional legislation in Lombardy with Law 1/2000 and EU Directive proposal 2001/0098; objective: to develop and implement, eventually in a coordinated effort with other Italian regions, a procedure for the energy certification of buildings.
• Home appliances with high levels of energy efficiency: promote, possibly through voluntary agreements, the increased use of high-efficiency appliances by home consumers (refrigerators, washing machines, lighting and air-conditioning) and in the public-lighting sector.
• Integration of renewable energy sources in buildings: supported by Law 10/91, with the goal of achieving relevant use of renewable or comparable sources of energy in restructuring projects within the Public Administration while setting minimum requirements of energy efficiency and promoting bio-climactic construction.
• Promotion of Facility Management and Energy Manager efforts: supported by Law 10/91 and involving training initiatives, plus activities designed to heighten awareness and spread information on the role of Facility Management and the figures of the Energy Manager, with financial support as well.
• Energy-efficient technology in public procurement: art. 4, paragraph 7 of Law 10/91, with the issue of measures meant to achieve significant progress towards the goal of introducing rational energy use and the use of renewable sources among the criteria for awarding economically significant contracts for the supply of goods and services to the Public Administration;
• Energy audits in the service industries and in the Public Administration: promoting the increased use of methodologies of energy diagnostics in various sectors with forms of financial support.
• Third Parties Financing (TPF): recommended under EU Directive no. 93/76, the resolution of the Inter-Ministerial Commission for Economic Planning approving the PNSS in implementation of Agenda XXI, with increased use of the TPF within the Public Administration and among private parties with a significant level of energy spending, plus establishment of a fund, under the auspices of the regional government, for promotion of the increased use and exchange of guaranteed energy-savings certificates.
• The Ministerial Decrees of 24 April 2001: the regional quantitative objectives for energy savings estimate, as of 2006, cumulative EE savings of 4,750 GWh (400 ktoe) plus savings of gas (400 ktoe).

Emilia Romagna (March 2001)
The Emilia Romagna region has committed itself to reducing emissions of CO_2, starting from the 1990 level, by 2 Mt as of 2010; taking into consideration a scenario that points to a spontaneous growth trend, a reduction of 7 Mt in CO_2 emissions by 2010, compared to the 1990 level. For the building sector, the commitment is estimated at 1.40 Mt of CO_2, with energy savings of 550 ktoe on an investment of 3.357 billion Euro (6.5 trillion Lire).
• Promotion of Facility Management and Energy Manager: supported by Law 10/91 and involving training initiatives, plus activities designed to heighten awareness and spread information on the role of Facility Management and the figures of the Energy Manager, with financial support as well.
• Integration of renewable energy sources in buildings: supported by Law 10/91, with the goal of achieving relevant use of renewable or comparable sources of energy in restructuring projects within the Public Administration while setting minimum requirements of energy efficiency and promoting bio-climactic construction.
• Systems of thermal regulation and heat accounting
• Re-phasing at the final user
• Electric motors with high energy efficiency
• Lighting systems: automatic systems for turning lights on and off; increased energy efficiency in the sector of public lighting;
• Replacement of electric water heaters with natural-gas devices
• Appliances and office machinery with high levels of energy efficiency.

Liguria (2001)
The regional government intends to pursue stabilisation of emissions at the levels of the year 1990, a key objective in light of the projected growth trend of 2-4% in emissions in the transportation sector by 2010. With the following measures, the regional

government intends to achieve, by 2010, overall savings of 10% of total regional energy consumption (344 ktoe).
• energy-related renovation of buildings: upgrading of buildings constructed before 1981 to bring them in line with Presidential Decree 412/93; the initiative would lead to a reduction of 3.4% in regional energy consumption (118.5 ktoe/year) and could be adopted, in part, through incentives;
• energy certification of buildings: must become obligatory for the sale and rental of real-estate units;
• insulation of the building shell: potential energy savings of 27% per residential unit;
• insulation of roof alone: potential energy savings of 12% per residential unit;
• replacement of existing boilers with modern gas boilers offering high levels of energy efficiency: potential energy savings of 13% per residential unit;
• thermal regulation systems: potential energy savings of 10% per residential unit;
• scheduled maintenance: contemplated under Presidential Decree 412/93, leads to energy savings of 3-5% on recent systems and 17% on old systems;
• development of Regulatory Plans and Cons-tructions Regulations: providing incentives for bio-architecture, solar energy, sustainable construction and energy savings;
• third party financing commitee: recommended under EU Directive no. 93/76, the resolution of the Inter-Ministerial Commetee for Economic Planning approving the PNSS in implementation of Agenda XXI, with increased use of the TPF and development of ESCO (Energy Service Companies).

4.6 Inter-sectorial strategies

The measures and commitments for which different sectors are responsible offer maximum effectiveness when appropriately coordinated and supported by actions that encompass more than one sector of economic activity. This section addresses measures involving sectors which were not directly discussed in the preceding sections.

Law 448/98, which introduced the carbon tax, mentioned that the Government would be able to draw on a portion of the resulting revenues for use as compensation for the measures taken in the different sectors and as subsidies for the reduction of emissions, for the promotion of energy efficiency and for the development of renewable sources.
The carbon-tax, for that matter, was supposed to have been gradually increased between 1999 and 2005; instead, on account of the high price of oil, it was frozen at the 1999 levels.

Law 388/00 proposes a number of different procedures for the reduction of emissions: specifically, lower taxation on products that permit decreases in emissions, such as bio-diesel, together with the promotion of energy efficiency and renewable sources.

4.6.1 Inter-sector measures implemented

The main inter-sectorial measures are summarised on table 4.10 below.
Estimates of the results obtained are not given in order to avoid counting the same reductions twice. In fact, nearly all the measures are either complementary to specific technological initiatives in the individual sectors or simply group together measures involving one or more sectors. The first example is the carbon tax, which should contribute to promoting more widespread use of automobiles with low levels of energy consumption, while the second example is provided by measures which regard the sectors of agricultural and forestry and which have already been evaluated, in terms of their effects, in the individual sectors.

4.7 Emissions from non-energy sources

The measures presented in the following paragraphs can be implemented without using any specific financial support or incentive, given the fact that they are characterised by negative emission-reductions costs. None of them are included in the trend scenario or in the reference scenario, despite the fact that many of these generally present excellent cost-benefit relations.

4.7.1 Industrial Processes

Reduction of N_2O emissions from the production of adipic acid and nitric acid

These two interventions can result in significant reductions in the emissions from industrial processes, with extremely limited reduction costs. In the case of adipic acid, the planned course of action calls for the adoption in Italy of the devices (thermal or catalytic) already used in the other European countries for the treatment of effluent gases. The measure referred to consists of a voluntary agreement with the only enterprise involved.
As for nitric acid, the most advanced technology calls for installation of SCR (selective catalytic reduction) systems for the treatment of process gases. The cost of reduction is relatively limited, amounting to less than 0.5 Euro for CO_2 equivalent ton. The proposed measure consists of a voluntary agreement with the respective industrial sector.

4.7.2 Agriculture

Energy consumption in agriculture

Organic agriculture is experiencing rapid growth, primarily as a result of the incentives provided

Table 4.10 – List of the inter-sectorial measures implemented

Measures implemented	Description
Law 448/98, Art. 8	"Carbon tax". Frozen at 1999 levels
Law 388/2000	Art 22: products that contribute to environmental protection exempted from taxes. Art 23: tax reductions for some sectors Art 110: fund for measures geared towards reducing emissions of CO_2 and increasing energy efficiency.
Legislative Decree no. 227 of 18 May 2001	Reorganisation and modernisation of the forestry sector, in accordance with article 7 of Law no. 57 of 5 March 2001. Regulates agricultural and forestry development in compliance with the objectives of sustainable development
MD of 21 May 2001	Distribution of financing to regional programs on the "Carbon Tax". Appendix 1 illustrates the break-down by region of the financing for the programs of
MD of 4 June 2001 Ministry of the Environment, Finance, Productive Activities	Programs of national importance involving emissions of greenhouse gases, in implementation of art. 3 of MD no. 337 of 20 July. Appendices 1 and 2 to the present decree identify the public entities responsible for implementation, as well as the presumed time period necessary for the performance of the national programs, plus the elements used to identify programs of national and international cooperation
Law no. 120 of 1 June 2002	Ratification and enactment of the Kyoto Protocol to the UN Framework Convention on Climate Change, established in Kyoto on 11 December 1997
Law no. 118 of 16 June 2002	Conversion into law, with modifications, of Legislative Decree no. 68 of 19 April 2002, containing urgent measures for the animal husbandry sector and for the fight against forest fires.

under EU Regulations no. 2078/92; the agricultural surface area on which the methods of organic agriculture are practiced, equal to 91,500 hectares in 1993, had already reached 1,069,339 hectares in the year 2000. Assuming that the specific level of energy consumption of organic agriculture is 30% lower than that of traditional agriculture, a projection through 2010 of current growth trends in the sector shows that the emissions avoided could total 0.337 Mt CO_2. This figure could be reduced to 0.28 Mt CO_2, taking into account the possible saturation of the sector, as well as the fact that the lower level of energy consumption in the production of fertilisers is considered under another item of the emissions inventory.

Emissions of nitrous oxide from agricultural soils

The emission reductions in question can result from a rationalisation of the use of fertilisers, with a subsequent limitation of the consumption and related emissions of nitrous oxide from agricultural soils. Of essential importance to achieving the above objective are:

- ongoing efforts to increase awareness of the practice, plus
- the adoption of codes of good agricultural practice.

On this subject, Italy has been one of the first countries of the European Union to draw up, under the provisions of EU Directive no. 676/91, a

Table 4.11 – Additional measures for industrial process emissions (not established)

Description	Estimated reduction in 2010 ($MtCO_2$)
Reduction of N_2O emission from the production of adipic acid	5.981
Reduction of N_2O emission from the productions of nitric acid	0.157

Table 4.12 – Additional measures in the waste sector (not established)

	Estimated reduction in 2010 (MtCO2)
Stabilisation of organic fraction, 50% of the biodegradable municipal waste as of 2010	*0.64*
Energy recovery from municipal waste, 30% of the municipal waste as of 2010 (+500 MWe)	*0.33*

"Code of Good Agricultural Practice for the Protection of Water from Nitrates", adopted under Ministerial Decree no. 86 of 19 April 1999. By combining these recommendations with others specifically aimed at protecting the atmosphere and the climate (such as the use of controlled-release formulas), additional, limited reductions could be achieved in the consumption of fertilisers, on the order of 5% as of 2010, compared to the levels of 1990, thus resulting in an estimated decrease of 0.46 CO_2 equivalent Mt.

Emissions of methane from manure management

The proposed initiative involves covering the holding tanks used to store liquid animal waste and then conveying the resulting biogas to combustion or cogeneration plants. The primary focus of the activities would be pigs (between 10% and 40% of the animals) and, to a relatively limited degree, cattle, with a reduction in methane emissions of between 7 and 39 kt of methane per year, at an overall cost of from 6.2 to 33.2 million Euro per year.

An analysis of the investment, taking into account the value of the electricity produced, generates a positive NAV, though the result is not sufficient to convince the operators involved to invest. The dimensions of the initiative would depend on:

- the level of incentives available for the production of electricity from renewable sources, and
- the availability of subsidies for the construction of the systems.

Another measure oriented towards this same objective is Directive 96/61/EC (Integrated Pollution Prevention and Control, or IPPC), which calls for the introduction of licensing processes based on the adoption of the best possible technology available for poultry farms with more than 40,000 birds and pig farms with more than 2,000 animals (heavier than 30 kg) or 750 sows. In terms of structural initiatives for existing facilities, financial incentives could be drawn from within the Rural Development Plans (PSR) financed by the FEOGA.

4.7.3 Waste: Stabilisation of the organic fraction and energy recovery

Two initiatives are proposed:

- fulfilment of the deadlines set for the reduction of the biodegradable fraction of the municipal waste in landfills, as stipulated under Directive 99/31/EC, which calls for a reduction of 50% as early as 2010, compared to the 1995 level, in the quantity of biodegradable municipal waste to be placed in landfills, making for a forecast decrease of 0,64 Mt;
- substantial respect of the objectives of Legislative Decree 22/97, in particular as regards the recovery of energy from waste: it is assumed that, by 2010, the portion of municipal waste sent to energy-recovery treatments shall be 30% (in line with the indications of the "White Book on the Energy Optimisation of Renewable Sources", ENEA, 1999), making for an additional increase of 500 MWe municipal electrical capacity from waste, compared to 2000, with a decrease in equivalent CO_2 of 0.33 Mt. The measures and incentives that shall hopefully be established are similar to those contemplated above for the renewable sources, and in particular for the energy use of waste.

4.7.4 Fluorinated gases

Four possible measures are currently being given consideration in this delicate sector:

• Aluminium. The recycling of aluminium not only generates the economic benefits due to reduced imports of the raw material and lower energy consumption, but also makes it possible to avoid emissions of PFCs from the processing of the raw mineral. We have assumed that, on the quantity of recycled aluminium will grow, between now and the year 2010, up to approximately 80% of the total consumption of this metal.

• Production of semi-conductors. A limited initiative consisting of the installation of abatement devices and the use in the etching process of fluids with a lower level of GWP is currently being studied. The European industry has voluntarily agreed to limit its emissions in 2010 to a figure 10% lower than 1995 levels.

• Mobile air conditioners. Reduction of from 10%

Table 4.13 – Additional measures for fluorinated gases (not established)

Description	Estimated reduction in 2010 ($MtCO_2$)
Reduction of PFC emissions through aluminium recycling	0.05
Installation of abatement devices and adoption of low GWP substances in the production of semiconductors	0.02
Reduction of HFC leaks from mobile air conditioners	0.65
Reduction of SF_6 leaks from electric equipment	0.04

to 5% in the rate of leaks from mobile air conditioners, to be obtained through adjustments made during the design phase of the systems and during the maintenance phase. These initiatives shall be promoted under the European framework-directive currently up for discussion.

4.8 Forestry sector

The measures contemplated in the sector "land use, land use change and forestry" for the generation and certification of carbon credits during the period 2008-2012 are summarised on table 4.14.

Table 4.14 – Maximum national potential for carbon removal

ACTIVITIES FOR CARBON REMOVAL CARBON WITHIN THE NATIONAL TERRITORY	Removal (Mt CO_2)	Investment (Millions of euro)
Art. 3.4 Forest management	4.1	10.0
Art. 3.3 Afforestation and Reforestation (old plantings)	1.0	6.0
Art. 3.3 Natural reforestation	3.0	6.5
Art. 3.3 Afforestation and Reforestation (new plantings)	1.0	200.0
Art. 3.3 Afforestation and Reforestation (new facilities in areas subject to hydro-geological imbalances – Law 183/89)	1	300
Art. 3.4 Agricultural land, pastures and re-vegetation	0.1	4.2
Total	**10.2**	**526.7**

• Electrical equipment. In addition to the results already achieved by manifacturers, the following assumptions have be en made: 1) stabilisation of manifacturing emissions at 2000 levels; 2) reduction of the leakage rate from installed equipment up to 0,5% by 2010; 3) reduction of the leakage rate from end-of-life equiment up to 1% by 2010. This will require the negotiation of an agreement between manifacturers and the Ministry for the Environment (also users shall be included as concerns the disposal of the systems).

Electrical equipment

In the case of the sulphur hexafluoride contained in electrical equipment, consideration was given to the effects of a scenario in which the leakage rate of installed equipment is reduced, by the year 2010, from 0.9 to 0.45%, while the leakage rate for equipment at the end of its life cycle falls from 3 to 1%.

A brief description is also given for each of the activities listed.

4.8.1 Forest Management (art. 3.4)

For Italy, the limit assigned by the UNFCCC was set at 0.18 Mt of C per year (the equivalent of 0.66 Mt of CO_2). The figure is clearly underestimated. There are two main causes for the underestimate:

1) The quantity considered by the FAO under the "Global Forests Resources Assessment 2000" and the "State of World's Forests 2001" regards the area of Italy's controlled forests (meaning those in which a multi-year management plan approved by the forestry authorities is in force), which is equal to approximately 10% of the total forest area; the area of Italy's managed forests, on the other hand, is much larger, given that Law no. 3267 of 1923 places all Italian forests under the Measures of General Operation and Forestry Policy;

2) The National Forestry Inventory has not been updated, and the system of forestry statistics is currently being revised;
The figure assigned to Italy can be modified, though, for this to be done, new and significant amounts of inventory data must be supplied to the Secretariat of the UNFCCC by June 2005, so that the figure can be corrected by 31 December 2006. From a technical perspective, the National Forestry Inventory of Carbon (INFOCARB) should be created by 2005. This inventory must then be updated every 5 years, corresponding to the end of the period of commitment under the Kyoto Protocol (meaning that the first update should be ready for 2012).

4.8.2 Afforestation and Reforestation activities (art. 3.3)
The condition that must be met in order for the planting to be considered valid for the purposes of generating carbon credits is that the reforested area have been free of forest since at least 1 January 1990.

There are no limits on the use of the carbon credits granted (RMU), and certification can be obtained for all the carbon accumulated in the biomass and in the dead material of the planted area (trunk, branches, leaves, roots, organic substance) from 1 January 2008 onwards.
Different categories of reforestation/afforestation activities can be considered under article 3.3:
a) the plantings performed (old plantings) under EEC Regulation 2080/92, which total 117,428 hectares. The lone cost to be sustained is their certification, which falls under the cost of the creation and management of the National Register of Agro-Forestry Carbon Storage pools. The carbon level for the first period of the commitment (2008-2012) is estimated at approximately 1.0 Mt CO_2;
b) so-called "natural reforestation", which includes the natural expansion of the forested area as a result of policies for the reduction of farming-pasture surface area and for the protection of the environment. Eligibility for carbon certification for the period 2008-2012 is tied to providing proof that these areas were the result of agricultural-environmental policies (human induced). The lone cost to be sustained is that of certification, which falls within the cost of creating and managing the National Registry of Agro-Forestry Carbon Storage pools. The levels of carbon set for the first period of commitment (2008-2012) is estimated at 3 Mt CO_2;
c) the new plantings to be made during the period 2003-2008, forecast at 40,000 hectares, for an average removal of 1 Mt CO_2 during the period 2008-2012 and of 20 Mt CO_2 at the maturity. These domestic plantings offer major advantages in term of the certification of carbon credits, and especially as regards reaping the full fall-out of the benefits generated by reforestations on Italy's economic and environmental systems. The planting operations require an average of 5,000 euro per hectare, including the cost of certification (which is completely absorbed by the National Registry of Agro-Forestry Carbon Storage pools) and the cost of occupying the terrain (which must either be zero or be compensated for by the sale of the property rights to the wood materials and by the sale of the contribution).
New plantings carried out in areas subject to hydro-geological imbalance (Law no. 183 of 18 May 1989) will present major advantages in terms of defence of the territory, prevention of hydro-geological risks and the reduction of damage due to imbalances. In fact, the tree cover, in addition to reducing the erosive action of the rain on the land is capable of sharply reducing the peak flows of floods (by as much as 90%) and increasing bank reinforcement times (by a factor of 2 to 7). It is estimated that planting operations cost an average of 10,000 euro per hectare, with the portion regarding the hydro-geological reclamation of the area being charged against he funds referred to under Law no. 183/89. The operating capacity of the Basin Authorities is approximately 6,000 hectares of reforestation per year for the period of 2003-2012, making for a total of 60,000 hectares. Average removal for this type of planting is estimated at 1 Mt CO_2 for the period 2008-2012 and at 10 Mt CO_2 at the maturity.

The type of planting shall be the same for all the afforestation and reforestation activities (art. 3, art. 6 and art. 12) carried out for the purposes of the Kyoto Protocol.
It has been deemed necessary to use two series of species in each planting: one featuring rapids growth and high rates of CO_2 removals but a low capacity for storage of the carbon in terms of both space (t/hectare) and time (meaning a low carrying capacity of the system, with rapid saturation), plus another set of species with slow initial growth but a capacity to ensure, for lengthy periods, high rates of growth and, most importantly, an elevated capacity for storing the carbon, in terms of both space (t/hectare) and time (meaning an elevated carrying capacity of the system, with slow saturation). A correct combination of the two groups of species makes it possible to obtain a planting that presents excellent initial rates of growth and, even more importantly, a high capacity for the storage of carbon.

4.8.3 Agricultural, land pastures and re-vegetation (art. 3.4)
The costs currently forecast for this activity involve the preparation of a special study-plan designed to

estimate the quantities of carbon absorbed/emitted by these activities, given the complete lack of data in the literature. This study-plan is necessary in order to arrive at a proper reporting within the framework of the Kyoto Protocol. Average removal of 0.1 $MtCO_2$/year is estimated.

4.8.4 National Register of Agro-Forestry Carbon Storage Pools

The National Register of Agro-Forestry Carbon Storage Pools is the tool for certifying the quantities of carbon removed by Italian agricultural and forestry system.

The registry provides an overview of the use made of Italian soil, placing within this picture the statistical data on the carbon contents of the different categories of agricultural and forestry activities. Certification of carbon credits will be a direct consequence of the accounting of the variations in the carbon contents of the aforementioned categories. The Register must analyse variations in the flows of greenhouse gases for the activities referred to under articles 3.3 and 3.4. These activities (forestry; agricultural land and the pasturing of livestock; re-vegetation) differ from each other in terms of the procedures used to calculate the carbon credits generated.

4.8.5 Re-vegetation

The term re-vegetation refers to all vegetable categories with a minimum extension of 0.05 ha not falling under the definitions of afforest or forestation/reforestation. An evaluation must be carried out to determine which types of vegetables and wood crops should be taken into consideration, quantifying the increases. Based on an analysis of the data, it must be decided whether or not to include these activities among the supplementary initiatives referred to under art. 3.4 of the Kyoto Protocol. The procedures for the accounting of the carbon credits are the same as those used in the agriculture-pasturing sector.

The Register shall ensure the necessary annual monitoring of the agro-forestry storage sites (agricultural land; forest soil, biomass and dead matter) in order to up date the estimates of the flows on a constant basis while registering the carbon credits generated.

4.9 Flexible Mechanisms

The present section addresses the use of flexible mechanisms: Emissions Trading, Clean Development Mechanism (CDM) and Joint Implementation (JI) project. These mechanisms complement internal policies, often on account of their greater convenience in terms of the unit cost for reducing emissions.

On the subject of Emissions Trading, it is calculated that the market price of a share of emissions (mean-

The following table summarises the situation for domestic plantings:

Table 4.15 – Plantings of domestic forestation

	CO_2 removal rate		
	Low [1]	Average [2]	High [3]
Hectares reforested per million credits generated during life cycle (50 years)	4,000	2,000	1,300
Cost per carbon credit during life cycle (50 years)	20	10	6.5
Hectares reforested per million credits generated in 2008-2012	100,000	40,000	30,000
Cost per carbon credit in 2008-2012	500	200	150

1 Average removal of 5 t hectare/year of CO_2 is assumed for the life cycle of the planting (50 years), while a figure of 2 t hectare/year of CO2 is assumed for the period of 2008-2012

2 Average removal of 10 t hectare/year of CO2 is assumed for the life cycle of the planting (50 years), while a figure of 5 t hectare/year of CO2 is assumed for the period 2008-2012

3 Average removal of 15 t hectare/year of CO2 is assumed for the life cycle of the planting (50 years), while a figure of 7 t hectare/year of CO2 is assumed for the period 2008-2012

ing the right to emit an equivalent ton of carbon dioxide) should be placed inside a spread of between 20 Euro and 33 Euro (estimates of the PRIMES model). These prices must also be considered as prices that fall within the upper portion of a probable price spread, given that the political accord reached at the sixth conference of the parties to the agreement in Bonn, held in July of 2001, calls for a series of decisions that will probably lead to a lowering of the prices.

As regards the cost of the lowering of emissions achieved under the CDM and JI projects, it should be remembered that the complexity of their monetary evaluation is tied to the multiple array of possible initiatives. The monetary volume of the CER and the ERU generated can represent a proxy for the costs of lowering emissions.

Low costs for the lowering of emissions would lead, with all other factors being equal, to low prices for CER and ERU, and vice versa.

Implementation of the CDM and JI requires, on the part of the public sector, a series of activities that stimulate and favour the projects. Without such activities, the private sector would remain isolated, lacking the necessary information and assistance to aid in the efforts. On the one hand, the private sector benefits from the revenues of the CER and the ERU which the project generates; at the same time, is must sustain a series of transaction costs higher than those it would have to sustain were the projects not entered under the CDM and the JI.

It is extremely important that the public sector adopt specific programs to assist the CDM and JI projects, eventually under the coordination of a specific agency. These programs (or the agency) can provide guidelines, serve as a partner or provide consulting to companies in order to spread information on the projects and facilitate their performance, especially internationally, through international initiatives formulated on an ad hoc basis – taking advantage of the existing networks operated by the Ministry of Foreign Affairs and the Institute of Foreign Trade – for the CDM and JI projects. As part of such efforts, a rapid, preferential procedure could be established for the CDM and the JI, in order to exploit all the potential for reducing greenhouse gas emissions latent in projects not specifically designed for this purpose.

In the course of consultations with the operators, the following sectors were indicated as holding potential for CDM.

a) reduction of flaring gas and venting gas up to a maximum of approximately 20 MT CO2 in the countries in which the ENI corporation has mineral extraction interests.
b) the generation of electricity, which represents a basin of great potential for the JI and CDM projects for at least three reasons: i) it is showing strong growth, especially in the developing economies; ii) it lies at the origin of a significant portion of the CO2 emissions; iii) apart from the CDM and JI projects, major investments are planned by the Annex I countries.

   In concrete terms, JI and CDM initiatives in the electricity sector have been proposed and evaluated regarding:

   - the construction of wind-power parks
   - the transformation of coal-fed power plants into combined-cycle plants fuelled by gas
   - the modernisation of coal-fed power plants through the renovation of burners and boilers.

   It is estimated that the related investments per MW would be:

   - wind power: 0.6 million euro
   - transformation to the combined cycle: 0.4 million euro
   - modernisation of coal power plant: 0.2 million euro

c) activities of land use, land use change and forestry, plus, in particular, projects of forestation and reforestation. Certification can be issued for all the quantities of carbon accumulated in the biomass and in the dead matter of the planted area (trunk, branches, leaves, roots, organic substances) since 1 January 2000, to or from which would be added or subtracted the carbon quantities of the baseline (meaning the flows of gas that would have occurred on that surface area without the planting) and of the leakage (meaning the variations in the flows of greenhouses gases that occur outside of the area of the planting as result of the planting itself). Both the plantings performed under JI and those carried out under CDM have such a high degree of variability in terms of economic and environmental parameters (given that they may be undertaken in countries with different economic structures and different environmental conditions) that estimating an average price for carbon credits proves impossible.

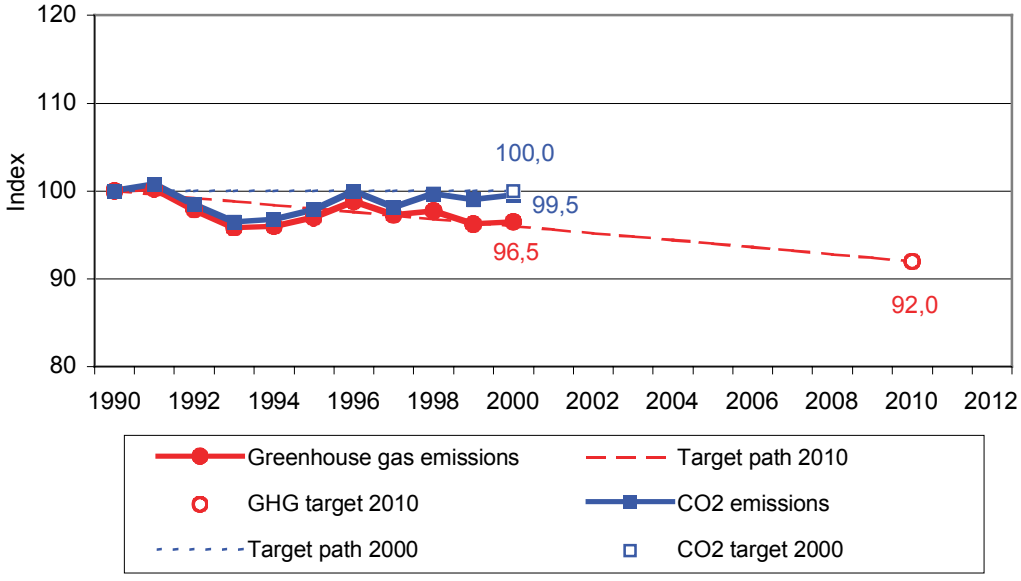
CHAPTER V
Projections and effects of policies and measures

The present chapter shows the trend scenario of greenhouse gas emissions to 2010/2020, implying the full implementation of several mitigation policies and measures that have already been approved, as described in the previous chapter, and the effects of possible additional measures. Further to the Kyoto Protocol and to the engagements undertaken in the frame of the European "*burden sharing*", the total yearly emissions at national level are expected to decrease by 6.5% over the 2008-2012 period with respect to 1990.

5.1 The international and European context

In foreshadowing national intervention strategies to mitigate climate changes, it is impossible not to consider other countries' prospective emission growth: the emissions of greenhouse gases in Italy account for nearly 2% of the earth emissions, and for 13% of European-Union emissions. Several final data on other countries' emissions are presented in chapter 2; the present paragraph takes accounts of the temporal evolutions estimated for the next years.

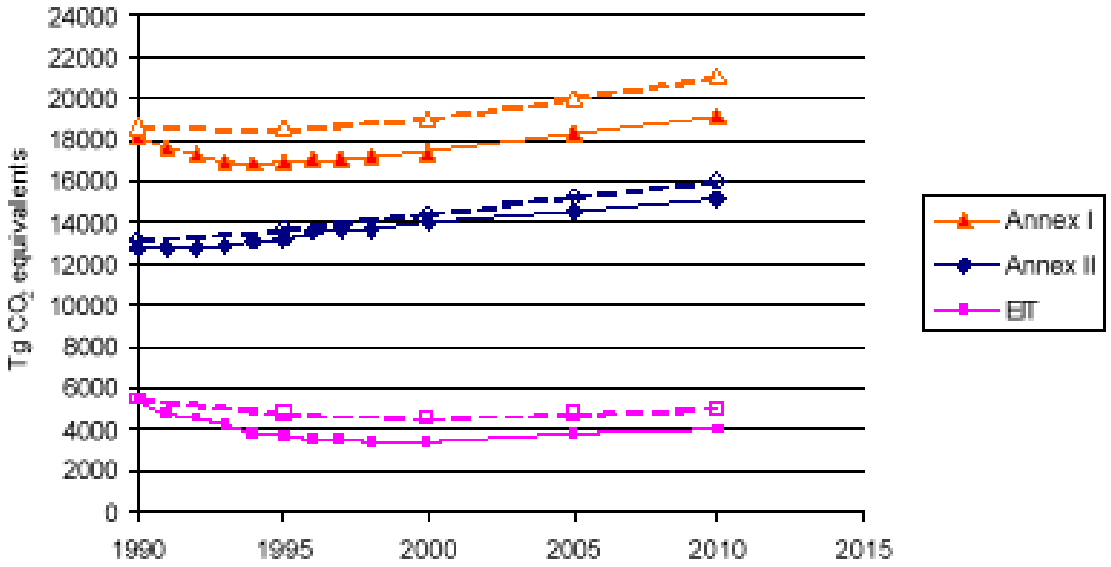
FIGURE 5.1 - ***Overall greenhouse gas emissions of Annex I, Annex II and EIT countries, in Tg of CO_2 equivalent terms. A continuous line indicates the forecasts formulated by the countries and standardised through the 1998 inventories whereas a dotted line indicates the emissions as they have been reported.***



Source: EEA, 2002

Edited by: Mario Contaldi (APAT) for §§ 5.1, 5.2 and 5.5, Alessandro Bianchi, Giuseppe De Bellis, Arturo Lorenzoni, Massimiliano Piacentini, Davide Tabarelli (Fondazione Alma Mater) for §§ 5.2 and 5.3; Enzo Di Giulio and Stefania Migliavacca (EniCorporate University) for § 5.5, Domenico Gaudioso (APAT) for § 5.4, Riccardo De Lauretis (APAT) for 5.4.2 and 5.4.3, Antonella Trisorio and Annalisa Zezza (INEA) for § 5.4.2, Pasquale De Stefanis (ENEA) for § 5.4.3, Sandro Federici and Riccardo Valentini (University of Tuscia) for § 5.4.4

FIGURE 5.2 - *Greenhouse-gas emissions in the EU from 1990 to 2000, compared to the objectives to be attained to 2000 and 2008-2012 (LUCF excluded).*



Note: The linear route must not be interpreted as an approximation of past and future emission trends; on the contrary, it quantifies the gap between current emissions and 2010 objectives, assuming domestic measures only. This figure, therefore, does not evaluate the compliance with the 2010 commitments but the situation in 2000 with respect to such commitments.

Source: IPCC, WORKSHOP, SEE NOTE 1

5.1.1 The International Context

Some recent data regarding the emission forecasts on developed countries are summarised in a recent work carried out by the Secretariat of the Convention on Climate Change[1]. A comparison between the information contained in the National Communica-tions of by the Annex 1 countries and the evaluations performed by other institutions up to 2010 is provided in the document. The document includes a list of all greenhouse gases and underlines the respective contributions of Annex II countries and of the countries with economies in transition (EIT, Economies In Transition). Three main effects are highlighted in figure 5.2:

a) In 2000, the emissions of Annex I countries were similar to the levels of 1990;

b) The emissions of Annex II countries increased approximately by 1% year from 1990 to 1998 and they are expected to continue to increase at the same rate;

c) The estimated emissions of EIT countries in the 1995-2000 period diverge remarkably from the data contained in the inventories provided, so, if according to their national communications they should reach in 2010 the levels of 1990, it is likely that they remain significantly lower.

The estimated emission increase rate of Annex I countries should be of 13% between 1990 and 2010 according to the declarations included in the Second National Communication. According to most recent data, instead, it is likely a decrease up to 6%.

5.1.2 The European Context

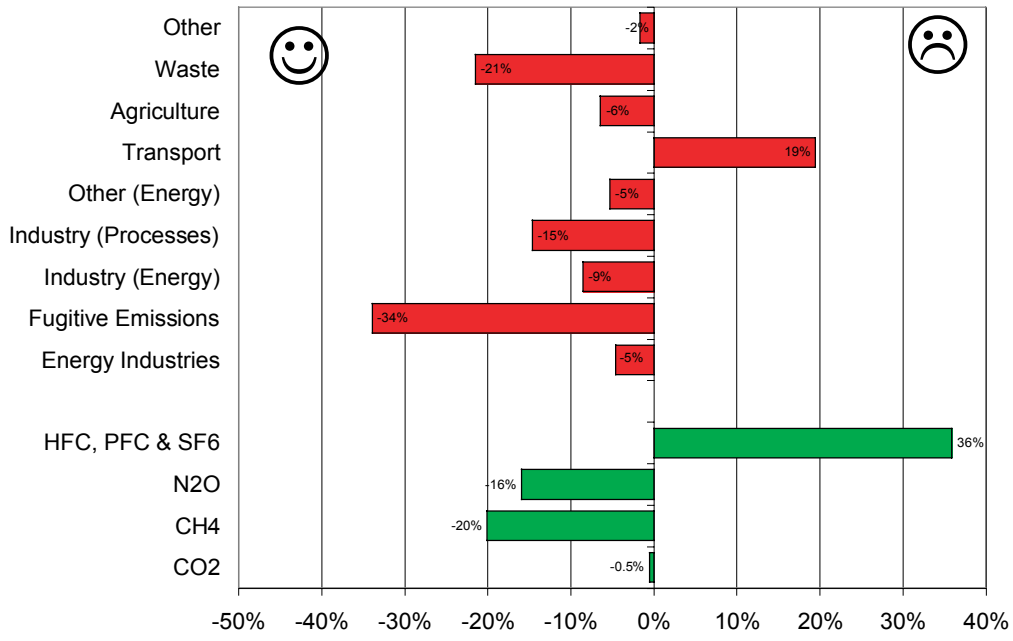
The European Commission started since year 2000 an appropriate Monitoring Mechanism of greenhouse gas emissions, which summarises the emissions of various countries on an annual basis. According to the data contained in the very recent report 2002[2], which is currently in press, and in that of 2001[3], a summary of the ongoing situation at EU level is provided as well as additional data concerning the countries involved and the greenhouse gases that are being considered.

[1] Working paper on "Comparison of greenhouse gas emission projections" from the Workshop "Preparation of national communications from annex 1 countries", Bonn, 28 February – 2 March 2001

[2] "Greenhouse gas emission trends and projections in Europe, are the EU and the accession countries on track to achieve the Kyoto Protocol targets?", B. Gugele, B. Strobel, P. Taylor, EEA, October 2002

[3] 2000 Report under Council Decision 93/389/EEC as amended by Decision 99/296/EC for a monitoring mechanism of Community greenhouse gas emissions, pubblicato nel novembre 2001.

FIGURE 5.3 - EU15, emission changes at sectoral level, 1990-2000 period, (%)



Source: EEA, 2002

Two figures, 5.3 and 5.4, are reported with reference to the 2000 situation. They summarize the evolution at aggregate level and the details at sector level, respectively. The first figure highlights that a stabilisation of greenhouse gas emissions can be actually attained through the policies that are being implemented in many countries, without forgetting that the Kyoto objective is to attain a 8% emissions reduction. This evaluation does not take into account the measures for the forestry sector and the use of flexible mechanisms. Figure 5.3 is noteworthy, especially because it highlights the noticeable contribution of transports to the emission increase, since the f-gas contribution is rather limited in terms of absolute value. Substantial reductions are also observed in the field of greenhouse-gas fugitive emissions (methane especially) from mines, oilfields, refineries and distribution networks. The Italian situation presents many similarities with the overall European framework.

With reference to the 2010 emissions, a 1% increase is foreseen with respect to the base year, essentially on account of the increase in the use of energy sources to meet the increasing demand from the transport and services sectors, see table 5.1. Emissions in the transport sectors should increase by 31% despite the inclusion of the ACEA agreements[4], on account of the remarkable growth of the road and air sectors. A significant increase in the number of buildings is recorded by the services sector. A slight increase is also observed in terms of fluoride consumptions.

The situation to 2010 is available at disaggregate level for each member state, see Figure 5.4, where the emissions estimated by the Commission in the "Sectoral objectives study" are compared to the emissions recorded by each country.

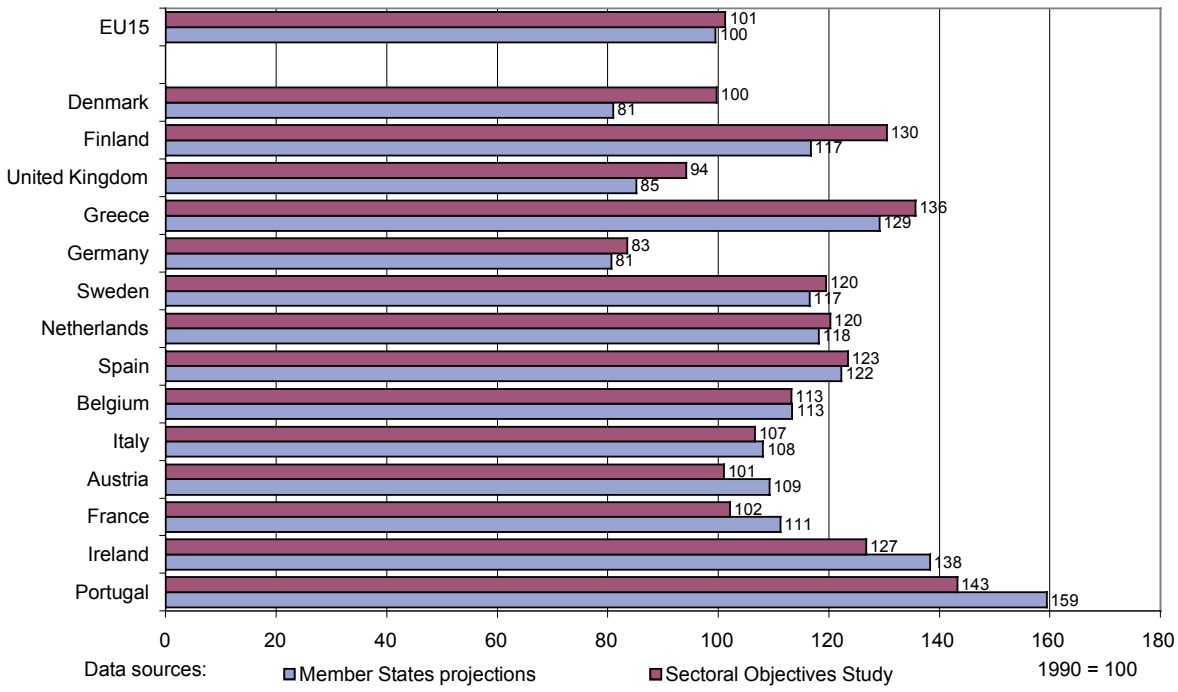
In conclusion, a slight increase in carbon dioxide emissions from the energy sector and a more noticeable increase from other sectors are estimated at European level. Methane and nitrous oxide emissions are expected to decrease whereas HFC, PFC and SF_6 emissions are already increasing. As shown in the following chapters, up-to-date Italian forecasts differ from these forecasts, due to specific national circumstances.

5.2 Trend emission scenario

The following emission projections have been geared

[4] The Association of European Motor Manufacturers, ACEA, and the respective Japanese and Korean associations, Jama and Kama, have reached an agreement with EU to reduce average CO_2 emissions from new cars up to 140 g/km within 2008/9.

FIGURE 5.4 - Projections on greenhouse-gas emissions to 2010 per Member State



Source: EU Commission, Report issued in November 2001

taking account of the energy scenarios described in paragraph 5.5, and specific estimates on non-energy source emissions. Annual average emission data, disaggregated per gas, are reported in table 5.2.
As it is possible to note, the overall emission increase after year 2005 is characterised by a rising trend, with a 5% growth increase every 5 years – about twice the historical data of 1990-2000.
The gases which recorded the higher growth rate between 2000 and 2010 are HFCs, +620%, followed by PFCs and SFs_6, but the rise in carbon dioxide emissions, +12%, is much more relevant from a quantitative point of view. A significant share of carbon dioxide emissions is generated by energy consumptions, which are analysed in details at sectoral level in the following paragraphs. Methane emissions and, to a lower extent, nitrous oxide emissions, instead, are apparently decreasing.

TABLE 5.1 - Emissions in the base year and in 2010 per EU15, disaggregated by major greenhouse gases

Gas	Emissions in the basic year ($MtCO_2$ eq.)	Emissions to 2010 ($MtCO_2$ eq.)	% change 1990-2010
CO_2 – from energy	3,068	3,193	4%
CO_2 – other sources	164	183	12%
Methane	462	380	-18%
Nitrous oxide	376	317	-16%
HFCs, PFCs, SF_6	67	116	73%
Total	**4,138**	**4,190**	**1%**

Source: Sectoral Objectives Study 2001

TABLE 5.2 – GHG emission from 1990 to 2020, disaggregated by gas. (Mt CO_2 eq.)

	Base year	*2000*	*2005*	*2010*	*2015*	*2020*
Carbon dioxide	439.8	463.3	463.9	491.9	519.8	559.9
Methane	39.5	37.8	34.2	29.9	30.0	30.1
Nitrous oxide	40.3	43.2	42.2	42.5	43.5	44.1
HFCs	0.7	2.0	7.0	14.1	19.0	23.0
PFCs	0.3	0.2	0.4	0.7	1.1	1.8
SF_6	0.5	0.3	0.6	0.7	1.0	1.4
TOTAL	**521.0**	**546.8**	**548.3**	**579.7**	**614.4**	**660.3**
Changes with respect to the - base year, 6 gases		5.0%	5.2%	11.3%	17.9%	26.7%
Changes with respect to the - base year, CO_2 only		5.3%	5.4%	11.8%	18.1%	27.3%

The increase in overall emissions between 2010 and 2020 continues, with more remarkable increases in carbon dioxide emissions and a slowdown in HFC, +63%, PFC and SF_6 increases.

5.2.1 Sectoral emissions

Most, about 85%, of the aforementioned emissions are caused by fossil energy use, characterised by an upward trend. In 1990, they amounted to a total of 425.2 MTon., in 1995 to 433.2 MTon. and to 452.5 MTon. in 2000. Fossil energy emissions as a whole have increased by 6.4% over the 1990-2000 period.

As shown in the following table 5.3, the highest growth rate (+20.5%) is recorded by the transportation sector, followed by the energy industry sector (+ 9.1%), and by other sectors (residential, agriculture, services). On the contrary, the emissions from the manufacturing and construction industries have decreased by 9%. The cause of this emission increase is a rise in the level of activity, not adequately offset by a gain in the level of efficiency or by variations in the energy mix. The 1995-2000 period has been characterised by higher emission increases than 1990-1995 (+4.7% against +1.9%). This trend affects the energy industry sector, in particular, where a 6.0% emission increase has been recorded over the 1995-2000 period. The manufacturing and construction industries, on the contrary, have recorded higher emission decreases during the first period (-6.7%), than in the second period (-2.5%). Finally, the transportation sector, shows a uniform growth rate of 9.8% in both five year periods.

An overall 7% emission increase from the combustion of fossil sources is estimated for the 2000-2010 period.

Again, the highest growth rate is recorded by the transportation sector (14.0%), even if a slowdown in the car-fleet expansion, and a gain in engine efficiency is observed with respect to the previous period. An upward trend (+ 6%) continues to affect the emissions from the energy industries and from other sectors (+6.5%), whereas industry, contrary to the preceding year, is increasing again (2.7% against –9%).

An overall 14.4% emission growth from the combustion of fossil sources is estimated over the 2010-2020 period, uniformly distributed among all sectors with a predominance of the transportation sector (+17%).

A summary of sectoral emissions divided per emission sector and final uses is contained in tables 5.3 and 5.4, respectively.

Table 5.4, which essentially divides the emissions caused by the use of electricity and fuels in relation to the consumption sector involved, allows underlining the most driving sectors in terms of final consumptions. Once again, a 2.9% decrease is recorded by the industrial sector between 1990 and 2000, a 3% increase over the following decade, and a further 16% increase from 2010 to 2020.

Emissions from the transport sector increase with comparable rates during the three decades from 1990 to 2020, that is by +17%, +13.2% and +16% respectively. A sector that was apparently stable in the previous tables, the domestic and services sector, is increasing remarkably during the three decades from 1990 to 2020, that is by +9.7, +4.9% and +17.6% respectively; the most relevant increases are in the services sector.

TABLE 5.3 – GHG emissions from 1990 to 2020, disaggregated by emission sector. (Mt CO_2 eq.)

Base	*year*	*2000*	*2005*	*2010*	*2015*	*2020*
FROM ENERGY USES, of which	424.9	452.3	456.0	484.1	513.1	553.9
- Energy industries	147.4	160.8	150.9	170.4	186.4	201.9
- Industry	85.5	77.9	79.1	80.2	84.2	88.2
- Transport	103.5	124.7	134.8	142.2	150.0	166.8
- Residential and tertiary	70.2	72.1	74.3	74.1	75.3	79.8
- Agriculture	9.0	9.0	9.1	9.6	9.5	9.4
- Other	9.3	7.8	7.7	7.6	7.8	7.8
FROM OTHER SOURCES, of which:	96.1	94.5	92.4	95.6	101.2	106.3
- Industrial processes	35.9	33.9	30.1	30.4	30.4	30.4
- Agriculture	43.4	42.6	42.0	41.0	41.0	41.0
- Waste	13.7	14.2	11.0	7.5	7.5	7.5
- Other	3.1	3.8	9.3	16.7	22.4	27.5
TOTAL	**521.0**	**546.8**	**548.3**	**579.7**	**614.4**	**660.3**

5.3 Emissions from energy use

5.3.1 Energy sector

This sector includes both the production of electric energy and refineries. Reference is made to all the emissions linked to the production of electric energy. It differs from the CRF data (sec chapter 3), which, instead, do not include self-generated and self-consumed unit electricity rates (which are included among industrial emissions), amounting to about 2.4% of total sectorial emissions in 2000.

As far as electricity production is concerned (accounting for the main quota of energy industries), the overall emission trend (3 gases) is characterised by a noticeable increase, from 125.5 to 142.9 Mt CO2 eq, between 1990 and 2000. This trend is expected to continue, see figure 5.6.

In terms of forecasts, the growth rate of the electric energy demand is expected to be in the range of 2%, with an increase in power supply (calculated as gross domestic production plus imports) from 319 in 2000 to 385 TWh in 2010.

FIGURE 5.5 – GHG emissions from energy use, MtCO_2 eq.

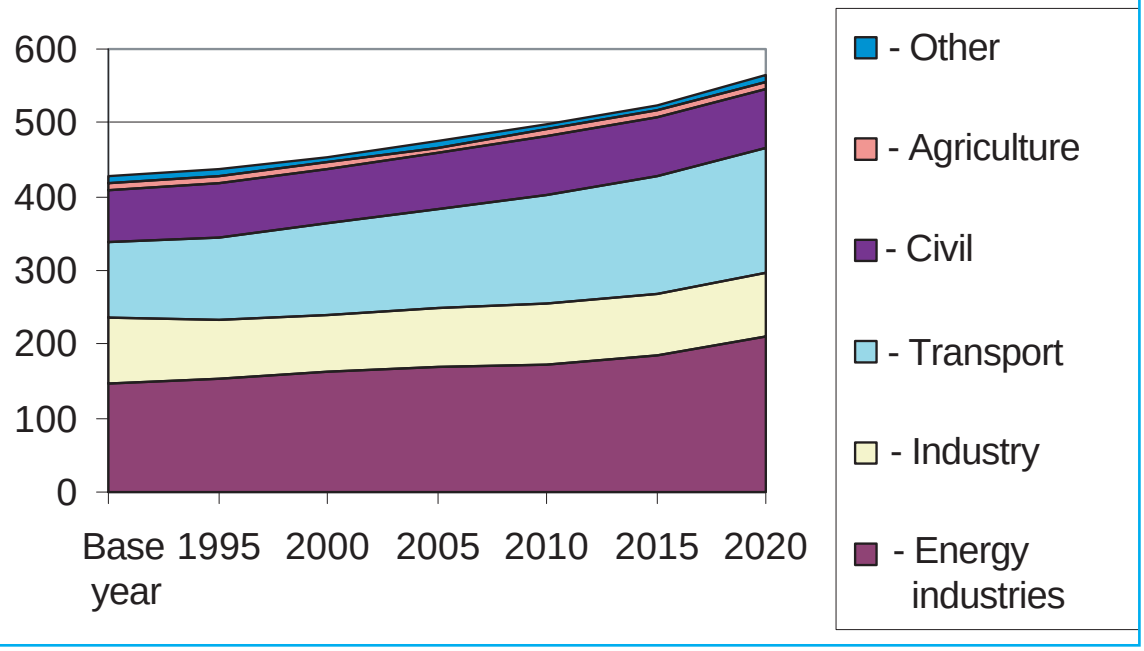


Table 5.4 – GHG emissions from 1990 to 2020, by end-use sector. (Mt CO_2 eq.)

	Base year	*2000*	*2005*	*2010*	*2015*	*2020*
Industry	154.8	150.5	145.6	156.1	166.5	176.5
Transportations	125.8	146.9	157.1	166.4	175.1	193.2
Residential and tertiary	123.7	135.7	134.1	142.2	152.2	164.5
Industrial processes	35.9	33.9	30.1	30.4	30.4	30.4
Agriculture	11.4	11.5	11.4	11.8	11.6	11.8
Land-use change and forestry	43.4	42.6	42.0	41.0	41.0	41.0
Wastes	13.7	14.2	11.0	7.5	7.5	7.5
Other	12.4	11.6	17.0	24.3	30.2	35.3
TOTAL	**521.0**	**546.8**	**548.3**	**579.7**	**614.4**	**660.3**

This increase in demand is satisfied by a growth in installed power, characterised by two periods until 2010:
1) 2003-2005: a decrease in total installed power is recorded over this period on account of the closing of old oil plants owned by ENEL, and, later by GenCo, for *repowering*;
2) 2005-2008: a rapid increase in installed power can be observed in this period, due to the introduction of new combined cycles, both *brownfield,* (particularly as a result of *repowering* activities in the sites indicated in point 1), and *greenfield*, for the implementation of new initiatives.
As a whole, power capacity goes from 70755 MW in 2000 to 79487 MW in 2010, with decreases until 2005 and increases from 2005 to 2010.
The basic scenario of the electric energy sector considers the effects of the measures implemented before 2002, aimed at reducing emission growth.
As far as renewable sources are concerned, production, except for the hydro-electrical sector, increases from 7 TWh in 2000 to 12 TWh in 2010, with dou-

FIGURE 5.6 - Final consumptions by sector

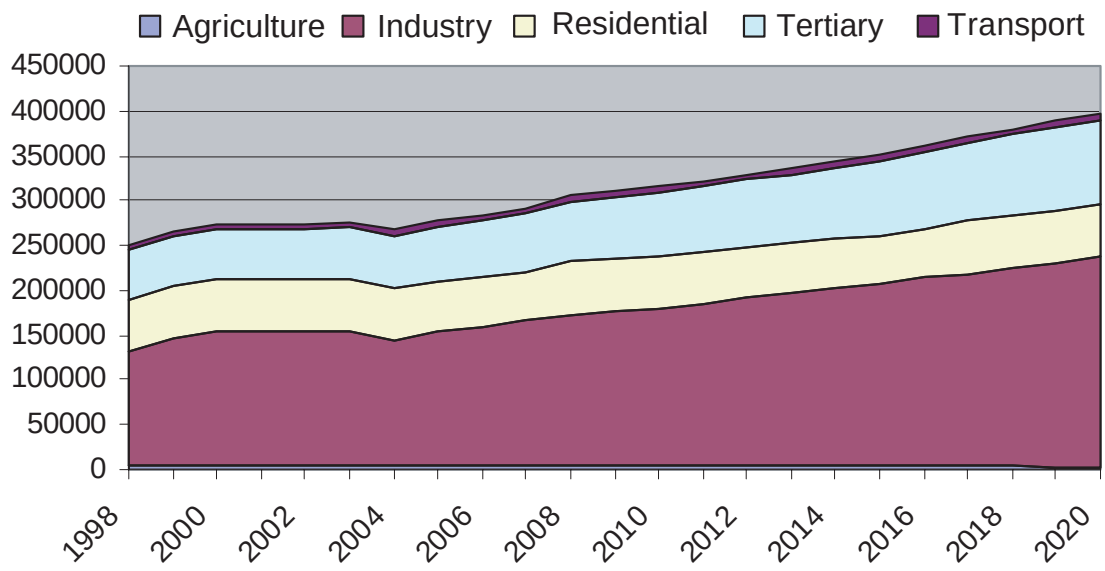
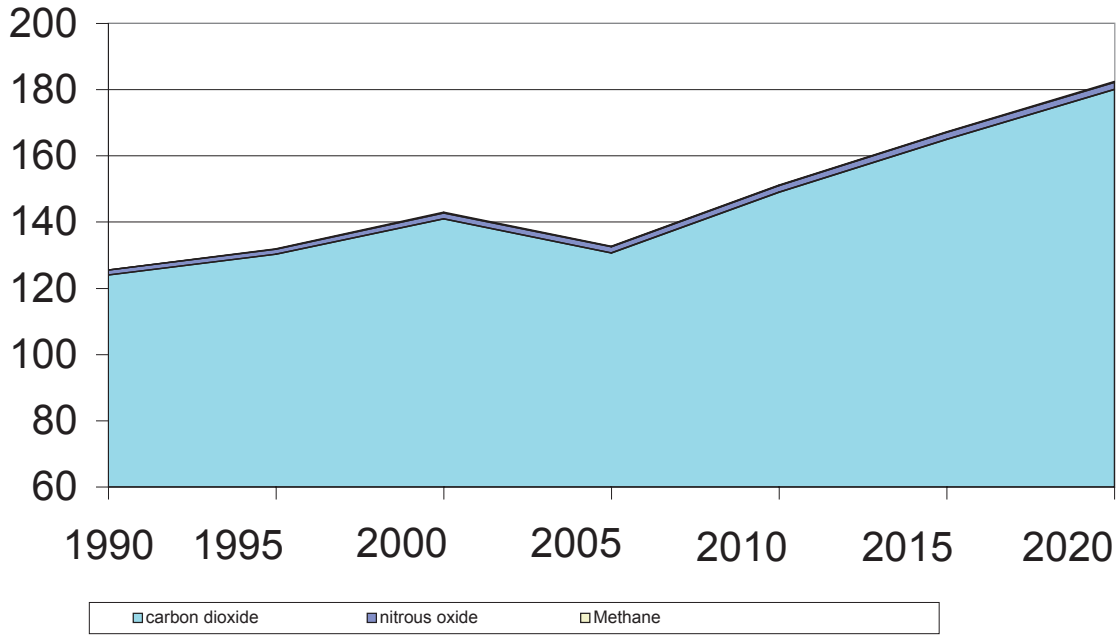


FIGURE 5.7 - Power sector, GHG emissions emissions growth (Mt CO2 eq.)



bled capacity, from 1700 to 3700 MW. The growth essentially affects the wind and waste-related capacity, and it substantially reflects the 2% standard set forth by Decree 79/99 on renewable sources. Hydroelectric production increases of 4 TWh, up to 49 TWh. The reference scenario also assumes the cogeneration production to go from little less than 60 TWh in 2000 to about 90 in 2010.
Some additional measures already estabilished and related to the production of electric energy have been considered in chapter 4. The effect of these measures on the overall emissions growth from the energy industry is synthesized in table 5.5

5.3.2 The industrial sector
The industrial sector considered herein excludes refineries and includes blast furnaces and coking plants. In particular, as referred to in the previous paragraph, all emissions caused by power self-production are also excluded. Reference is made to the emissions directly resulting from the industrial sector, with the exception of process emissions (see paragraph 5.4.1).

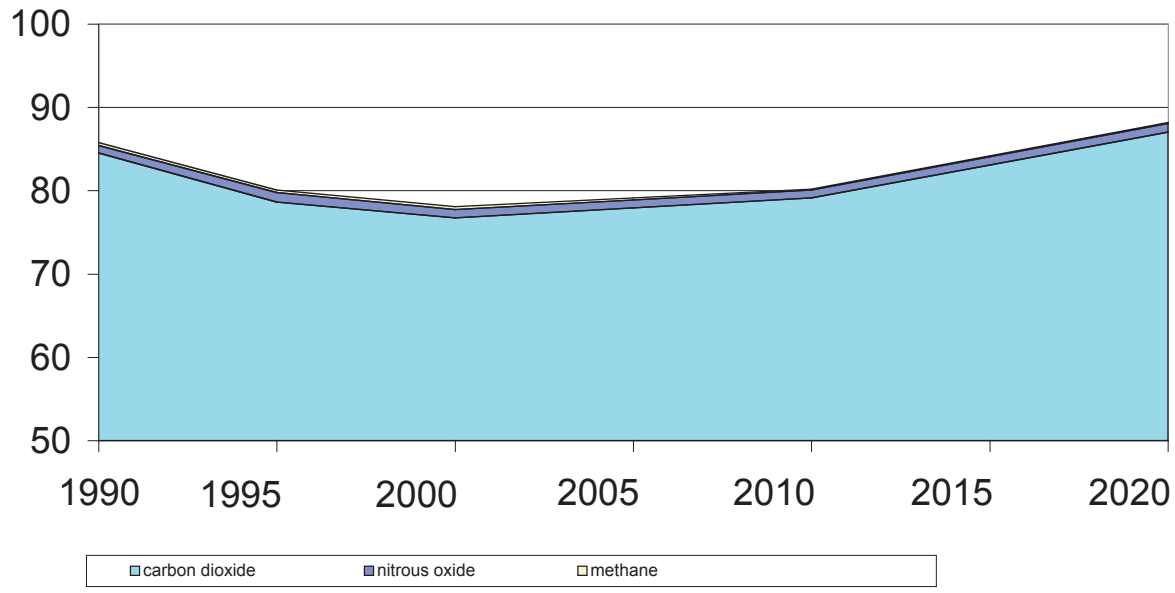
The emission growth is reported in figure 5.8

Generally speaking, the industrial sector is going through a period of slowdown in the levels of efficiency increases – already so largely exploited in the previous years –, a slight additional penetration of gas and a differentiated evolution of the levels of activity of the sub-sectors.
A primary tool to reduce the emissions of greenhouse gases is to improve the level of energy efficiency of the industrial processes. Higher levels of efficiency are exhibited by the Italian industrial sector with respect

Table 5.5 – Energy Industry ($MtCO_2$) , Additional measures already established

	2000	2005	2010
CO_2 emissions (trend scenario)			
Reduction resulting from :	**160.8**	**150.9**	**170.4**
Further 3,200 MW of new CC			8.9
Expansion of the import capacity for 2,300 MW		7.0	10.6
Higher increase of renewable sources for 2,800 MW			6.5
CO_2 emissions (reference scenario)	**160.8**	**143.9**	**144.4**

FIGURE 5.8 - Industrial sector, emissions from the use of fuels (Mt CO_2 eq.)



to other European countries, which find it more difficult to pursue the aforementioned objective.
Considering the gain in energy efficiency exhibited by the industrial sub-sectors to date, the trend scenario takes account of a series of hypotheses. It is assumable that, for some sub-sectors (among which, the mechanical, food and paper-making sectors), energy intensity will be stable in the future, since minimum levels have already been recorded. On the contrary, further decreases characterise the base scenario for the sectors exhibiting high energy intensity levels: the yearly variation rate is around -1%.
As far as the energy mix is concerned, the trend scenario considers the increasing penetration of gas in the industrial sector: gas consumptions are set to increase by more than 2% between 2000 and 2005, and to exceed 3% in the following five-year period. Contemporaneously, the reduced employment of fuel oil contributes to slow down the emission rates from the industry sector against the upward trend affecting energy consumptions.
As for any other sector, the base scenario of the industry sector considers the measures that have already been started to date. The effects of law 10/91 on the appointment of *energy managers*, for instance, have been inserted. We also consider the effects of the new EU standards on Italian steel plants, as well as the effects of Presidential Decree 203/88 on the subject of environmental protection, and the related 1990 guidelines regulating the increase of gas use.
The outcome of all the factors contemplated in the base projections indicates a general stationary trend for CO2 emissions.

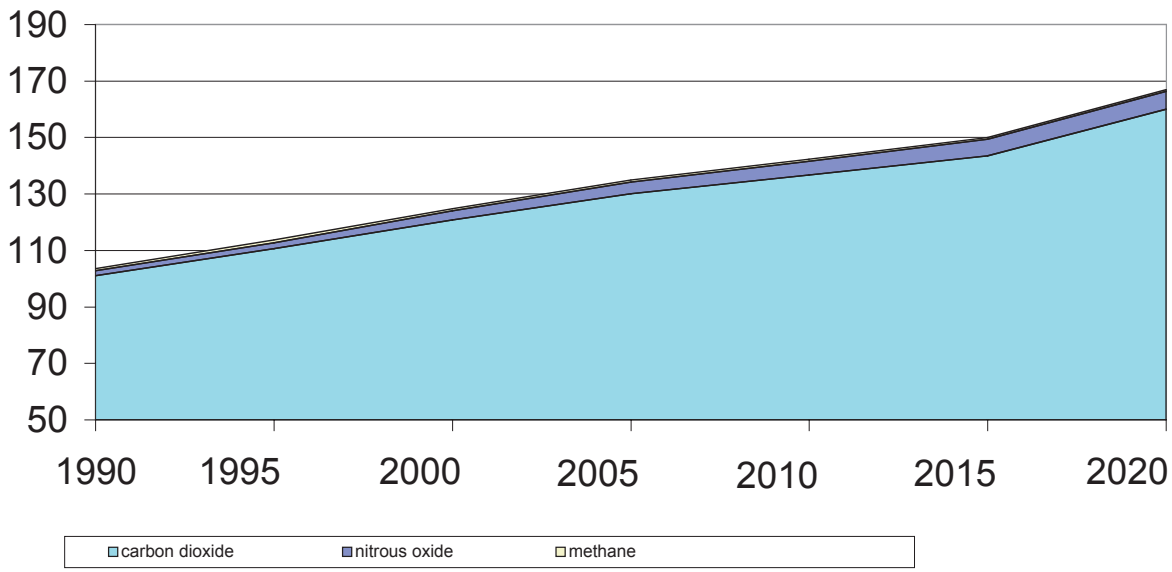
5.3.3 Transport sector

The transportation sector considered herein, in conformity with the IPCC-OECD methodologies, includes road and railway transportations (except for the emissions from the use of electric energy), domestic air traffic, the national amount of international air flights (*landing and take-off*) and coasting navigation, as well as the consumptions in the harbour from ships effecting international voyages.
The emission growth is reported in figure 5.9

The projections on the transportation sector have been carried out by estimating the effects of a series of in-progress measures, which can be divided into four categories:
- efficiency gain: includes the development of low-consumption vehicles (agreement FIAT-Acea), the employment of low-carbon fuel buses and the improvement of heavy transport vehicles;
- fuel optimisation: enforcement of protocols agreed on between government and producers for the development of low-emission fuels (methane, LPG, liquids from biomass …)
- modal optimisation: *car sharing*, *car pooling* and shared taxi initiatives for passenger transport
- infrastructures: extension and modernization of the local railway network.

Estimates for car and truck stocks are reported hereunder. They are responsable for the emission growth in the transport sector, insufficiently offset by a reduction in unit consumptions.
The expected scenario – to be considered as the most plausible for Italy according to the projections provided in the EU White paper (European commission, white paper: "Transport policy in europe up to

FIGURE 5.9 - Transportation sector, GHG emissions growth (Mt CO_2 eq.)



2010", com (2001) 370, September 2001) – substantially follows the PGT "high" scenarios. In particular, a 1.8% yearly average increase is expected for passengers, and a 1.6% increase is expected for goods. Considering that estimates on GDP growth for the next 10 years are in the range of +2% a/y, forecasts on goods account for little less elasticity than the EU average, whereas elasticity for passenger is no doubt higher, but in line with national historical data.

The modal split is substantially unchanged for passengers, whereas a significant increase in goods railway transportation is expected. Specific average consumptions of cars are expected to decrease by about 12% in relation to extra-urban traffic, whereas a stationary trend is forecasted in relation to urban traffic. Table 5.8 shows the historical growth rates and national forecasts according to the PGT scenario and the aforementioned EU White paper. In particular, compared with the previous scenarios, the most recent one takes account of the effects of the EU enlargement in the transport sector, and it identifies a series of actions undertaken at Community level to cope with the expected upward trend. It is estimated, in fact, that a significant increase in transported goods will be recorded on account of the enlargment of the free trade area.

As far as passenger transport is concerned, the comparison between national and European scenarios does not provide additional information to the data provided in the previous paragraphs. The white paper confirms the "high" scenario of PGT, perfectly in line with the estimated 3% GDP growth, which is rather high rate for such a long period.

The following table 5.9 shows the breakdown of the emission increases from different subsectors.

Table 5.7 – The Italian car fleet (unit)

	Total Cars	Petrol cars	Diesel cars	Gas cars	Trucks
2000	32,296,848	27,356,786	3,521,166	1,418,897	684,335
2005	34,927,130	29,317,097	3,929,416	1,680,617	818,638
2010	37,312,093	30,936,481	4,384,999	1,990,613	979,299
2020	39,702,237	32,451,045	4,893,403	2,357,789	1,171,490

European Commission, White Paper: "Transport Policy in Europe up to 2010", COM (2001) 370, September 2001.

TABLE 5.8 - Transport, Growth rates in several scenarios.

	1990-1995	1995-2000	2000-2005	2005-2010
Passenger, in Gp-km				
Final values	2.8%	1.4%		
PGT, "low" scenario			1.33%	1.33%
PGT, "high" scenario			1.90%	1.90%
EU White Paper, BAU (with GDP +3% a/y)			1.83%	1.83%
Goods, in Gt-km				
Final values (> 50 km)	3.8%	3.0%		
PGT, "low" scenario			1.28%	1.28%
PGT, "high" scenario			1.61%	1.61%
EU White Paper (with GDP +3%a/y)			2.74%	2.74%

Source: APAT

The breakdown of the emissions from the road sector is shown in the table 5.10.

Gas fueled cars record the highest increases in emission levels (+2.3% average/year), on account of the large development of this energy source. Remarkable increases are also recorded in trucks and buses (respectively +2.1% and 1.9% average/year). Lower rates are recorded in the emission growth of petrol and diesel oil (respectively +0.02% and +0.2%). Finally, a 1.8% average / year increase in emission growth relates to motorcycles.
The implementation of the already estabilished policies, presented in chapter 4, concerning carbon dioxide emissions alone, would imply a reduction in emission rates as described in table 5.11.

5.3.4 Residential, tertiary and agricultural sectors
Figure 5.10 shows the emission growth in the civil sector and agriculture.
These sectors are characterised by the following features:
-moderate growth in agriculture (0.6% year), and moderate penetration of gas, with consequent slight reduction in CO_2 emissions (from 9.07 in 2000 to 8.48 Mton. in 2010).
- buildings: a 1.4% yearly increase in the total square meters of all residential and services buildings is expected. This rate will slowly decrease up to 1% year in 2015, on account of saturation phenomena. The increase will be only partially offset by the estimated gas expansion, and by the expectied efficiency gains, with a consequent increase in CO2 emissions (from 68.28 in 2000 to 71.47 Mton. in 2010).
- electric energy consumptions: consumptions from the residential sector are slightly increasing, in line with historical trends, thanks to the effects of the existing tariff structure; consumptions in the service sector, instead, are expected to increase significantly (about 2% year).
Several measures aimed at reducing greenhouse gas emissions from the residential and service sectors have been put into effect in the last years. The most important measures are provided for in law 10/91 (control of energy consumptions in buildings; rules set forth in the frame of the National Energy Plan implementation), and law 449/97 (41% deduction of building restoration expenses, including renewable resources), and in the self-regulation code for environment quality in public administration buildings. These measures are already incorporated in the projections of the model.

TABLE 5.9 - CO_2 emissions increases from the transportation sector (%), per sub-sector

	Road	Air	Railway	Water
2000 - 2010	+8.2%	+46.8%	+15.6%	+18.7%
2010 - 2015	+3.8%	+15.6%	+6.7%	+9.4%

TABLE 5.10 - CO_2 emissions from the road sector (Mton.)

	Petrol cars	Diesel cara	Truck	Buses	Gas-powered cars	Motorcycles
2000	52.17	22.37	24.19	2.66	4.57	2.59
2005	52.91	22.59	26.83	2.93	5.12	2.84
2010	52.84	22.80	29.77	3.22	5.73	3.11
2015	52.45	23.02	33.04	3.54	6.43	3.40

The effect of additional measure already estabilisched in the civil sector is summarized in table 5.12.

5.4 Emissions from other sectors

5.4.1 Projections of emissions from industrial processes

5.4.1.1 CO_2, CH_4 and N_2O emissions

As far as mineral products are concerned (cement, lime and glass), the emission trend from 1990 to 2000 is the following:
- reduction in emission levels from the production of clinker, from 17.9 Mt in 1990 to about 15,4 Mt in 2000;
- increase in emission levels from lime production, from about 1.34 Mt in 1990 to about 1.65 Mt in 2000;
- increase in emission levels from glass production, from 2.18 Mt in 1990 to about 2.21 Mt in 2000.

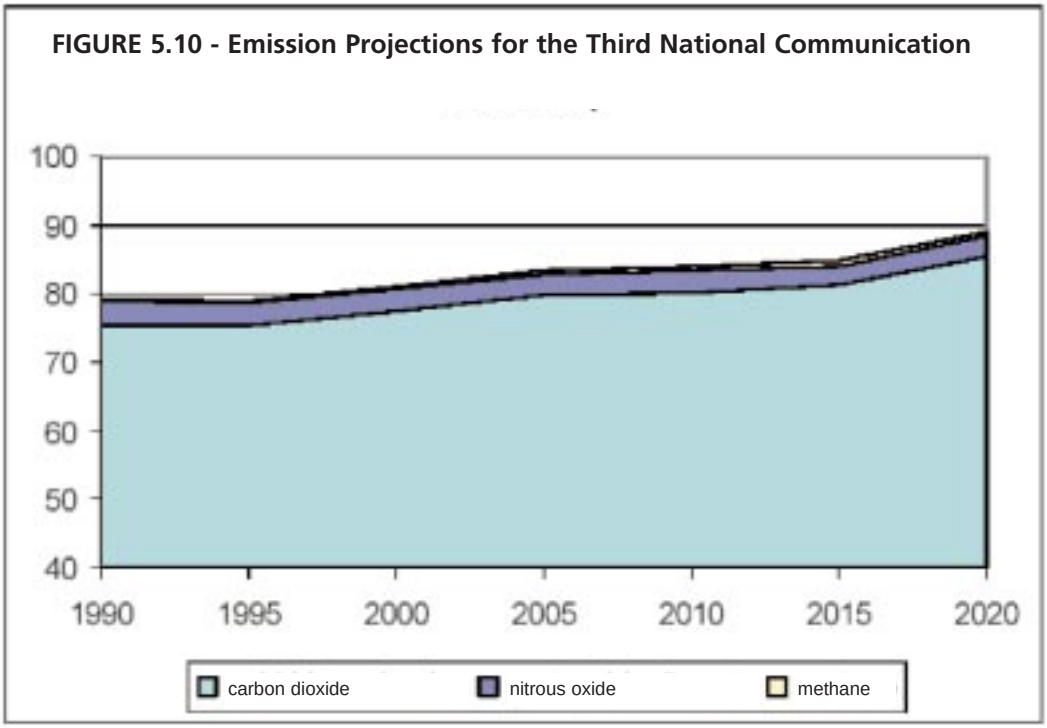
A slight reduction in the aforementioned levels of emissions, related to the general trend of the building materials sector, is expected by 2010.
A 46% reduction in the emissions of N_2O from the production of nitric acid was recorded between 1990 and 2000, due to a decrease in the levels of production. Further decreases are expected by 2010 as a result of further cut in production. In order to evaluate the emission trend to 2000, 2005 and 2010, it has been assumed that the production of HNO_3, equal to 1037 Mt in 1990 and to 431.5 Mt in 1995 will decrease to 100 Mt in 2010.
Finally, it is assumed that the emissions of N_2O from the production of adipic acid, which had already increased by 45% between 1990 and 2000, will slightly increase by the year 2010, on account of the dynamics of the chemical sector.
The two specific interventions on the industrial sector, analysed in chapter 4, imply a reduction in nitrous oxide emissions from the production of adipic acid and nitric acid. The effects of the aforementioned measures regulating N_2O emissions from the industrial sector are underlined in table 5.14..

5.4.1.2 HFC, PFC and SF_6 emissions
A 78.3% increase in the emissions of fluorinated gases has been recorded between 1995 and 2000, with a 15.7% yearly average increase (it must be noted that, as far as F-gases are concerned, the Kyoto Protocol gives the chance to choose the base year between 1990 and 1995). The emissions from the production of halogenated hydrocarbons

TABLE 5.11 - Potential of additional measures in the transport sector ($MtCO_2$ eq.)

	2000	2005	2010
Total greenhouse-gas emissions in transports (trend scenario)	**124.7**	**134.8**	**142.2**
Buses and private vehicles using low carbon density fuels	_	_	1.5
Optimisation and collectivisation systems for private transport (car pooling, car sharing, shared taxis)	_	0.8	2.1
Implementation of information-telematic systems			
Development of national infrastructures	_	–	3.9
Total transport system (reference scenario)	**124.7**	**135.6**	**134.7**

FIGURE 5.10 - Emission Projections for the Third National Communication



and sulphur hexafluoride (-96,8%) are decreasing, as a result of the installation of abatement systems for fugitive emission from production plants. On the contrary, an increase in emissions is recorded from metal processing (6.7%), and from the consumption of halogenated hydrocarbons and sulphur hexafluoride (277.4%) – in particular as an effect of the utilization in some production cycles, where 100% of the substances is released into the atmosphere, as in the case of semiconductors which started being employed in 1995, and of metered propeller inhalers for the medical sectors, which started being employed in 1999.

The projections concerning F-gases emissions presented in the Second National Communication have not diverged to date from the actual emission trend recorded in the final balance.

Nevertheless, most recent trends relating to the refrigeration and air-conditioning sector, the production of medical aerosols, and the semiconductor industry suggest that overall emissions are set to increase far beyond the estimated values from now to 2010.

The values presented in the Second National Communication have been revised as indicated in table 5.15, in conformity with the market forecasts on several substances, supplied by the Italian producers in the aforementioned studies promoted by the Directorate-General for the Environment of the European Commission.

The effects of the measures presented in Chapter 4 on overall fluorinated gas emissions are summarised in table 5.16.

5.4.2 Projections of emissions from the agricultural sector

A 1.7% decrease in greenhouse gas emissions from agricultural activities has been recorded between

TABLE 5.12 – Residential, tertiary an agricultural sector, reduction potential measures ($MtCO_2$ eq.)

	2000	2005	2010
Total GHG emissions from residential, tertiary and agriculture (trend scenario)	**81.1**	**83.4**	**83.7**
Decrees on efficiency in final uses (residential & services) (extension 2012)		4.0	6.3
Total GHG emission from residential, tertiary and agriculture (reference scenario)	**81.1**	**79.4**	**77.4**

TABLE 5.13 – Emission forecasts for the Third National Communication (trend scenario)

Carbon dioxide emissions (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Mineral products	24,193.0	20,744.6	22,722.1	19,956.6	20,101.6
B. Chemical industry	2,257.6	955.8	941.5	911.7	941.4
C. Metal production	1,804.2	1,659.7	1,592.1	1,653.4	1,780.9
D. Other (paper-making and food industries)	558.6	566.3	546.4	651.4	718.6
Total industrial processes	**28,813.4**	**23,926.4**	**25,802.2**	**23,173.1**	**23,542.5**
Methane emissions (Gg) 1	**990**	**1995**	**2000**	**2005**	**2010**
A. Mineral products					
B. Chemical industry	3.1	3.3	3.1	3.4	3.5
C. Metal production	2.4	2.4	2.3	2.3	2.5
D. Other (paper-making and food industries)					
Total industrial processes	**5.5**	**5.7**	**5.4**	**5.6**	**6.0**
Nitrous oxide emissions (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Mineral products					
B. Chemical industry	21.8	23.1	25.2	21.9	21.0
C. Metal production					
D. Other (paper-making and food industries)					
Total industrial processes	**21.8**	**23.1**	**25.2**	**21.9**	**21.0**
Greenhouse gas emissions (Gg CO_2) equivalent)	**1990**	**1995**	**2000**	**2000**	**2000**
A. Mineral products	24,193.0	20,744.6	22,722.1	19,956.6	20,101.6
B. Chemical industry	9,070.1	8,175.6	8,811.8	7,766.6	7,519.8
C. Metal production	1,854.7	1,709.7	1,640.2	1,700.7	1,832.9
D. Other (paper-making and food industry)	558.6	566.3	546.4	651.4	718.6
Total industrial processes	**35,676.4**	**31,196.2**	**33,720.6**	**30,075.3**	**30,172.9**

1990 and 2000 (0.17% average yearly decrease), with decreases due to enteric fermentations (-6.5%), residues manure management (-1.1%), field assumed burning of agricultural wastes (-7.6%), and increases due to rice cultivation (2.3%) and, more significantly, agricultural soils (1.1%).

The reduction of total methane emissions hypothesised in the Second National Communication (16% with respect to 1990) was almost entirely related to a reduction in the bovine and diary cow sector, in particular, and to a more efficient use of ingested energy, with marginal effects from other factors.

TABLE 5.14 – N_2O emissions from the industrial sector ($MtCO_2$ equivalent)

Nitrous oxide emissions ($MtCO_2$ equivalent)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Mineral products					
B. Chemical industry	6.7	7.1	7.8	6.8	6.5
C. Metal production					
D. Other (paper-making and food industries)					
Total industrial processes (trend scenario)	**6.7**	**7.1**	**7.8**	**6.8**	**6.5**
Emission reduction from adipic acid treatment				2.9	6.0
Emission reduction from nitric acid treatment				0.3	0.2
Total industrial processes (scenario with additional measures)	**6.7**	**7.1**	**7.8**	**3.6**	**0.4**

TABLE 5.15 Emissions projections for the Third National Communication (trend scenario)

HFC emissions (Gg CO_2 equivalent)	1995	2000	2005	2010
A. Metal production				
B. Production of halogen. hydrocarbons and sulphur hexafluoride	440.8	22.2	22.2	22.2
C. Consumption of halogen. hydrocarbons and sulphur hexafluoride	230.5	1,939.5	7,025.4	14,098.4
Total HFC	**671.3**	**1,961.7**	**7,047.6**	**14,120.6**
PFC emissions (Gg CO_2 equivalent)	**1995**	**2000**	**2005**	**2010**
A. Metal production	79.2	84.5	62.3	62.3
B. Production of halogen. hydrocarbons and sulphur hexafluoride	134.3	0.0	0.0	0.0
C. Consumption of halogen. hydrocarbons and sulphur hexafluoride	59.0	147.2	296.0	595.4
Total PFC	**272.5**	**231.7**	**358.3**	**657.7**
SF_6 emissions (Gg CO_2 equivalent)	**1995**	**2000**	**2005**	**2010**
A. Metal production				
B. Production of halogen. hydrocarbons and sulphur hexafluoride	119.5	0.0	0.0	0.0
C. Consumption of halogen. hydrocarbons and sulphur hexafluoride	350.3	327.7	606.6	678.3
Total SF_6	**469.8**	**327.7**	**606.6**	**678.3**
HFC. PFC. SF_6 emissions (Gg CO_2 equivalent)	**1995**	**2000**	**2005**	**2010**
A. Metal production	79.2	84.5	62.3	62.3
B. Production of halogen. hydrocarbons and sulphur hexafluoride	694.6	22.2	22.2	22.2
C. Consumption of halogen. hydrocarbons and sulphur hexafluoride	639.8	2,414.4	7,927.9	15,372.0
Total HFC. PFC. SF_6	**1,413.6**	**2,521.1**	**8,012.5**	**15,456.5**

The actual trend of bovine and swine stocks between 1990 and 2000 shows a lower reduction than the expected values: other bovines (0.3% instead of 2.0%), swine (1.7 instead of 5.0%), and, above all, dairy cows (21.8% instead of 35.7%); this explains for the differences between the effective emission trend and the forecast.
The trend in animal stock accounts for the upward trend characterising the emissions of N_2O from agricultural-soils influenced by nitrogen contributions of animal and mineral origin – against a slightly down ward trend observed in the last years in the consumption of nitrogenous fertilizers. "On the basis, and taking also into account the influence of the events related to the BSE, it has been assumed that swine and bovine stocks should remain unchanges untile the years 2010".
Therefore, a substantial stationary or downward trend can be assumed with regard to CH_4 and N_2O emissions from the agricultural sector, against the increase forecasted in the Second National Communication between 2000.
The three specific interventions taken into consideration in chapter 4 for the agricultural sector, concern the reduction of CH_4 emissions from manure management, the reduction in CO_2 emissions from energy consumptions, through the promotion of organic farming, and the reduction in

TABLE 5.16 – HFC, PFC, SF_6 emissions from the industrial sector (MtCO2 equivalent)

HFC, PFC, SF_6 emissions (Gg CO2 equivalent)	1995	2000	2005	2010
A. Metal production	0.079	0.084	0.062	0.062
B. Production of halogen. hydrocarbons and sulphur hexafluoride	0.695	0.022	0.022	0.022
C. Consumption of halogen. hydrocarbons and sulphur hexafluoride	0.640	2.414	7.928	15.372
Total HFC. PFC. SF_6 (trend scenario)	**1.414**	**2.521**	**8.013**	**15.457**
Reduction of PFC emissions through/aluminium recycling			0.025	0.050
Installation of abatement devices and adoption of low-GWP substances in the production of semiconductors			0.010	0.020
Reduction of HFC leak from mobile air conditioners			0.230	0.645
Reduction of SF_6 leak from electrical equipment			0.050	0.040
Total HFC. PFC. SF_6 (scenario with additional measures)	**1.414**	**2.521**	**7.723**	**14.702**

TABLE 5.17 – Evolution of bovine and swine stocks from 1990 to 2001

Animal categories	Dairy cows	Other bovines	Swine
1990	2,641,755	5,195,972	6,949,091
1991	2,339,520	5,654,073	6,723,815
1992	2,146,398	5,517,632	6,602,920
1993	2,118,981	5,418,698	6,611,115
1994	2,011,919	5,258,445	6,419,256
1995	2,045,517	5,418,213	6,681,963
1996	2,070,300	5,258,907	6,670,187
1997	2,078,388	5,256,337	6,795,447
1998	2,116,176	5,199,598	6,802,442
1999	2,106,000	5,155,000	6,669,000
2000	2,065,000	5,180,000	6,828,000
2001	2,154,000	5,040,000	6,939,000

Source: ISTAT

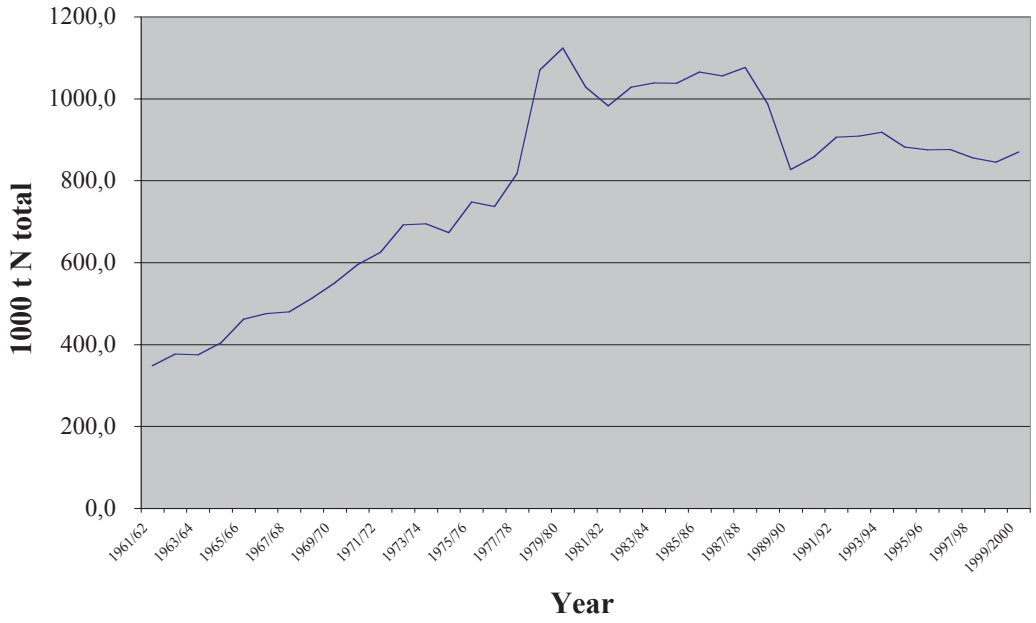
N_2O emissions from soils, through the rational use of nitrogen fertilizers. Since the second measure is considered in the section dealing with energy consumptions, the table 5.19 take into account only the effects of the two remaining measures.

5.4.3 Projections of emissions from the waste sector

A 3.5% increase in the emissions of greenhouse gases from waste management has been recorded between 1990 and 2000 (0.35% average yearly increase), with decreases due to landfills (-1.0%), and increases due to waswater (11.0%), indneration (20.0%) and composting (650.0%).

The following projections have been prepared in conformity with most recent inventories and evaluations on the implementation of the mitigation measures foreseen in the Second National Communication. They include a trend scenario based on the actions that have already been put

FIGURE 5.11 - Consumptions of nitrogen fertilizers in Italy from 1960 to 2000



Fonte: International Fertilisers Association 2001

TABLE 5.18 – Emission projections for the Third National Communication (trend scenario)

Methane emissions (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Enteric fermentation	648.8	636.1	606.9	593.1	570.6
B. Manure Management	190.0	184.5	185.5	189.7	194.3
C. Rice cultivation	73.3	81.4	74.9	74.9	74.9
D. Agricultural soils					
E. Prescribed burning of savannas					
F. field burning of agricultural residues	0.6	0.6	0.6	0.6	0.6
Total agricultural sector	**912.7**	**902.5**	**867.9**	**858.3**	**840.4**
Emissions of nitrous oxide (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Enteric fermentation					
B. Manure Management	12.4	12.8	12.4	12.5	12.6
C. Rice cultivation					
D. Agricultural soils	65.6	66.9	66.3	64.8	62.9
E. Prescribed burning of savannas					
F. field burning of agricultural residues	0.0	0.0	0.0	0.0	0.0
Total agricultural sector	**78.0**	**79.7**	**78.8**	**77.3**	**75.5**
Greenhouse gas emissions (Gg CO_2 equivalent)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Enteric fermentation	13,624.9	13,357.1	12,744.0	12,455.1	11,982.6
B. Manure Management	7,836.6	7,839.5	7,751.3	7,861.8	7,992.5
C. Rice cultivation	1,538.5	1,708.6	1,573.6	1,572.9	1,572.9
D. Agricultural soils	20,337.4	20,741.8	20,553.8	20,094.2	19,490.0
E. Prescribed burning of savannas	0.0	0.0	0.0	0.0	0.0
F. Field burning of agricultural residues	17.1	16.9	15.8	12.6	12.6
Total agricultural sector	**43,354.5**	**43,664.0**	**42,638.6**	**41,996.6**	**41,050.6**

into effect, and examine the effects of two possible mitigation interventions.

According to these projections, as shown in the trend scenario, a 45% reduction can be expected in overall greenhouse gas emissions from the waste sector, expressed in terms of CO2 equivalent, essentially as a result of a reduction in methane emissions from landfills. This reduction is clearly more significant than the increase in CO2 emissions from waste incinerators with energy recovery.

Chapter 4 also analyses two additional interventions aimed at reducing greenhouse gas emissions, in particular methane emissions, from the waste-management cycle. Both interventions are linked to the implementation of both national and European regulations on this topic. The first intervention consists in complying with the deadlines for the reduction of biodegradable fractions of MW in landfills,

TABLE 5.19 – GHG emissions from the agricultural sector ($MtCO_2$ equivalent)

Greenhouse gas emissions ($MtCO_2$ equivalent)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Enteric fermentation	13.62	13.36	12.74	12.46	12.00
B. Manure managment	7.84	7.84	7.75	7.86	7.99
C. Rice cultivation	1.54	1.71	1.57	1.57	1.57
D. Agricultural soils	20.34	20.74	20.55	20.09	19.49
E. Prescrided burning of savannas	0.00	0.00	0.00	0.00	0.00
F. Field burning of agricultural residues	0.02	0.02	0.02	0.02	0.02
Total agricultural sector (trend scenario)	**43.35**	**43.66**	**42.64**	**42.00**	**41.0**
Reduction in CH_4 emissions from manure management				0.08	0.15
Reduction in N_2O emissions from soils through the rational use of nitrogen fertilizers				0.24	0.46
Total agricultural sector (scenario with measures)	**43.35**	**43.66**	**42.64**	**41.68**	**40.44**

TABLE 5.20 Emission projections for the Third National Communication (trend scenario)

Carbon dioxide emissions (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Solid waste disposal on land B. Wastewater handling C. Waste incineration D. Other (composting)	911.7	1105.3	1010.5	825.1	650.1
Total waste sector	**911.7**	**1,105.3**	**1,010.5**	**825.1**	**650.1**
Methane emissions (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Solid waste disposal on land	453.6	455.1	449.2	310.6	152.5
B. Wastewater handling	98.0	103.8	111.9	107.8	107.8
C. Waste incineration	7.6	12.9	11.9	11.9	11.9
D. Other (composting)	0.0	0.0	0.1	0.1	0.1
Total waste sector	**559.2**	**571.7**	**573.1**	**430.4**	**272.3**
Nitrous oxide emissions (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Solid waste disposal on land B. Wastewater handling	3.2	3.2	3.3	3.3	3.3
C. Waste incineration D. Other (composting)	0.3	0.5	0.4	0.4	0.4
Total waste sector	**3.5**	**3.7**	**3.8**	**3.7**	**3.8**
Greenhouse gas emissions (Gg CO2 equivalent)	**1990**	**1995**	**2000**	**2005**	**2010**
A. Solid waste disposal on land	9,526.5	9,556.7	9,434.2	6,676.6	3,249.1
B. Wastewater handling	3,041.9	3,184.9	3376.0	3,291.5	3,295.6
C. Waste incineration	1,168.6	1,528.3	1,399.7	1,208.7	1,037.4
D. Other (composting)	0.2	0.5	1.5	1.9	2.3
Total waste sector	**13,737.2**	**14,270.3**	**14,211.4**	**11,024.8**	**7,537.6**
Carbon dioxide emissions (Gg) in the energy sector	**1990**	**1995**	**2000**	**2005**	**2010**
A. Commercial/Institutional	237.6	353.5	575.2	893.2	1211.2

set forth in directive 99/31/CE. The temporal objectives provide for a 50% reduction in the amount of biodegradable municipal waste in landfills by 2010 with respect to 1995. The second intervention consists in complying with the objectives set forth in law decree 22/97, particularly with regard to energy recovery from wastes. According to this assumption, 30% of municipal waste will be set to undergo energy biodegradability processes by 2010, in line with the indications of the "White paper for the energetic valorisation of renewable sources" (ENEA, 1999), with a further 500 MWe increase in the additional power capacity from municipal waste with respect to 2000. The effects of the two aforementioned interventions on the emission growth from the waste sector are shown in the table 5.21.

5.4.4 Land-use change and forestry sector

The analysis of this sector in Italy essentially takes into account CO_2 absorption, instead of CO_2 emissions, over the period under review, caused by the expansion of wood and forest lands and by the carbon concentrations stored in the existing forests and woods.

A preliminary action to evaluate both CO_2 increases and absorptions is to prepare an updated inventory of natural vegetation and reforestation activities. If no action to survey reforestation are undertaken (see chapter 4), if no new plants are set up (see chapter 4), or if the reforestation issue is not tackled by means of through measures or preparing updated inventories (see chapter 4), the contribution from this sector would be of no value.

The following projections for the Third National Communication have been elaborated in conformity with most recent inventories and assessments on the implementation of mitigation measures foreseen in the Second National Communication. The projections include a trend scenario based on the actions that have already been started to date, and examine the effects of four different mitigation interventions:

a) a survey of all the reforestation activities is carried out, no new plants are set up, the issue is not tackled by means of adequate measures or preparing a new inventory on natural vegetation (see chapter 4).

b) a survey of all reforestation activities is carried out, new plants are set up, the reforestation issue is not tackled by means of adequate measures or preparing a new inventory (see chapter 4).

c) a survey of all reforestation activities is carried out, new plants are set up, the reforestation issue is tack-

Table 5.21 - GHG emissions from the waste sector ($MtCO_2$) equivalent)

GHG Emissions ($MtCO_2$ equivalent)	1990	1995	2000	2005	2010
A. Solid waste disposal on land	9.5	9.6	9.4	6.5	3.2
B. Wastewater handling	3.0	3.2	3.4	3.3	3.3
C. Waste incineration	1.2	1.5	1.4	1.2	1.0
D. Other (composting)	0.0	0.0	0.0	0.0	0.0
Total waste sector (trend scenario)	**13.7**	**14.3**	**14.2**	**11.0**	**7.5**
Stabilization of the organic fraction. 50% of biodegradable MW by 2010				0.25	0.64
Energy recovery from municipal waste. 30% of municipal waste produced by 2010 (+500 MWe) (accounted for in the energy sector)					
Total waste sector (scenario with additional measures)	**13.7**	**14.3**	**14.2**	**10.7**	**6.9**

led by means of adequate measures or preparing a new inventory (see chapter 4).

5.5 Energy forecasts and effects of policies and measures

5.5.1 Formulation of new scenarios – methodology

The scenarios of greenhouse gas emissions from the combustion of energy sources are drawn from the CEPRIG model (**E**mission **C**alculation and **P**olicies for the **R**eduction of **G**reenhouse **G**ases), based on the System Dynamics approach. The CEPRIG model formally elaborates statistical and/or econometric data, obtained by means of differential equations.
The following sectors have been analysed as CO2 generators:
- industry
- residential
- service
- agriculture
- transport
- power
- bunkers

The basic year of the model is 1998. The modelling of the Industrial, Residential, Service, Agricultural sectors focuses on three key variables:
- level of activity;
- energy intensity: energy consumptions/level of activity;
- energy mix: rates of coal, gas, oil, fuel oil, electricity.

These variables are modelled in conformity with statistic-econometric analyses, based upon the Italian energy history of the last 30 years. In brief, the idea is to draw useful information for the future from the time-series of each variable. The model follows a bottom-up approach: the idea is to start from a single sector, or sub-sector, and to identify the derivative aggregate data.

This approach yields greater accuracy and details compared to the top-down approach, where sector variables are derived from a macro-variable (ex. income). In any case, the expected values are not independent from prices. In fact, both energy intensity and fuel shares, estimated on a yearly basis from 1998 to 2010, interact with three price scenarios (basic, high, low) divided per energy sources (coal, gas, oil, fuel oil, electricity).

Table 5.22
Carbon dioxide removals from land-use change and forestry (MtCO2)

	2005	2010	2015	2020
Carbon dioxide removals ($MtCO_2$), relating to art. 3.3				
A. Survey of reforestation works carried out to date	0.54	1.06	1.02	0
B. Set up of new plants	0.55	1.21	1.29	0.46
C. Up-to-date inventory for natural reforestation	2.35	4.21	6.09	7.66
Carbon dioxide removals ($MtCO_2$), relating to art. 3.4				
A. current cap	0.66	0.66	0.66	0.66
B. cap revision	0	4.10	4.12	4.12
Total land-use change and forestry (scenario with additional measures)	**4.10**	**11.26**	**13.18**	**12.90**

As far as fuel shares are concerned, they are dynamically linked to prices: the low price of a source of energy favours its expansion, and vice-versa. From this interactions among variables, it is possible to derive both sectoral and sub-sectoral energy consumptions, as well as carbon dioxide emissions.
The modelling for every single sector is described below.

Industry, Residential, Service, Agriculture
Industry is divided into 11 sub-sectors, the same as those identified in the National Energy Budget: Iron and Steel, non-ferrous Metals, Mechanical Manufactures, Food, Textile and Clothing, Building and building materials, Glass and pottery, Chemical and petrochemical, Paper-making, Mining and Other manufactures. The level of activity is synthesised by the value-added variable of the sub-sectors. Forecasts on the three main variables have also been submitted to the operators for examination, both by means of telephone interviewing and through a structured questionnaire. The *feedbacks* of this questionnaire have been analysed and a forecast "adjustment" has been carried out.
In the case of the residential sector, the square metres per habitation are taken to be the level of activity. It has been decided to take account of this variable instead of population, since the latter is not sufficiently dynamic for Italy, and, consequently, it is not meaningful to explain the energy consumption growth relating to this sector. The level of activity of the agricultural and service sectors, is derived from the value-added variable.

Transport
Modelling is based on detailed disaggregation, which accounts for both road and railway, air and water. With regard to road, the modelling of the Italian car fleet (petrol, diesel, gas-powered cars) and heavy vehicles is provided. With regard to motorcycles and buses, direct forecasts on energy consumptions and emissions are provided. The analysis also considers such variables as passengers-km, tons-km, mileage and unit consumptions (litres-km). The latter perform a similar function than the role covered by energy intensity in other sectors.

Energy industry
As far as the energy industry sector is concerned, modelling is performed considering a high plant disaggregation level and operation mechanism, according to a principle of energy exchange, market where the punctual demand/offer balancing is provided. The power demand is satisfied by an extensive plant portfolio, either existing or to be created. As to the existing one, a nominal census of about 200 principal production groups scattered all over the Italian territory has been conducted. Beside the nominal census, the remaining Italian power-generating plants have been evaluated in terms of aggregated data, without considering the plant propriety. In the end, it was established to supply overall aggregation data taking into account production technology, which led to the definition of 14 plant typologies. The exchange model is similar to the model initially adopted in England, where all electricity is filtered by the *pool,* and the demand is communicated to the operators.

Bunkers
It is modelled in conformity with the statistical/econometric analysis of time series.

5.5.2 Trend scenario, main variables and energy consumptions
At aggregate level, the scenario indicates a 2% increase in GDP. A stationary trend is expected for population.
The yearly average growth rate of greenhouse gas emissions in 2010 is 0.8%. The annual average growth rate of consumptions until 2010 is 1.1%. It must be noted that, as a whole, greenhouse gases – which, however, increase also on account of non-energy emissions – increase to a lower extent than energy consumptions, due to a gain in efficiency levels and to variations in the energy mix.
A main variable concerns the estimates on crude oil prices, which, either directly, as in the case of gas, or indirectly, as in the case of oil products, determine the final consumption quotations of other sources. According to the trend scenario, final quotations will be in the range of 22 dollars/barrel.
Forecasts on coal import prices in Italy are in the range of 34 dollars/ton. Gas prices at the Italian border have been forecasted also in relation with oil quotations: until 2010, the prices of almost all imported gas will be pegged to oil products, as it happened in the past.

In order to reach the end-user price, the prices of primary sources at the Italian border have been included with logistic costs, transportation and distribution costs and with trade margins.

The results of the trend scenario simulations to 2010 and 2020 are referred to hereunder.
The emission trends analysed so far are largely linked to energy consumptions. The energy balances for the years 2000 (final balance), 2010 and 2020 (forecasts) are provided in order to offer a concise view of the energy consumptions trend per source.
It must be noted that the trend scenario described above incorporates the effects of existing emission-reducing measures, as underlined and described in the previous paragraphs on both energy sector and other sectors.
The major changes recorded over the 2000-2010 period can be summarised as follows:

TAB. 5.23 - Energy demand (trend scenario)

2000 (Mtoe)	Renewables	Coal	Gas	Oil	Electric energy	**Total**
electricity	-11.32	-7.23	-18.83	-19.42	56.8	**0.00**
industry	0.23	4.00	16.75	6.78 1	1.73	**39.49**
transportations			0.33	40.45	0.73	**41.51**
agriculture	0.13		0.12	2.55	0.42	**3.22**
res. + serv.	1.16	0.07	20.7	7.19	10.59	**39.71**
non-energy uses		0.16	0.98	6.35		**7.49**
losses	0.07	1.42	0.66	5.81	43.09	**51.05**
bunkering				2.74		**2.74**
total	**12.91**	**12.88**	**58.37**	**91.29**	**66.56**	**185.21**
2010 (Mtoe)						
electricity	-12.17	-9.20	-26.75	-15.40	63.52	**0.00**
industry		4.42	17.12	5.96	15.11	**42.61**
transportations			2.23	43.61	0.85	**46.69**
agriculture			0.39	2.50	0.38	**3.27**
res. + serv.	1.07	0.00	27.57	2.90	1.05	**42.59**
non-energy uses		0.12	0.50		10.03	**10.65**
losses		0.97	0.72	6.66	44.08	**52.43**
bunkering				2.05		**2.05**
total	**13.24**	**14.71**	**75.28**	**89.11**	**71.47**	**200.29**
2020 (Mtoe)						
electricity	-12.08	-9.20	-41.44	-17.36	80.08	**0.00**
industry		4.56	19.02	6.78	20.25	**50.61**
transportations			2.80	47.81	0.98	**51.59**
agriculture			0.88	1.95	0.31	**3.14**
res. + serv.	0.92	0.00	31.24	1.19	13.16	**46.51**
non-energy uses		0.09	0.30	12.83		**13.22**
losses		0.85	1.07	6.66	52.64	**61.22**
bunkering				1.79		**1.79**
total	**13.00**	**14.70**	**96.75**	**96.37**	**87.34**	**228.00**

- steep increase in gas consumptions (+29%), particularly in the electric energy sector (+42%) and in the residential and service sectors (+33%). Steep increases are also recorded in the transportation and agricultural sectors, although starting from lower initial absolute values than other sectors.
- increase in electricity consumptions (+7%), particularly in the industrial sector (+28.8%), and in the residential and service sectors (+4.3%).
- slight decrease in oil consumptions (-2.4%), on account of reduced use in the energy-generation sector, the industrial sector and in the residential and service sectors.
- a remarkable use of coal is still recorded (+14%).

These trends indicate an increase in the relative burden of gas, whose quota, among fuels, passes from 24% to 28%. Oil and coal quota, instead, decrease from 37.7% to 33.7% and from 5.3% to 5%, respectively. The electricity quota is stationary, around 27%. The absolute value of renewable sources increases too, also on account of the 2% standard required by the green certificates.

In fact, the slight growth in terms of energy corresponds to a more significant growth in terms of generated TWh, in proportion to the increase in efficiency recorded over the years. Hydroelectric sources and other renewable sources, that yielded, respectively, 50 TWh and 7.5 TWh in 2000, will yeld 52.5 and 11,5 respectively to 2010.

5.5.3 Reference Scenario

Additionally to the measures foreseen in the trend scenario, the reference scenario also considers:

a) The full implementation of all measures approved or at the drafting stage, also of not strict environmental nature, implying a general gain in energy efficiency, and in particular:

b) The country's modernization through the realization of infrastructure works, as a decisive action for the transport sector to achieve the transfer to rail and to speed up road traffic;

c) The realization of additional combined-cycle plants and new import channels from abroad for gas and

electricity to favour the introduction of new operators, thus improving energy efficiency and creating the essential conditions to reduce the price of electricity and gas in the frame of the energy markets liberalization policies;
d) The integrated management of the territory and the environment for the exploitation of renewable sources through the efficient realisation and management of integrated industrial systems; this particularly involves the exploitation of wind energy and waste management.

In particular, it is expected that all measures described in paragraph 4.1, table 4.1 will be implemented.
The evolution of the energy scenario is similar to the evolution of the trend scenario; a reduction in overall consumptions of about 14 Mtep is, however, expected. This would cause total consumptions to reduce up to about 186 Mtep by 2010.

The effects of these measures and their disaggregation per each sector, over the entire period under exam, is shown in following table 5.24. Overall emissions to 2010 should be equal to about 540.1 Mt, with a residual gap of about 41 Mt compared to the Kyoto objective. This is considered as the most believable scenario by the time being, and it is therefore considered as the reference scenario at national level, particularly to the purpose of evaluating sectoral emissions over the 2008-2012 period.

5.5.4 Scenario with additional measures, the Kyoto objective

Together with the description of the trend scenario at sectoral level, some additional measures and their possible effects on emissions have been described in chapter 4 and in the previous paragraphs 5.3 and 5.4. The potential overall emission reduction achievable through the implementation of measures summarized in table 4.2 is equal to 30-43 Mt.
A new scenario could shape up if all these measures were implemented. By the year 2010, the new measures would bring overall emissions to about 502.5-490 Mt with a residual *gap* of about 15-3 Mt with respect to the Kyoto objective.

A series of additional measures, which, by now, have not been considered at national level (see paragraph 5.4.4, sinks) would allow reducing the *gap* even further or to annul it. An alternative to the use of additional measures is to resort to some flexibility mechanisms.

5.5.5 Scenario without measures

The preparation of a "no-measure" scenario from 1990 is rather complicated and difficult to attain. Considering the importance of this kind of a scenario in the European and international contexts, the available elements are now quoted.

For the year 2000 only a overall quantified evaluation is contained in the first National Communication. It refers to the emissions of carbon dioxide for the year 2000 only and it foresees an increase in CO_2 emissions of 60-65 MT compared to 1990. Therefore, taking into account most recent inventories, it indicates that overall emissions should have been equal to about 582-587 Mt CO2 equivalent, +7% with respect to a consumptive of about 546.6 Mt.

TABLE 5.24 – Reference scenario, GHG emissions from 1990 to 2020

	GHG emissions		[Mt CO2eq.]	
	Base year	**2000**	**2005**	**2010**
FROM ENERGY USES, of which :	*424.9*	*452.3*	*4445.1*	*444.5*
- Energy industries	147.4	160.8	144.9	144.4
- Industry	85.8	77.9	79.0	80.2
- Transports	103.5	124.7	134.0	134.7
- Civil	70.2	72.1	70.3	68.0
- Agriculture	9.0	9.0	9.1	9.6
- Others (military+leaks)	9.3	7.8	7.7	7.6
FROM OTHER SOURCES, of which:	*96.1*	*94.5*	*92.4*	*95.6*
- Industrial processes	35.9	33.9	30.1	30.4
- Agriculture	43.4	42.6	42.0	41.0
- Wastes	13.7	14.2	11.0	7.5
- Others (F gas+solvents)	3.1	3.8	9.3	16.7
TOTAL	**521.0**	**546.8**	**537.5**	**540.1**
Kyoto target				**487.1**
Carbon Credits From JI-CDM				**-12**
Gap				**41**

For the year 2010 data on the energy sectors are available. They combine the results of a complete trend scenario for this sector, that is, the trend scenario of the Second National Communication, see par. 5.6, and the emissions reduction taken into account in the considered measures (ref. Tab 6.8 of the SNC). The total effect of the measures is evaluated autonomously in that table and it amounts to about 68.2 Mt of carbon dioxide, about 32.7 of which in the electric sector.

In this "no-measure" scenario, overall carbon dioxide emissions from energy sources to 2010 would therefore amount to about 554 Mt, which are to be added with the estimate relating to the methane and nitrous oxide emissions from the energy sector, about 7.7 and 13.1 Mt of CO_2 eq., respectively. In total, about 575 Mt of CO_2 eq. This value is approximately higher by 16.8% than the emissions hypothesised in the "basis of calculations scenario" included in the SNC and about 16% higher than the current trend scenario.

As far as the emissions from other sectors are concerned, it is not advisable to take the estimates of the SNC as a landmark, since the methodology for estimating emissions have been significantly modified over the last 5 years. To have an idea: the overall emissions foreseen by the SNC to 2000 amounted to about 118 Mt whereas the final emissions in the inventories amount to about 93.3 Mt, even though the under lining activity factors have increased. Therefore, the only reliable scenario for comparison with the ongoing scenario, is the one included in the current trend scenario, even though it cannot be considered as a "no-measure" scenario from a methodological point of view.

In the end, according to this hypothetical "no-measure" scenario, total emissions would amount to about 672 Mt by 2010, that is, about 13% higher than the current trend scenario.

The exercise has not be attempted at aggregate level in this third communication: technologies have undergone many structural changes in the last 12-year period and a "no-measure" scenario is hardly devisable by now. Anyway, additional information is available for the electric sector only. The model that has been set up to meet the energy demand foreseen by 2010, has allowed estimating the amount of carbon dioxide produced by a stock of thermal power stations similar to that of 1995-98, see figure 5.12.

It is a "virtual" evaluation since, in any case, it would require a greater number of plants of similar efficicency for that period to be added to the existing ones. The exercise is, however, indicative for assessing the impact of the measures adopted in this extremely important sector. As shown in figure 5.12, the measures adopted or foreseen in the course of the last 5-7 years, have allowed reducing trend emissions from the electric sector to 2010 of about 60 Mt CO_2, compared to the trend that would have been recorded if no measures had been adopted.

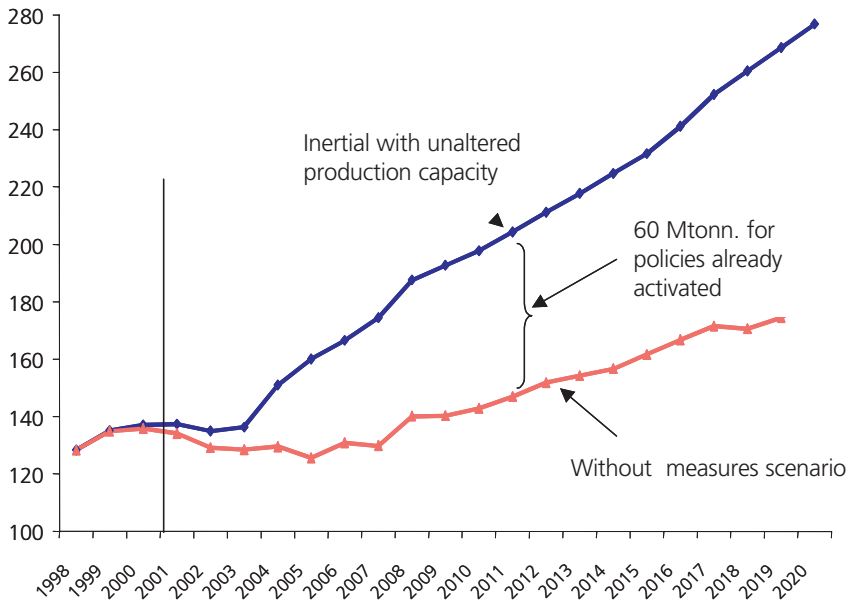
5.6 Scenarios of the SNC (Second National Communication)

An outline of the emission scenarios contained in the SNC, published in 1998, is reported in order not to leave anything out.

5.5.6.1 Adopted methodology

Two methodologies had been adopted to formulate

FIGURE 5.12 - CO_2 emissions from the thermoelectric sector



the new scenarios: an optimisation model, and sectoral simulation models. It was established to start from a "basis of calculation" without modifying the trend utilization pace of technological and organisational options aimed at reducing emissions; since, at the time, there was no availability of either documents investigating the medium and long-term potential economic expansion of Italy in the international context or official projections on the energy sector alone to 2010, it was agreed to construct an independent "basis of calculation".
in the first approach, the methodology based on the Markal technological long-term, minimum-cost model was adopted; in the second model, the emissions to 2010 were calculated by detracting the emission reductions that could be attained through the adoption of the technological options aroused from the implementation of the above-mentioned policies and measures. On the whole, similar measures were selected from the optimisation model.
The basic assumptions of the model are described in the following paragraph, and they are summarised in table 5.25. The optimization model also included an intrinsic increase of the varying energy gains from one sector to the sector, equal to about 1% year. The model also considered the costs of technologies, the optimisation consists in reducing the overall costs for the country system. The second methodology allowed to investigate the impacts of a series of polices approved or forecasted, through interactions between the basic scenario (defined as the "basis of calculation") and the Markal model. The use of the latter methodology implies some approximation, due to the difficulty to provide accurate evaluations of the effects of different overlapping measures on emissions.

5.5.6.2 The "basis of calculation" scenario
The trend scenario reproduces, to some extent, the projections attainable from the current evolution hypotheses in terms of demand, prices, and economic and administrative systems; the scenario, initially constructed in conformity with the technological model where interventions are chosen by assuming the persistency of the existing gaps between the discount rates perceived by the different sectors of the national energy system, can be reconstructed in conformity with the econometric method, assuming a continuous intrinsic gain in energy efficiency (about 1% yearly average).
The emission values had been obtained by extrapolating most recent elasticity (consumption/income) values to 2010 for electricity and for the transport sector, which leads to estimate to 2010 an electricity demand from the system equal to 340 TWh, and a fuel demand of 48 Mtoe. According to this assumption, power demand to 2010 was estimated to reach 196 Mtoe, and carbon dioxide annual emissions from the energy sector were estimated to amount to 485 $MtCO_2$/year, stability of coal quantities, methane increasing to 71 Mtoe and a reduction in electric energy imports to 25 TWh.
Taking into account the medium-long temporal horizon (13 years) and the relative development of the energy market, and assuming the arising of saturation effects both in the transportation sector (characterised by 0.6 elasticity, leading to a fuel demand equal to 46,5 Mtoe/year) and in the energy sector (elasticity 0.9, power demand from the system 325 Mtoe), it is possible to reduce primary energy requirements to 193 Mtoe/year, and emissions to 470 $MtCO_2$/year to 2010. This scenario is defined as the "basis of calculation" scenario, and it was set on medium-low values with respect to other energy scenarios arranged by other analysts at those times.

TABLE 5.25 - Basic economic assumptions until 2010 according to the SNC

	1990	1995	2000	2010
Population (millions)	56.7	57.3	57.3	56.5
GNP (in thousands of billions in 1990)	1,311	1,386	1,530	1,865
Yearly rate of growth		1.1	2.0	2.0
Industrial production (index)	100.0	106.9	118	145
Family consumptions (in thousands of billions in 1990)	1,041	1,093	1,207	1,471
Passengers Km (in billions of passengers/km)	717	824	878	994
Tonnes Km (in billions of tonnes/km)	230	244	272	331

CHAPTER VI
Vulnerability assessment, climate change impacts and adaptation measures

INTRODUCTION

The present chapter describes the impacts and vulnerability to climate change in Italy, and the sectors involved and outlines options to adapt to such change. It also provides an overall view of some major adaptation measures adopted at governmental level.

Fig. 1 - Total precipitation trend in (a) winter, (b) spring, (c) summer and (d) fall. Results are expressed as percentage variations against the mean value recorded between 1951 and 1996.

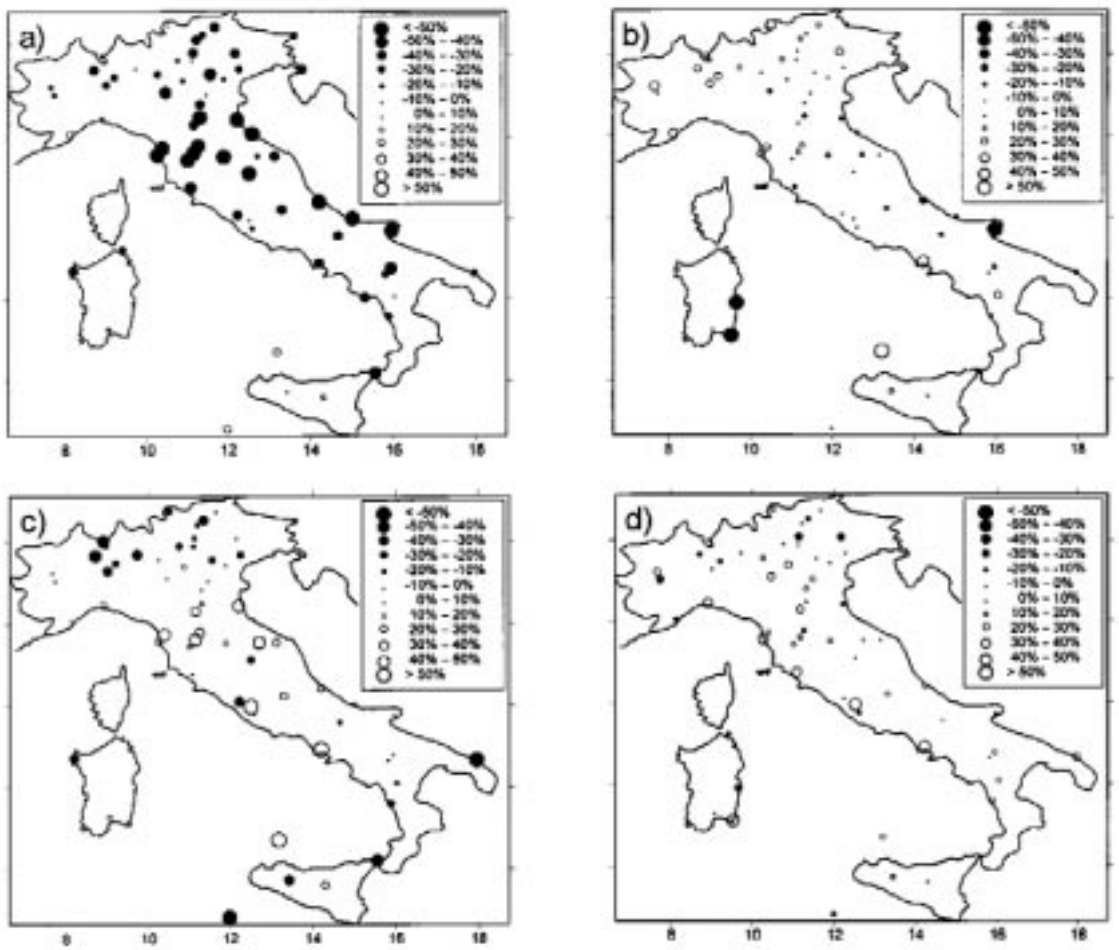


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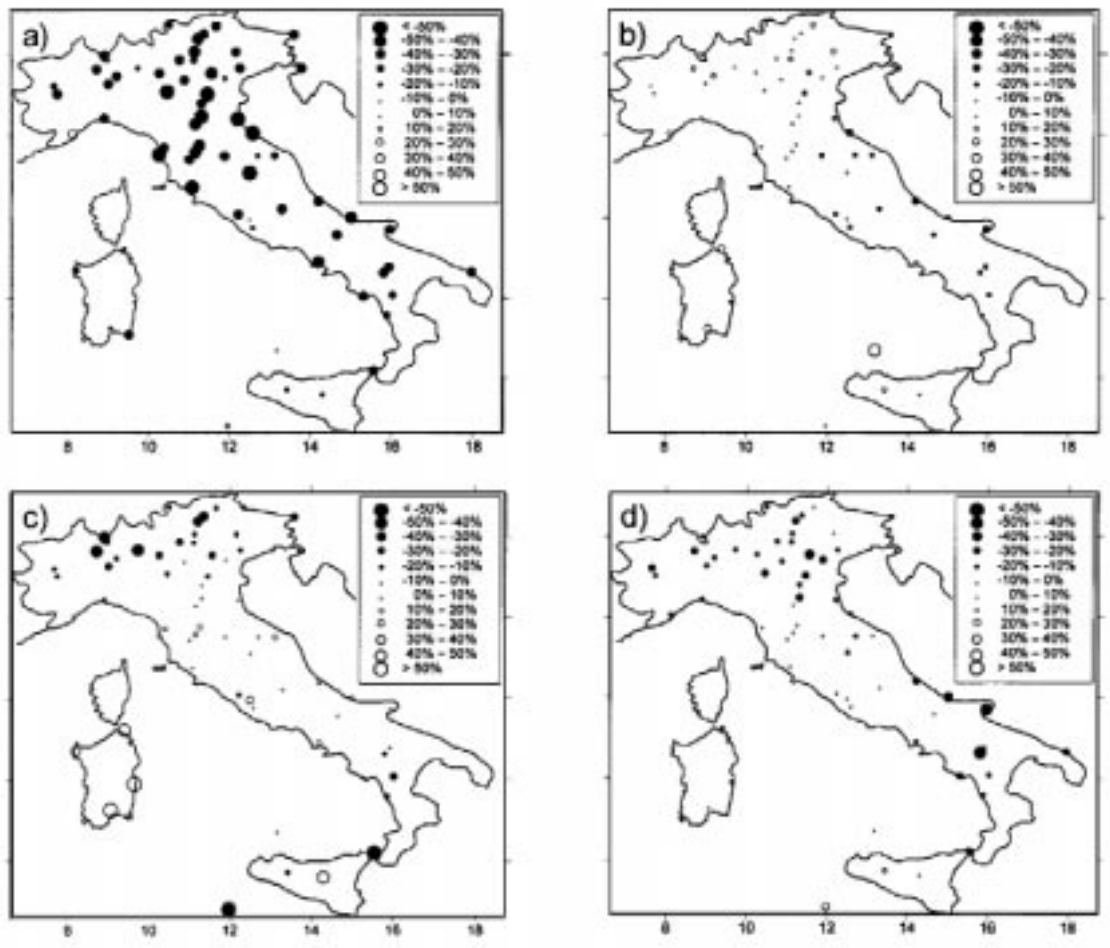
Fig. 2 - Trend of the number of rainy days in (a) winter, (b) spring, (c) summer and (d) fall. Results are expressed as percentage variations against the mean value recorded between 1951 and 1996.



6.1 ENVIRONMENTAL CHANGES OBSERVED IN ITALY

6.1.1 Temperature and precipitation trends

A great deal of historical data has allowed to outline a picture of the climate evolution, and evaluate the ongoing changes on a long-term scale. The most remarkable climatic phenomena and their social and economic impacts on the Italian territory have been documented in several researches and projects since the year 1000 (Pfister, et al., 1999; Camuffo et al., 2002). The first instrumental recordings have been carried out since the 18th century in Rome, Milan, Padua and Bologna. Each secular time series of monthly and daily temperature and precipitation values has been examined and analysed within several national and European scientific programmes (Moberg, A., et al.2000).
The number of recording stations has significantly increased since the second half of the 19th century. ISAC-CNR in co-operation with the Institute of Applied Physics of the University of Milan, has carried out researches on historical climatology. They have also created a temperature and precipitation data base, both on a monthly and on a daily basis. The secular series (1865-2000) come from UCEA and Servizi Idrografici, whereas the pluri-decadal series (1951-2000) come by the Italian Air Force Meteorological Service.
The series have been digitalised, and uniformed to work out a climatic trend.
The time series analysis (about 40) referring to the 1865-1996 period (Buffoni et al., 1999; Brunetti et al. 2000, Brunetti et al 2001) shows that:

- Monthly maximum and minimum temperature increases differ from the North to the Centre-South;
- A 0.6 °C increase in maximum temperatures has been observed in the North, and a 0.8 °C increase has been observed in the Centre-South during the considered period;
- A 0.4 °C increase in minimum temperatures has been observed in the North, and a 0.7 °C increase has been observed in the Centre-South during the considered period;

• Increases in maximum and minimum temperatures have been recorded in wintertime, both in the North and in the South;
• As from 1930 both in the Centre and in the South of Italy, in addition to these temperature increases, a progressive reduction in precipitation and, as a consequence, an increase in aridity has been recorded.
The analysis, carried out on seventy-five daily precipitation series relating to the 1951-1996 period (Brunetti et al., 2001; 2002), shows that:

• A reduction in precipitation has been observed all over the national territory during the considered period; the most significant reductions have been recorded in the Centre and in the South, figure 1;
• The reduction in rainy days throughout the national territory (about 14% both in the North and in the South) is statistically significant; greater reductions have been observed in wintertime, figure 2;
• A rise in precipitation intensity has been observed both in the Northern and the Southern regions;
• In the Northern regions, the persistency of dry periods increases in wintertime and in the Southern regions in summertime.

The observed trends can be attributed both to variations in the atmospheric circulation and to an increase in atmospheric moisture ratio due to local and global rises in temperature. Reductions in winter precipitation could be due to an increase in the frequency and persistence of extra-tropical cyclonic phenomena across the Mediterranean basin (Colacino, 1993; Maugeri *et al.*, 2001), whereas the increase in precipitation intensity could be due to the intensification of the hydrologic cycle.

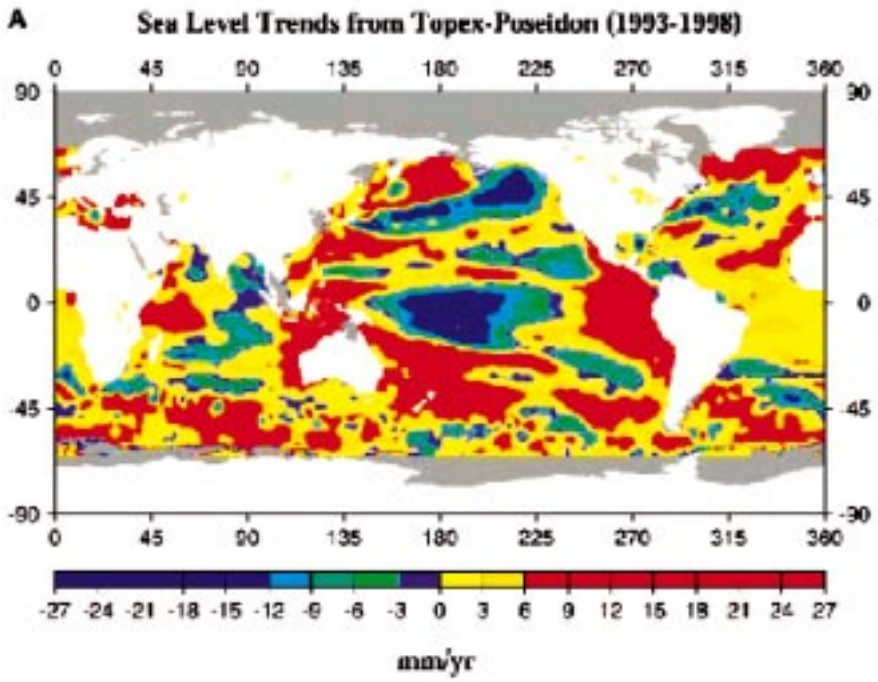
6.1.2 Sea level rise

Several factors contribute to the sea level rise, such as, the ocean thermal expansion, the melting of medium and low latitudes glaciers and of polar caps. According to the last IPCC report, by the end of 2100, the different contributions to the sea level rise can be be divided as follows:

(*the + sign indicates a positive contribution; the – sign indicates a negative contribution*):
- Thermal expansion: from +20 to +37 cm;
- Contribution from artic ice caps: from +2 to +5 cm;
- Contribution from antarctic ice caps: from -8 to -2 cm;
- Contribution from other glaciers (polar ones excluded): from +8 to +11 cm.

Following to accurate computations from Topex-Poseidon satellite data, a new ocean average world rise rate of about 0,7 mm/a-1, due to thermal expansion, was recorded (fig. 3).

Figure 3 - The geographical distribution of sea level trends over 1993-1998 computed from Topex/Poseidon altimetry (Science 2001)



At regional level, the sea level rise differs from one region to another.
In the Mediterranean region the sea level is expected to rise between 20 and 30 cm in the year 2100, without considering vertical tectonic movements. Considering that the Northern Italy - especially the eastern side – presents slower subsidence phenomena than Southern Italy, the sea level rise will tend to be higher along the Northern coastal zones than along the Southern ones.
About 4500 square kilometres of coastal areas and plains would be at risk of sea flooding (according to a study carried out by NASA-GISS); floods might be distributed as follows:
- 25.4% in Northern Italy (Upper Adriatic Sea);
- 5.4% in Central Italy (the coastline between Ancona and Pescara; the coasts nearby Rome and Naples):
- 62.6% in Southern Italy (Gulf of Manfredonia, coasts between Taranto and Brindisi, Eastern-Southern Sicily);
- 6.6% in Sardinia.

However, the trends referred to the Mediterranean basin and, consequently, to the Italian seas during the last 30 years seem to differ from the ocean trends observed at global scale.
The data of satellite Topex Poseidon referred to the Mediterranean, the tide gauge analysis and other observations would indicate remarkable anomalies or even a standstill in the sea level rise for, at least, the last 30 years. This trend, compared to the ocean average trend, would necessarily involve the formation of a "step" that is expected to form nearby the Strait of Gibraltar. Pirazzoli & Tomasin (1999), Tsimplis & Baker (2000) and Tsimplis & Josey (2001) have recently published the alleged causes of this phenomenon that have been generally interpreted as due to wind or atmospheric variations (pressure). In practice, a significant average increase in pressure would cause the sea to "flatten". In fact, the tide gauge analysis and/or meteorological-climatic observations indicate a period of "stability" for the Italian seas.

The formation of a "step" nearby Gibraltar and the results of some researches recently carried out by ENEA support the above data (Sannino et al., 2002).

Although the Mediterranean is not considered to date as one of the most critical areas, in terms of population at risk of flooding, nevertheless, it appears to be as one of the world's most vulnerable areas in terms of loss of humid zones, ecosystems and marine-coastal biodiversity.
The sea flooding of flat coastal areas and coastal marshes accelerates coastal erosion, increases salinity in the estuaries and deltas through the intrusion of the saline wedge, and causes the seeping of brackish water in the aquifers of the littoral zone.
Moreover, low coasts will be exposed to additional flooding events resulting from extreme meteorological situations and sea surge waves higher than 5 metres: in these conditions, the river down-flow onto the sea is more difficult, with higher risks of overflowing and flooding events.
However, it should be remarked that in reality the risks for Italy are, additional to those caused by the ongoing anthropic pressure and by the exploitation of the coastal areas. As a matter of fact, climate change is not associated to new risks, at least as far as Italy is concerned; they only tend to emphasise (sometimes with unpredictable effects) the existing risks caused by urbanisation, industrial production, fishing, tourism, maritime transport etc.

6.1.2.1 The Tyrrhenian Sea, new data from ENEA

On the occasion of a workshop held at the Accademia dei Lincei in Rome, a state of the art of the scientific knowledge concerning climate variation in the Mediterranean area during the Holocene (last 10 ka) has been made. The first data of a research carried out by ENEA on the marine notches carved on the carbonate cliffs of the Tyrrhenian Sea were also exhibited. The formation of the present day tide notch (Figures 4 and 5) has been possible thanks to the stability of the sea and the coast. If there is tectonic instability of the coast or a rapid sea level rise notches do not form. The notches are shaped by the action of the waves and, most of all, by the chemical mixing of salt and fresh water. Tide notches only occur in coastal areas with proved tectonic stability, and only when the sea level is at a standstill. Evidence of this is given by the fact that notches do not form in areas with a tectonic activity rate exceeding 0.3/0.4 mm/a (Eastern Sicily, or south Calabria for instance). The cavity produced by the notch is shaped exactly by the maximum and minimum tidal flow line. The marine notch shown in figure 4 (Cala Luna, Sardinia) has been monitored over a three-month period; maximum tidal excursions have never exceeded the upper edge of the cavity, which, on the other hand, corresponds to the size of the tidal flow (Fig 5). It is known that the average age of a tidal notch is about 200/300 years. If the present tidal maximum level does not exceed the higher cavity, at a proves that the Sardinian sea is almost standstill.

6.1.3 Vulnerability of the Italian coasts

As commonly known, vulnerability is strictly connected to the topographic altitude of a surface with respect the sea level, its lithology and, above

Fig 4 - Sardinia, Cala Luna, the marine notch under control

all, the sea rise rate. If however, as it seems, the Italian seas level rise does not show clear positive values, we need to make it clear why such zones are at risk of sea flooding and why does coastal erosion actually occur. The answer is that the phenomena linked to coastal tectonic movements in a seismically active basin – like many Italian coastal areas are – might cause severe consequences to the coastal areas. The movements that are not associated to the eustatic movement of the sea, entailing negative (and positive) vertical slips, are: Tectonic, Subsidence and Isostasy.

• **Tectonic** is formed by the whole of geologic phenomena linked to the presence of faults which, following the movement of plates relative to one another, cause a constant motion of some portions of the earth's crust. Tectonic movements can be positive, negative or transcurrent. Many portions of the Italian coastal areas are affected by active tectonic phenomena, characterised by vertical positive or negative movements higher than 2 mm/a.

• **Subsidence** is the whole of negative movements that may take place in the coastal plains induced by the compaction of specific geologic formation, such as peat, or by anthropic activities (water or gas pumping).

• **Isostasy.** The elastic movement of the mantle due to ice or water variations, which press the continental shelves, instead, causes the isostatic phenomena. Such movements are strongly correlated to cyclic glaciation phenomena and to consequent

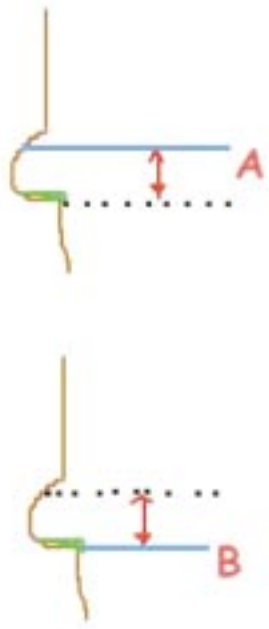


Fig 5 - Schematic image of a marine notch, the cavity and the maximum (A) and minimum (B) tidal level recorded.

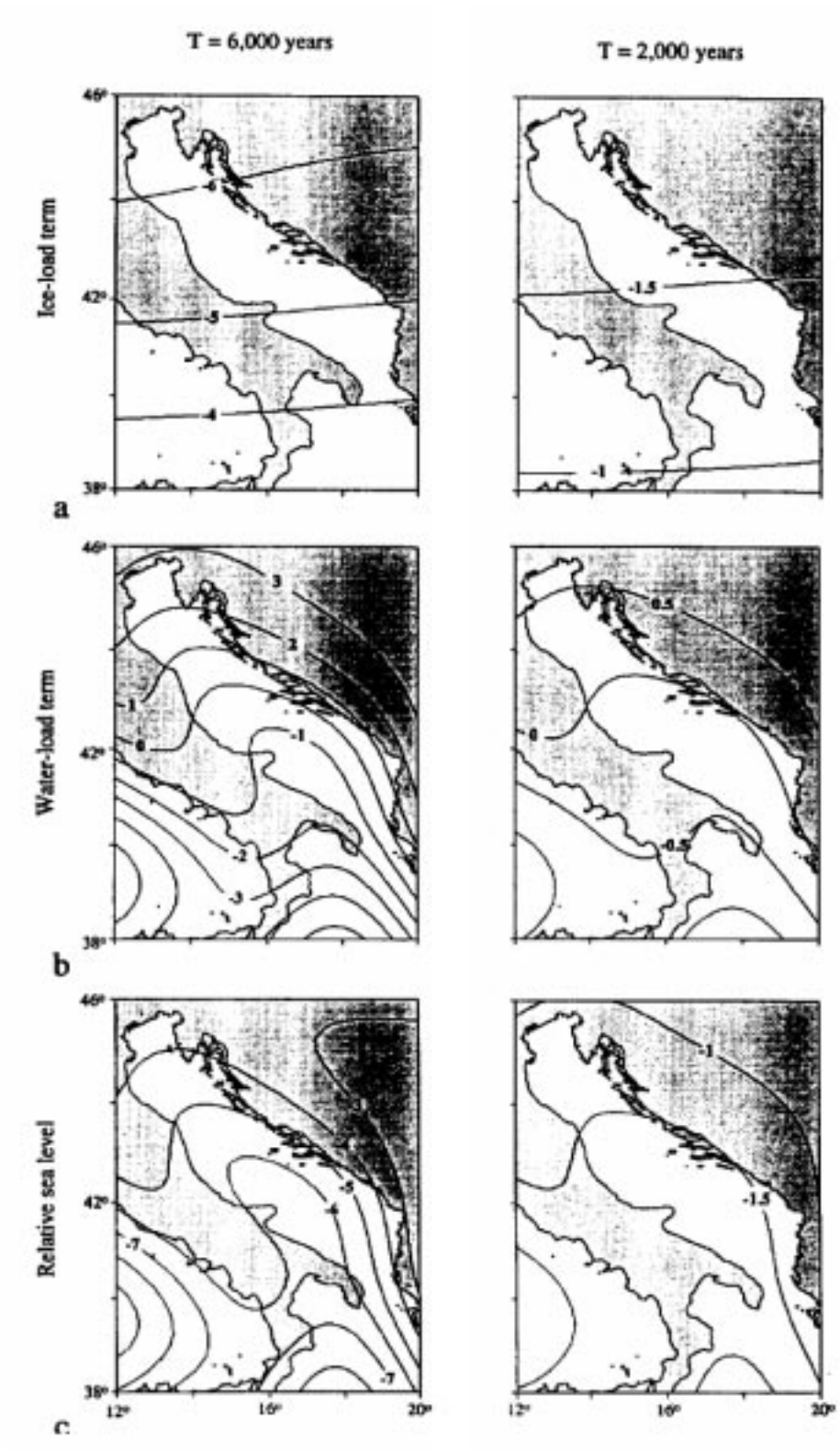


Fig 6 - The isostatic contribution to the relative uplift of the sea level in the last 6,000 years (Pirazzoli et al 1997).

Figure 7 - Italian map with areas at risk of sea flooding and tectonic indications (Antonioli et al., 2001).

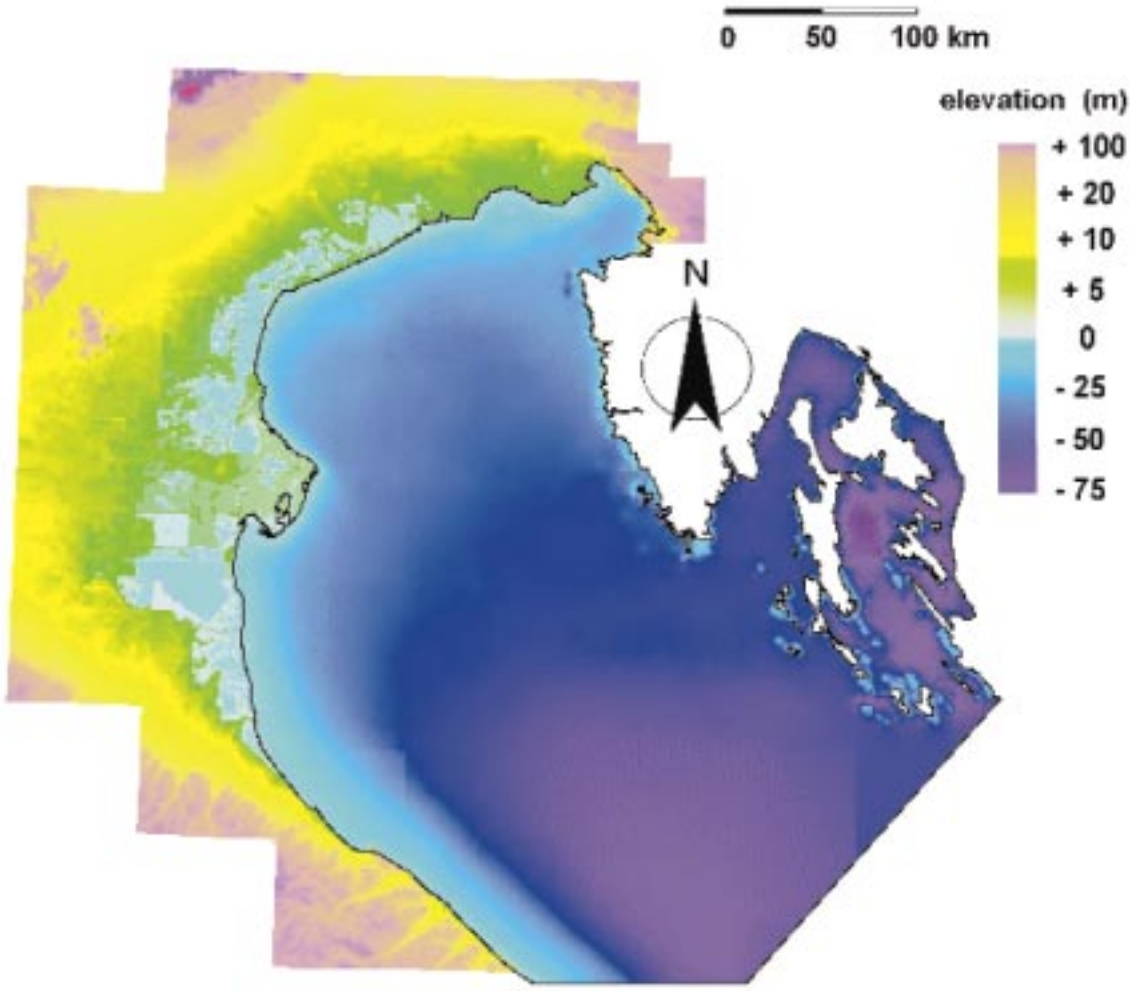


Figure 8 - Scenario referring to the year 2100 of the topographic lay out of the Po' valley. It must be noted that many areas are at risk of flooding (by: CENAS EC Environment Programme 1990-1994)

sea transgressions and regressions, and they can be modelled and foreseen (Lambeck & Jhonston 1995, Lambeck & Bard 2000). Several preliminary data on the Italian coasts have highlighted that these isostatic movements (which have reached some meter extent in the last 6000 years) are directly proportional to latitude (Figure 4).

A study recently requested by the Ministry of the Environment to ENEA (2001) indicates that, considering the great variability of tectonic and isostatic movements in Italy (uplift and subsidence of the coastal crust), a study on the tectonic activity of the Italian flatlands should be promoted to provide accurate rates. In fact, many coastal areas at potential risk (being topographically depressed, under the sea level) show higher uplift and subsidence values than the average uplift rates expected for the Italian seas (about 0.2- 0.4 mm/year). Figure 6, in addition to showing the coastal segment currently positioned at zero level (or under the sea level), highlighted in red in Figure 7, it introduces a new factor relating to the tectonic trend of the plain under review. If the factor is equal to 7, it means that the plain is stable; if it is higher than 7 it means that it is uplifting, and if it is lower than 7, the plain is subsiding. The first results of this study underline that 33 Italian coastal plains potentially at risk of sea flooding (fig. 7) are currently in stable or uplifting areas. Some problems, instead, may affect in the near future the Padano-Venetian (fig 8) and the Versilia (fig 9) plains, and the plains surrounding Fondi and the Pontina countryside, which, in addition to presenting several square kilometres under zero level, show remarkable tectonic subsidence phenomena.

Some geological projects have been recently started by ENEA to detect the subsidence rates (tectonic, isostatic and anthropic) of all the Italian coastal plains at risk of sea flooding by means of suitable actions.

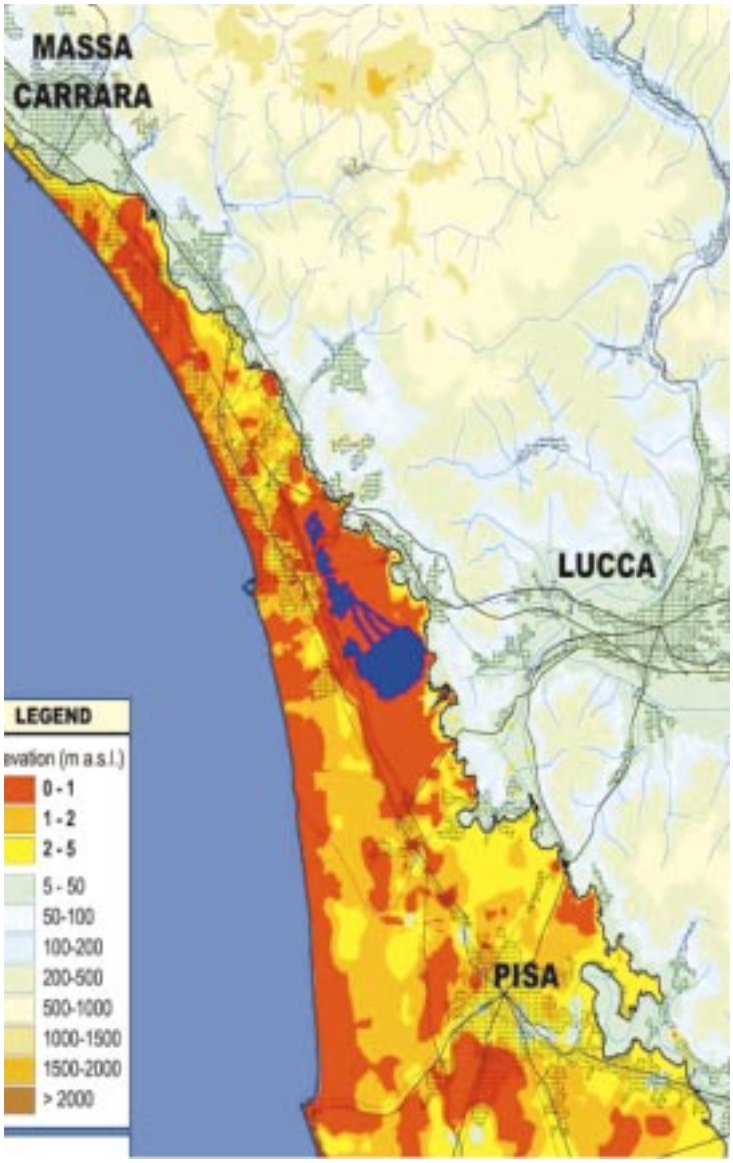


Figure 9 - Enlargement of figure 7. In addition to presenting a large segment of depressed coastal areas, the Versilia plain shows tectonic features with significant subsidence evidences.

6.2 IMPACTS OF EXPECTED CLIMATE CHANGE AND EVALUATION OF VULNERABILITY

6.2.1 Socio-economic size of the impacts of climate change and of vulnerability in Italy

The impacts of climate change on the Italian natural and social systems imply variable costs and benefits in relation to the degree of territorial vulnerability. Vulnerability to climate change is not only related to environmental criteria but also to social and economic factors, as it will depend on the ability of the whole system to cope with stress factors and to restore a balancing condition. This ability depends on many factors, such as wealth and its distribution, technology, training, knowledge, infrastructures, resource availability and access, management skill, level of social integration and cohesion, and, of course, ecological and environmental vulnerability.

Using a classification method employed in literature (Burton et al 1993), according to which adaptation measures are divided into eight categories (capacity to endure losses linked to climate change, to divide losses, to modify 'threats' and to prevent their effects, to change the way of using goods and services affected by climate change, to relocate production activities, to invest money in research, and finally, to train, inform and encourage different lifestyles), it is possible to note how different levels of economic development in a country or in a region allow to adopt specific adaptation measures to climate change, causing the country or the region to become less vulnerable to climate change. For instance, poorer regions are more vulnerable to climate change being unable to endure losses through the implementation of change-responding measures; to re-localise economic activities; to invest in research favouring new technologies and other adaptation measures; to disseminate informa-

tion and knowledge in order to modify people's lifestyles and the behaviour of the production agents.

The sectors that have been identified as the most vulnerable of the Country are agriculture, forestry, water supply, tourism, health; the most vulnerable zones are the coastal and the alpine areas, which, respectively, are subject to estimated sea level rise and change in the hydrological cycle. Many studies deal with the "physical" extent of the impacts. Only a few studies, instead, are aimed at exploring the social and economic size of vulnerability and of climate change impacts. These kind of studies, however, could be very useful to identify adequate adaptation strategies.
As a matter of facts, some studies evaluate the economic value of climate change impacts, but they essentially focus on analyses carried out on a world scale, according to the results of general models of economic balance. Since these models do not refer to a specific country but to macro areas, they can only provide very rough estimates to be applied to the majority of developed countries. For example, Nordhaus, in a study on the United States relevant to all developed countries, after having obtained the opinions of many experts from different sectors, arrives at an estimate of the total impact between 0.7% and 8.2% of the US GDP, with a 90% confidence interval and a median equal to 1.9%. Also other studies range around 2% of the GDPs of the developed countries.
Some interesting results have arisen from the WISE (Weather Impacts on Natural, Social and Economic Systems) project, financed by the European Commission and carried out, as far as Italy is concerned, by a group of Italian researchers from the Eni Enrico Mattei Foundation during the three-year period 1997-1999 (EU, 199). The project is aimed to evaluate climate change impact (particularly during very hot summers and mild winters) on the natural, social and economic systems of several European countries, providing, where possible, the economic estimation of such change. It is a double-faceted study as it provides both the quantitative evaluation of the impacts of climate change on several economic sectors through the use of econometric models and national statistical data, and it analyses the individual perception of such impacts on everyday life through questionnaires and interviews.
In Italy, the output of the survey, carried out in 1998 based on the results of a questionnaire submitted to a sample group of 300 individuals from Lombardy and Sicily indicates, beyond all doubts, a correspondence between extreme climate seasons, particularly very hot summers, and the negative impacts on everyday life; in general, well-being, labour, leisure, health, housework, and the choice of the most appropriate means of transport are strongly influenced by extreme climatic episodes.

In details, according to the model, the average number of **fires** per region caused by climate change increased up to 328 in 1985, characterised by a very hot and dry summer season. The expenditure on fire damages in the period 1985-1994 characterised by extremely hot summers, was 26,3% higher than the previous season.

As far as **tourism** is concerned, estimates indicate that domestic tourism is fairly sensitive to climate change, even if variations in tourist demand are observed all the year long and relation to the different characteristics of the regions, with balancing effects. Measuring the national tourist flows on the basis of the number of reservations recorded at the accommodation facilities, estimates indicate that seasonal tourist flows tend to decrease in correspondence with very hot seasons by about 39.494 reservations per region on the average, that is to say, 1.22% against the number of reservations recorded under normal climate conditions. However, the effects of temperature increases are not distributed homogeneously across the regions: summer tourism of the coastal areas increases in correspondence with very hot seasons. It is estimated that a 1°C increase in summer temperature in the coastal regions alone, implies an increase of 62.294 reservations per night.
In the alpine regions, instead, temperature increase and the drop in winter precipitation with respect to standard values have negative impacts on winter tourism. It is estimated that a 1°C temperature increase in December implies a drop of about 30.368 reservations per night in the month of January in the alpine regions alone.

The **energy sector** shows a clearer response to extreme temperature where a decrease in consumption is recorded during exceptionally hot seasons. According to estimates, in fact, a downward trend in gas and energy consumptions for domestic use is observed in very hot years, both in summertime and in wintertime, with greater reductions in mild winter seasons than during extremely hot summer seasons with respect to standard values. Extremely high temperatures were recorded in 1994. In that year, in Italy, winter gas consumptions for domestic use decreased of 510,000,000 oet (oil equivalent tonnes) on the average, that is, a reduction of 414 million Lira, i.e. 213.810 Euros, at current prices.

As far as human health is concerned, the climate impact on cardiovascular and respiratory diseases, particularly affected by climatic parameters, has

been evaluated. Estimates show that high temperatures in summer months tend to increase mortality, whereas higher average temperatures in winter months tend to reduce it. An 1°C increase in summer mean temperature would cause an average increase of 27 deaths across the country. According to estimates, the exceptionally hot summer of 1994 caused an increase of 63 deaths.

As far as **agriculture** is concerned, only a few products are susceptible to temperature increases with consequent economic damages: the exceptionally hot and dry season of 1985, for instance, caused a reduction of 13 quintals per hectare in average regional potato crops, that is, an economic loss of 376.346 Lira per hectare, at current prices, i.e. about 194 Euros. Equally, the extreme season of 1994 caused a reduction of 519 thousand hectolitres in average regional wine productions, that is, a total economic loss of 44.677.395 thousand Lira at current prices, i.e. about 23 million Euros. The scenario of the agricultural effects of climate change, however, is not homogeneous: temperature increases seem to favour fruit productions both in the North and in the South, whereas corn production does not seem to be particularly affected by them.

6.2.2 Sea level rise

The sea level rise will imply higher risks for the Italian coastal areas. In particular, it is estimated that most of the problems will be linked to the loss of humid zones nearby the rivers estuaries , to the intrusion of salt water into coastal fresh-water beds with repercussions on agriculture and fresh-water supplies, and, finally, to greater and more rapid erosion phenomena affecting low-laying coastal zones and the beaches formed thanks to hydraulic defensive works along coastal and drained areas. Apart from entailing remarkable variations in the territorial layout, the sea level rise will have significant effects on agriculture, industrial production, tourism, health, and, above all, on the insurance sector.

6.2.3 Soil vulnerability

The quality of the Italian soils will generally undergo towards a deterioration, if no appropriate measures are implemented. In particular, Northern regions might be affected by landslides and erosion phenomena due to run-off especially in slope soil-sand and hilly areas, while the lowlands of the Po delta could be significantly affected by the sea level rise and by the intrusion of saltish water.
On the contrary, in Southern Italy, the expected climate change will imply other risk factors, including desertification risks, which are the object of studies in the frame of Annex IV of the UN Convention To Combat Desertification (see § 6.2.6). The possibility of future degradation caused by climate change is associated with two concurrent factors, which according to climate experts are probable, not certain, such as: a decrease in the amount of total yearly precipitation below the threshold of 600 mm/year and the dry period stretching for many months, especially if such period includes the hot semester (extremely high evapotranspiration). The Italian soils, although irrigated, might equally deteriorate if human activities (agriculture, above all) continue to stress the land use, reducing biodiversity and unbalancing the ecosystem.
However, it is very difficult to foresee soil erosion, even with the support of sophisticated numerical modelling, due to lack of data, and verify theories and parameterizations inserted in the models.
Only general conclusions could be reasonably assumed and drawn on the findings of by IPCC in the TAR.

6.2.4 Climate change and agriculture

According to IPCC, the rise in temperature will affect both natural vegetation and croplands. A particularly negative effect is expected at local scale level in Southern Italy, since both vegetation and lands are already experiencing a marginal water supply regime. On one hand, the warmer and drier climates of Central-Southern regions might favour the expansion of specific cultivations to the North such as oil, grapevines and citrus trees. On the other, the rise in temperature and the impacts on the hydrologic cycle require several management changes in many regions. Each climate variable will affect cultivations in different ways but the final result will depend on the interactions between variables. For example, winter corn yields should not decrease in Italy if adequate water resources are provided. Equally, even if agricultural production in Northern Italy is subject to agro-alimentary variations, it is not expected to decrease if more efficient water-drainage, pollution-preventing and crop-protecting systems are adopted.
Among the indirect effects of climate change in agriculture, it must be considered also the loss of useful farming lands particularly in the coastal areas of the Upper Adriatic caused by the sea level rise and by the intrusion of salt water in water-bearing layers.

The most important direct effects of climate change in agriculture could be summarised as follows:
- Lengthening of the growing period of about 10-15 days per each °C of rise in yearly average tem-

perature and consequent shortening of cold winter periods. Consequently, olive-tree, citrus tree and vine cultivations would be favoured in the North of Italy, whereas corn cultivations would be disadvantaged in the South;
- Movement of all ecosystems to the North and towards the mountain heights: about 100 Km northward and 150 meters upwards per each °C of rise in yearly average temperature. Such movements represent a potential danger to Italy due to the territory orography features and to temporal incompatibility between the movements of the ecosystems and climate change;
- Increased variability in rain distribution with possible flooding phenomena in autumn, drought phenomena in winter, and increased variation in extreme thermal values with possible frosts and heavy downpours in spring and summertime. Corn seeding would be disadvantaged in autumn; harvests would be poorer in winter and springtime; summer and fall crops would be damaged.

6.2.5 Forests

On the grounds of the available data, it is still difficult to make a distinction between the extent of climatic anthropogenic alterations and natural climatic variations along the national territory. However, it is evident that forest ecosystems are vulnerable to an increase in aridity and to coastal modifications. Moreover, nitrogenous depositions, in addition to increasing the soil pH value, modify the standard growth rates of forest formations, stimolating accretion, modifying their phenology, and exposing them to higher risks of biotic and abiotic damages.
The response of the Italian forests to climate change goes into two different directions: a negative trend associated to the reduction of water supply, and a positive one associated to the lengthening of the growing and to nitrogenous depositions.
The increased aridity observed in Central-Southern Italy makes the Italian forests more vulnerable to biotic and abiotic disturbances reducing their resistance and resilience. In fact, a oak deterioration, mainly associated to a twenty-year-long water stress, is observed. It is an alarming data considering that oaks account for the 26.5% of national forests.
Besides, an average of 55.000 ha of woodlands are more or less seriously damaged by fires every year, with a 10% increase recorded in the last 20 years.
In addition, it must be noted that about 3% of forests are located along areas at risk of subsidence. It follows that about one third of the Italian forests is seriously jeopardised by climate change. This will inevitably imply a significant loss in habitats and biodiversity.
An opposite trend caused by the lengthening of the growing period is recorded in Central-Northern Italy where a forest expansion is observed.
Moreover, even if no data regarding forest ecosystem productivity are available, the negative effects determined by deterioration, and the positive effects caused by the lengthening of the growing period can be observed.

6.2.6 Climate change and desertification

Large Mediterranean areas with dry climate affected by the combined effect of the anthropic pressure on natural resources and climate change are subject to a reduction in the biological and economic productivity of the agricultural activities and natural ecosystems.
Aridity has increased in the course of the 20th Century in the Southern and insular regions of Italy both in terms of increase in number of areas involved and in terms of index values. Arid, semi-arid and dry sub-humid areas currently cover 47% of Sicily, 31.2% of Sardinia, 60% of Apulia, and 54% of Basilicata.
At the same time, the mistaken conception and implementation of several agriculture supporting-policies, the use of inappropriate water resources for irrigation purposes; forest fires; the increased urbanisation of coastal areas have all contributed to a slow depletion of the soil resources, both quantitatively and qualitatively.
The main physical processes that are responsible for land degradation and desertification in Italy are erosion, salinization, loss of organic substance and waterproofing.
The future scenarios of climate change and their effects on the factors causing soil degradation allow to affirm that the number of lands subject to desertification will increase in the next decades if no appropriate mitigation measures are identified and implemented.
Climate change will affect desertification with the following phenomena:
an increase in the intensity of rainfalls, which will stress erosion phenomena;
an increase in evapotranspiration, which will increase salinization;
an increase in aridity, which will contribute to reduce soil concentrations of organic substance, and an increase in droughts, which will jeopardise many anthropic activities.

6.2.7 Water resources

The assessments carried out in the frame of the last two campaigns of the National Conference on

Water based on the pluviometric data for the 1921-50 period indicate a 296 billion m3 global rain contribution not homogeneously distributed across the national territory. Such contribution, distributed between the North (41%), the Centre (26%), the South (20%) and the Islands (6%), decreases on account of evapotranspiration. Consequently, the amount of net usable resources is 52 billion m3 divided into underground water (5-13 billion m3) and surface water (40 billion m3). 10 billion m3 of these resources are distributed between natural or man-made basins.

Water resources are used more intensively in the North - 78% of the available renewable resources of the area, i.e. 65% of total national resources. A critical situation is observed in the South and in the Islands where uses cover 96% of local supply, i.e. 23% of the overall national supply. The Centre uses 52% of the national available resources and it is consequently less vulnerable than other areas of the Country. Water consumptions in the agricultural sector – which is by far the greatest water consumer both in the North, the South and in the Islands – are covered by surface waters in the North and by artificial basins in the South and in the Islands.

Underground water is the primary source for potable water although in the South artificial basins, interregional aqueducts play an essential role. Both underground and surface water are vulnerable, since water uses are steadily increasing whereas meteorological contributions are either stable or decreasing. The water supply issue is particularly crucial in the South since the last years have been characterised by persistent drought convitions.

Water supply is becoming a social and economic emergency in both Apulia, Basilicata, Sicily and Sardinia. The steady reduction of water resources stored in six basins of the Basilicata region, five in Apulia, twenty-four in Sicily, thirty-one in Sardinia, have steadily decreased during the last years reaching, in January 2002, a minimum quantity that barely allows covering drinking-water needs.

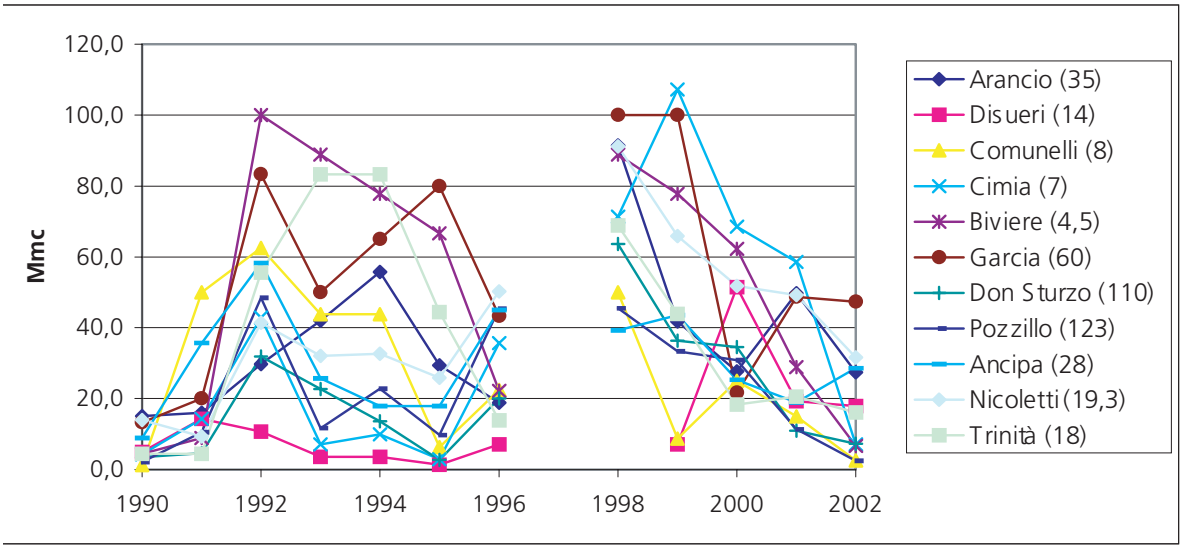
The figure below shows the evolution of the Sicilian water conditions following the serious drought affecting several basins between 1989 and 1990.

The figure indicates that the filling capacity of the basins during the decade under review have never exceeded 50% of the basins maximum capacity on the average. Therefore, the necessary resources for the implementation of standard irrigational programmes have not been guaranteed.

Additional decreases in the supply of water resources would cause serious damages to the regional economy, putting at risk also drinking-water supplies.

The ongoing and, above all, the future anthropic pressure on water resources and, above all, on their employment and management, will become more critical due to climate changes. The risk of floods will tend to increase as well as the risk to loose adequate water resources, particularly in Southern Italy. Stressing the already existing differences between North and South of Italy.

Figure 10 - Stored water in some Sicilian dams in the period 1989-1990



Source: Consorzio Nazionale Bonifica, 2002.

6.2.8 Ecosystems

The increase in average temperature and the rise in carbon dioxide concentrations in the atmosphere may alter the balance between natural ecosystems, with possible modifications in the landscape. The Mediterranean vegetation and the most typical ecosystems of the area will tend to move northwards and towards central Europe. A higher risk of forest fires and a loss of ecosystems and biodiversity are also expected.

6.2.9 Alpine and mountain environments

It is assumable that temperature increases in the high mountain areas, in addition to causing a shift of the ecosystems towards higher altitudes and to favour the melting of glaciers may also alter the mountain hydro geological cycle, with repercussions both on the water balance of rain-collecting basins, and on the stability of mountain slopes.

6.2.10 Extreme events

The trends foreseen by IPCC at global level will have repercussions at national level too. In particular, they are expected to increase the frequency and, most of all, the intensity of extreme phenomena, such as droughts, floods and other extreme meteorological phenomena (whirlwinds, storms, squalls etc).

The recrudescence of extreme phenomena will increase the risk of natural catastrophes and territorial vulnerability, which is being evaluated through a series of attentive surveys.
The assumable increase in the frequency and intensity of extreme meteorological events, hypothesised by IPCC, might increase, also in Italy, the economic and social damages caused to residential and productive structures and infrastructures. The entity of such damages will depend both on the vulnerability of the single structure and infrastructure, and on the environmental and territorial vulnerability, which is not but homogenous across the Country. The recrudescence of extreme events might also affect production activities.

6.3 ADAPTATION MEASURES

6.3.1 General considerations on adaptation in Italy

The Third Assessment Report issued by IPCC on impacts, adaptation and vulnerability indicates that the European socio-economic systems are highly adaptable to climate change, thanks also to their economic conditions (high GDPs and steady growth), population stability and to the presence of well-developed political, institutional and technological systems. On the other hand, the same report indicates the Southern European regions as highly vulnerable to climate change, especially the coastal and peripheral areas and those affected by poorer economic conditions.

Given the Italian topography, a major source of potential risk is given by the rise of the sea level, essentially because of the presence of residential areas and economic activities along the Italian coasts. Consequently, research should be intensified to define the best adaptation strategies, also in terms of economic efficiency, especially for those coastal areas which, according to recent studies, basically carried out by ENEA, are more vulnerable than others. Although a standstill in the sea level has been recorded in the last years, the trends relating to future decades are quite unstable. Moreover, it is possible to assume that, even if mean temperature and sea level values tend to increase slowly with almost unperceivable impacts, the frequency of extreme phenomena, like coastal and riparian floods, will tend to increase as from the next years. Therefore, it would be a wrong strategy to delay important protection interventions along both the Italian coasts and the river and lake banks till they are considered as indispensable, since this strategy might cause great structural losses. The same conclusion was reached on the basis of formal economic evidences by Fankhauser *et al.* (1999) who suggested the arrangement of timely and long-term adaptation measures. Moreover, a pro-active attitude to the ongoing trend would certainly prove favourable to the insurance sector, which would be able to reduce the premium-rise trend that has been affecting the *property* sector in the last years.

The water system and the agricultural sector, which seem set to have serious repercussions in the next decades, require important adaptation measures too. In these cases, the dangers connected to ill-timed interventions are even more serious, especially if we consider the difficult condition affecting many Southern areas, particularly Sicily and Sardinia, following the previous dry winter season: water supplies have significantly decreased in the last summer - even for domestic use – and the agricultural sector has been affected even more seriously than usual.
Apart from reasons of climatic and environmental nature, the desertification process in Southern Italy is also favoured by the lack of infrastructures and by the inefficiency and mismanagement of the existing structures. Fundamental works, such as the repair or replacement of many segments of the water net-

work or the construction of water pipes and pumping plants in many areas of the South, imply enormous financial efforts. The expenditure, however, should not fall under the adaptation cost category, as the above mentioned interventions should be considered as *no-regret*, that is, necessary, regardless of the impact of climate change. The agricultural sector in Northern Italy would require less financial efforts: it would be adequate to modify the water-management system and several agricultural practices, with limited structural interventions. Massive embanking works and the arrangement of emergency plans will be necessary particularly in the North to face the risk of cultivation damages following floods. Another appropriate measure could be to inform the agricultural world about future climate trends, appropriate cultivations and agricultural practices. This would favour timely adaptation policies, reducing monetary losses until new climatic scenarios come into being.
Finally, distorted market signals should be avoided: since people modify their behaviour only if this change in behaviour turns out into greater well-being, it is of vital importance to let market signals steer the agents towards appropriate adaptation strategies.

The agenda of economic planning should include several interventions aimed at favouring other climate change-vulnerable sectors having a strong impact on social sectors, such as public healthcare. In this regard, a study has been financed by the European Union (*Climate Change and adaptation strategies for human health in Europe*) it is co-ordinated by the World Health Organization and it will be completed by 2004 (EU, 2002). The objective of the study is to evaluate the vulnerability of European people to of climate change impacts on health, as well as to identify most efficient health-addressed adaptation policies, also from the economic point of view. The Italian case study is likely to be included in the analysis.
Other highly vulnerable sectors, generally controlled by the private sector, such as tourism and energy (the hydroelectric sector in particular), might require additional public aids to face the new challenges of climate change.

6.3.1.1 Brief critical analysis of literature on the economic size of the adaptation strategies, in the light of the Italian reality

Only a few economic assessments on adaptation are provided in Italy. Some studies deal with extremely specific issues, such as the issue on high water in Venice, extremely important at local level, which do not provide, however, general information on the incidence of adaptation on the Italian economy. In this regard, some works carried out at university level have adopted a model-producing approach to evaluate the economic repercussions of specific intervention typologies. For instance, from the analysis of the results provided by several authors (Cline, 1992, Tol, 1995, Fankhauser, 1995), it is possible to quantify adaptation costs with respect to the total impact of climate change. According to estimates, adaptation costs are in the range of 7-25% with respect to total cost[6] (it is important to note that total cost generally ranges around 2% of the national GDP in Developed Countries). It must be noted, however, that these calculations are not fully reliable, both because they do not take into account the peculiar features of each single Country, and because they only consider a few adaptation measures. In details, only the following cost items have been considered among the totality of adaptation costs:
- coastal protection;
- energy expenses;
- migration and human re-settlement costs.

In some studies, where adaptation is also foreseen for other sectors such as agriculture or public health, it is implicitly assumed that adaptation policies do not give rise to additional costs to the society.

Other studies take account of specific issues, such as the sea level rise, with the aim to define the overall economic impact of the phenomenon also from the adaptation point of view. In this connection, the model presented by Fankhauser (1995) is particularly instructive. It has the objective to derive the optimal coastal protection rate from the economic efficiency point of view, that is, to reduce total cost[5], providing unbundled data for each Country, including Italy. The study shows that the impact of the rise of sea level on optimal coastal protection rate cannot be defined a priori. Given the rise of the sea level, in fact, on one hand there is the need for more efficient protection strategies – considering that larger areas are increasingly threatened and that the benefits from protection strategies are increasing too -; on the other hand, protection-related costs would increase too. The final result depends on the relative importance of these two effects.
The hypotheses formulated in the model (amongst which, a 100cm-rise of the sea level in 2100) suggest that Italy would better consider the possibility to protect the whole of its coastal areas given its great economic value. Particularly, in correspondence with cities and port, the mean value of which is very close to 100%, and along the coasts (95% mean value against the 80% mean value expressed by OECD), and the beaches (90% mean value against the 57% mean value expressed by OECD).

As far as adaptation in the agricultural sector is concerned, some studies aim at analysing the impact of

specific policies on several agricultural productions. According to our data, however, none of these studies explicitly refers to Italy. The policies identified in the course of some studies can be of technical nature (modifications in the management of seeding and harvesting methods), or of institutional nature (distribution of water resources) and they can be applied more or less intensively according to the different scenarios. The results indicate that even moderate adaptation policies may significantly reduce agricultural damages caused by climate changes, but the size of the avoided damage varies enormously according to the underlying hypotheses of each single study, that is, from a few percentage points at global level (Rosenzweig and Parry, 1994), to 30-60% for a specific region of the United States (Easterling *et al., 1993*). Further to several production estimates, Reilly *et al.* (1994) have evaluated the effects of the adaptation policies on the economic losses suffered by the agricultural sector at world level due to climate change. Unfortunately, none of these studies accounts for the cost-component associated to the adaptation policies under review. According to some models and under certain conditions, in the passage from a non-intervention scenario to a scenario promoting adaptation measures, the economic loss turns into a profit. Such a hypothesis probably suits to Northern Italy, where no production drops are expected if farmers succeed in exploiting in full the opportunities arising from the ecosystem northward movement. On the contrary, the implementation of shrewd adaptation measures in the Southern regions could only partly reduce the size of several desertification-related issues.

Generally speaking, from a comprehensive view of literature on the economic aspects of adaptation measures, it is possible to understand that the results of these studies are of little avail for the public decision-makers: and the choice should strongly depend on local peculiarities, implying a high number of *ad hoc* and expensive studies.

6.3.2 Sea level rise

Several actions have been carried out in the last decades to adapt the current situation to the relative uplift of the Italian sea level[7], a phenomenon affecting particularly the Italian coastal plain areas. The implementation of the ***Mose plan*** in Venice can be considered as one of the most representative efforts ever made to face the sea-rise issue. It should answer the purpose of "keeping down" maximum peak levels during *high water* episodes. Such episodes, in fact, have recently reached alarming levels and rates due to effective subsidence phenomena and, above all, to meteorological and climate events (prevalence of southerly winds).

Among the others, the following measures should be adopted to thwart the negative effects of the relative sea level rise in Italy, such as:

1. Channelling and pumping works with draining pumps of depressed areas following reclamation works;
2. Dismantling of wells for gas-hydrocarbons and water;
3. Sand feeding;
4. Saline wedge.

6.3.2.1 Channelling and pumping works with draining pumps of depressed areas following land reclamation works

Following numerous land reclamation works carried out on the national territory from the first years of the century to date, almost all the Italian coastal plains with depressed areas are currently equipped with artificial channelling and drainage units, which are able to pump water from depressed areas in the sea. These works, initially planned to dry out soils currently used for agricultural purposes, are an important resource to cope with the phenomenon of the sea level rise. A study aimed at analysing the changes (level, power, consumption etc.) performed over time in the plants of many Italian plains, is strongly suggested.

6.3.2.2 Dismantling of wells for gas-hydrocarbons and water

Remarkable subsidence phenomena (nearly 10cm/year) occurred between the 60s and the 80s in the area between Cesenatico and Ravenna causing the closing of methane-producing and water-exploiting wells. The response to these "adaptation measures" was almost immediate, and subsidence rates reverted to more acceptable mm/year values.

6.3.2.3 Sand feeding

Following to coastal erosion caused by different factors, hundred billion sums have been spent every year to rebuild the sand mantle for mere tourist purposes.

6 Total cost associated with climate change impacts is considered, in literature, as the total of adaptation costs and residual damage.

7 By relative uplift is intended the summation of all movements causing the uplift in the sea level.

This, of course, has been achievable only in tourist areas where high profits are recorded.

6.3.2.4 Saline wedge

In the coastal areas, the balance that has formed between fresh-water and salt-water aquifers creates an unstable "system" due to several reasons. It is clear that a (negative) variation in the balance between fresh-water and salt-water aquifers may cause an increase in sea base level, and that a decrease in fresh-water aquifers (on account of over-exploitation) may cause the breaking of such balance. The concurrence of these two factors in many Italian coastal areas has caused the penetration of the saline wedge up to 3\4 kilometres from the coast. In some cases, the closing and\or regulation of water pumping plants has given positive results. As a general rule, no alarming movements have been observed in the last 30 years in the depressed coastal areas subjected to channelling works.

6.3.3 Desertification

After having acknowledged the significance of the desertification issue, and having adhered to the UN Convention to Combat Desertification, the Italian Government has arranged a National Action Plan (MATT, 1999). The Plan, approved upon deliberation of the Interministerial Committee for Economic Planning of 21.12.1999, outlines an information and awareness path addressed to the Regions and the Basin Authorities to spot the most vulnerable areas and define prevention, mitigation and adaptation strategies. The Regions and the Basin Authorities have been sided by a working group to set up the guidelines and summarise the different proposals.
Ten Regions and eleven Basin Authorities covering, in total, 87% of the national territory, have presented their programmes to the National Committee to Combat Desertification. The scope of the Plan has been successively enlarged to non-arid zones affected by territorial degradation phenomena, even if not associated to climate change factors.
The priorities and financial requirements to combat desertification in Italy have been identified in conformity with the Programmes presented by the Regions and the Basin Authorities. The intervention plan includes the realisation of studies and researches, infrastructures and training and information activities on several sectors, such as land protection, sustainable management of water resources, reduction of the production activities impacts, and restoration of the territorial balance. The plan implementation does not include the allocation of financial resources specifically committed to combat desertification; nevertheless, it provides for the adoption of principles and priorities regulating the territorial protection through sectoral policies having an impact on desertification, promoting the use of structural funds and provisional plans to be included in the regulatory framework, such as Law no 183/89 on Land Protection.

6.3.4 Agriculture

The Italian actions aimed at thwarting the undesired effects of climate change in the agricultural sector follow the indications provided in the Agenda 21 of the United Nations. They consist in:
- the arrangement of an attentive territorial and land-use planning according to a multifunctional view, taking into consideration both present and expected global changes;
- the creation of diversified agricultural productions compatible with local territorial peculiarities and with the climatic region where the farmland is to be established;
- protection and conservation of biological and ecological diversity and existing genetic heredity in terms of genetic, vegetable and animal resources;
- efficient energy use in agricultural and food-production practices;
- attentive planning of surface and aquifer water resources compatible with agricultural, human and industrial requirements, with particular reference to:
a) enhancement of infrastructures for water accumulation and storage;
b) removal of discharges and pollutants that may contaminate water resources;
c) reduction of water misuse. .

6.3.5 Forests

The actions to protect the Italian forests also contribute to prevent degradation and desertification phenomena. The following measures need particular attention:
- the increase of specific and structural forest biodiversity improving resistance and resilience to disturbances. This measure would enable forests to adapt at the ever-changing climate conditions ensuring tree coverage, both in terms of space and time, even if this would imply the formation of different tree species;
- the establishment of new poly-specific forest plants on abandoned lands;
- the creation of wooded areas in agro-industrial landscapes and urban areas;
- the implementation of efficient fire-prevention and extinction policies.

6.4. Regulatory framework of adaptation measures to climate change

The Italian regulatory framework providing for specific and direct adaptation measures to climate change is not provided to date. It must be found in the rules governing land protection (instability and hydro and geological risk), reclamation of polluted areas, mining activities, subsidence phenomena, risk of seismic activities, hydrological vulnerability, protected areas, natural habitats, the fauna and the flora, landscape protection and any rule governing the management of water resources and water protection.
The synoptic table annexed to this document presents the Italian regulatory framework on mitigation and adaptation measures. (cf. annexe I)

6.5 Vulnerability assessments, climate change impacts and adaptation in the programmatic documents of the Italian government

6.5.1 1998 Guidelines of the National Research Plan for Climate Protection

In 1998, the Ministry of the Environment set the guidelines of the National Research Plan for Climate Protection. The objectives of the plan include the strengthening and analysis of response measures and research activities aimed at developing new technologies to reduce the effects and/or the emissions of harmful components that may jeopardise climate, evolution, including feasibility studies, cost-benefit and cost-efficiency analysis to evaluate the response to efficient strategies. In particular, the research will have to study and ensure, in a transversal way, specifications on the normative, institutional and technological aspects, the role of operators (firms, trade associations etc.) users and consumers (possible requirements and roles) and the setting up of agreement, premium and certification instruments.[8]

6.5.2 Deliberation of the Interministerial Committee for Economic Planning on the priority research themes of the National Research Programme on Climate, 21 December 1999

On December 21 1999, the Interministerial Committee for Economic Planning approved the priority research themes of the National Research Programme on Climate for the three-year period 1999-2001.[9] Among the identified themes, the study of climate change impacts in the Mediterranean area and of vulnerability in Italy is included, in the frame of the Intergovernmental Panel on Climate Change (IPCC) indications, with the purpose to evaluate the effects on:
- land and water ecosystems, with particular reference to the modifications of: forests extensions flora and fauna typology; glaciers and snow mantle, land erosion, sea level rise, humid coastal areas;
- water resources, with particular reference to the variation in the availability and distribution of water supply for man-feeding and irrigational purposes;
- availability of food resources and timber, with particular reference to the variations in soil agricultural productivity for alimentary uses and other industrial or energy uses;
- public health, with reference to the outbreak of new pathologies associated to "heatwaves", the effects of UVB radiations, photochemical smog, outbreak of new infective diseases, and transmission of known infective diseases.

The deliberation of the Interministerial Committee for Economic Planning also establishes that particular attention must be given to actions aimed at promoting forest conservation and extension as a response to the effects of climate change in Italy; land protection on account of the loss of humus and hydrogeological instabilities; actions aimed at protecting the coastal areas of the Upper Adriatic region and the Venice lagoon from the sea level rise.

6.5.3 Agenda 21

The Ministry for the Environment and Territory is actively engaged in supporting the development of the Local Agenda 21 experiences and initiatives through the promotion of incentive actions, such as the Prize Sustainable Cities. In February 2000, 51 local authorities adhered in "Carta di Aalborg"– the European Campaign for Sustainable Cities. Through this adhesion, the 51 local authorities have acknowledged the existence of general environmental sustainability-related issues, such as social equity, adoption of sustainable land-use models, conservation of biodiversity, awareness of citizens and stakeholders in the environmental issues, to assume responsibility with respect to climate issues at planetary level. A series of measures aimed at preventing pollution at ecosystem level have been also adopted

However, many difficulties and problems thwart the diffusion of Agenda 21 in many Italian Central and Southern regions. The information network is not available to all municipalities, which have no direct access to the European circuit and cannot show their interest in the topics at issue. Many Italian munici-

8 Guidelines of the National Research Plan for Climate Protection. Published by Avverbi, 1998, page. 16.
9 CIPE Deliberation no. 226/99.

palities are characterised by a combination of different realities, which, however, are rather homogeneous from the economic-environmental point of view. This aspect could help them sharing and planning a series of development strategies through the setting up of common co-ordination and governmental structures (APAT, 2000).

6.5.4 National Plan for Sustainable Development, 5 December 2000

On 1 April 1999, the Minister for the Environment assigned the task to arrange the National Plan for Sustainable Development to an expert from the technical-scientific Commission of the Ministry itself. The Plan, which was presented on 5 December 2000 (Signorino, 2000), has the aim to provide a series of guidelines on sustainable development. Even if the Plan does not directly mention climate change - related issues, it deals with many sectors directly or indirectly connected to climate vulnerability, through the analysis of some major environmental gaps at national level. The land use is considered as one on the most important factor to integrate environmental policies. The territory is final "receiver" of all public policies implemented by a plurality of subjects, who often approach the environmental issue according to an incoherent logic, trying to pursue diverging and sectoral objectives. It is advisable that a territorial strategy is implemented in co-operation with the Government, the Regions and the local authorities.

6.5.5 Deliberation of the Interministerial Committee for Economic Planning for the National Research Programme, 21 December 2000

On 21 December 2000, the Interministerial Committee for Economic Planning approved the National Research Programme (MIUR, 2000) which set up the features for the Strategic Programme for Sustainable Development and Climate Change. The objective of the Programme is to meet a demand of research affecting a wide range of issues, such as seasonal and inter-annual climate variability; climate change on a decennial and century-old scales; direct and indirect climatic effects on the chemical composition of the atmosphere; land use and land-use change, water and terrestrial ecosystems; response strategies and mitigation measures; effects on public health.

In order to meet the above-mentioned requirements, the Plan foresees the creation of a research infrastructure, acting as a *EuroMediterranean Centre for the Research on Climate Change* supporting the Research Centres and Laboratories networks involved in the Programme[10].

10 National Research Programme, Approved by the Interministerial Committee for Economic Planning on 21.12.2000, pages 29-30.

CHAPTER VII
"Financial Resources and Technology Transfer"

INTRODUCTION

This chapter provides a brief overview of the measures adopted by Italy between 1997 and 2000[1] in undertaking the commitments of the Convention on Climate Change, articles 4.3, 4.4 and 4.5. As set forth in these articles, the Industrialised Countries are called to assist Developing Countries and Transition Economies in the implementation of policies and strategies according to the Convention objectives. In particular, they are required to supply financial resources through projects and programmes, promote the transfer of technologies aimed at reducing the impacts of human activities on Climate Change and support adaptation measures.

1. OFFICIAL DEVELOPMENT ASSISTANCE

Italian Official Development Assistance (ODA) as a whole registered an 80% increase in 1998 with respect to 1997 [DAC-OECD, 2001a], when ODA recorded its all-time low for the 90s, with a ODA/GDP ratio equal to 0.11% [MAE-DGCS, 1998]. As a matter of fact, the poor result of 1997 suffered the Parliament delay in approving the relevant Budget Law, which provided for the allocation of considerable financial resources in favour of the International Development Association (IDA). The Law also included the capital replenishment of several development banks and funds and of some credit aids. These allocations, along with considerable debt rescheduling operations in favour of Developing Countries, were thus included in the 1998 ODA calculation, causing a 0.20% increase in the GDP ratio of that year. In 1999, the ODA/GDP ratio returned to the average values of the period, decreasing to 0.15% [MAE-DGCS, 2000]. In 2000 the Italian ODA calculation failed again to include the payments for the capital replenishment of development banks and funds, bringing the ODA/GDP ratio back to 0.13% [MAE-DGCS 2002]. If we consider aid flows in terms of absolute values, Italy was the seventh leading contributor among the members of the OECD Development Aid Committee (DAC) both in 1998 and in 1999, and the tenth in 2000 [DAC-OECD, 2001b].

As regards the distribution of financial contributions according to ODA objectives, compared to other DAC/OECD member countries, Italy shows a prevailing share of commitments in favour of *emergency aids* and *debt-related actions* (in 1998, in fact, the two items together amounted to 37.6% of the overall Italian commitment – against the 15.5% DAC average. In 1999, the same items amounted to 40.3% – against the 18.5% DAC average). As a result, fewer resources are devoted to other co-operation fields, including the environment.

The priority actions of Italian ODA are still anchored not only to the general criteria set forth by the Development Cooperation Law no. 49 of 1987, but also, and above all, to policy guidelines established at governmental level. Such policies state, among other things, that Italian development co-operation should also support actions favouring environmental protection [DAC-OECD, 2001a].

Italy, along with other DAC member countries, is in the process of defining a series of indicators capable of distinguishing the financial resources devoted to meet the commitments undertaken in the frame of the Global Conventions for the Environment – and, among these, those specifically earmarked to climate change – and other environment-related development co-operation initiatives. However, a common standard, shared by all DAC members, has not yet been agreed. It follows that, in many cases, it is technically difficult to single out data referring to co-operation initiatives specifically targeted to the objectives of the Framework Convention on Climate Change, clearly distinguishing them from other components of development cooperation projects and programmes.

[1] As set forth in the Guidelines of the UNFCCC Secretariat.

2. MULTILATERAL CO-OPERATION FOR THE ENVIRONMENT

The Italian commitment in environmental protection is gaining more continuity and coherence at the multilateral level, through the definition of more effective co-operation strategies with several international environment institutions. This is due to the increased awareness of the need to reinforce synergy between the activities envisaged by the various Global and Regional Conventions for Environmental Protection, and the need to integrate them in the wider international co-operation objectives, with particular reference to the fight against poverty.

The Italian commitment in favour of multilateral environmental protection initiatives has been concretely shown on several occasions. The First Conference of the Parties of the *Convention to Combat Desertification* has been organised in Rome[2] in co-operation with the Food and Agriculture Organisation (FAO) and the International Fund for Agricultural Development (IFAD). Successively, the co-operation with the *Commission for Human Settlements,* set by the HABITAT Conference held in Cairo in 1997, was strengthened through a number of initiatives funded by Italian voluntary contributions in the framework of the Informal Settlement Upgrading Programme, the International Forum on Urban Poverty[3], and the *International Forum Towards Sustainable Cities for Children*.

An international workshop to favour the integration among *desertification, climate change*, *biodiversity* and *forests*-related multilateral activities with particular reference to the Mediterranean area, was organised last February 2000 at FAO headquarters in Rome, in order to stimulate a stronger synergy and interaction. In agreement with the results of the workshop, Italy financed a joint action programme between the UN Convention to Combat Desertification (UNCCD) and the Convention on Biodiversity. It also supported the need of setting up a joint administrative secretariat in Bonn for UNCCD and UNFCCC, and obtained the inclusion of representatives of the Desertification, Biodiversity and Climate Change Conventions secretariats in the *Collaborative Panel on Forests* (CPF) [MAE-DGCS, 2002].

Furthermore, Italy has actively participated in the reorganization of the *UN Environmental Programme* (UNEP) [MAE-DGCS, 1998], and has provided financial support to favour the Developing Countries participation, both at the governmental and at the NGOs level, in the Conferences of the Parties of the main global Conventions. [MAE-DGCS, 2002].

Italy has also actively and continuously participated to the activities of the OECD Working Group on the subject of *"Assistance to Development and Environment".* This ensured the involvement in the discussion and monitoring of the approaches followed by other OECD member countries in fulfilling the obligations set by the global environment Conventions since the United Nations Conference on Environment and Development (UNCED) held in Rio in 1992 [MAE-DGCS, 2000].

With regard to the co-operation with international non-governmental organisations, it is worth mentioning Italy's contribution to the *International Union for the Conservation of Nature – The World Conservation Union* (IUCN). Since 1997, such contribution has made possible to prepare studies and technical missions in support of ongoing programmes and projects in Egypt (National Environmental Action Plan) and in Lebanon (environmental-impact studies and assessment for water adduction and sewage treatment) [MAE-DGCS, 1998].

Italian climate change related activities are further enriched by the active support provided to the *Regional Environmental Centre for Central Eastern Europe (REC),* mainly with reference to the *"Capacity for Climate Change in Central Eastern Europe"* project. The objective of such project, financed by the Italian Ministry for the Environment and Territory, is to provide support to the private sector and to NGOs in promoting the climate change debate, spurring the dialogue with national governments and favouring regional level exchanges as well as between Eastern and Western countries.

Italy also participated in the *"Climate Technology Initiative"* (CTI) in cooperation with the International Energy Agency (IEA). A workshop for energy and environment experts from Southern Mediterranean countries has been organised in Italy, at Portici (Naples), in the framework of the CTI, to favour the exchange of information and to lay the foundations for future *Clean Development Mechanism* projects.

3. Bilateral Co-Operation with Developing Countries

New and additional resources aimed at technology transfer in the environmental sector were triggered by the signature of the Kyoto Protocol and by the anticipation of its ratification. These can be considered as additional resources responding to the commitments

2 29 September -10 October 1997.

3 Organization of the first conference of the *Forum* (Florence, November 1997).

GLOBAL ENVIRONMENT FACILITY

An important, new and additional resource to solve global environmental issues is certainly the Italian contribution to the *Global Environment Facility* – GEF.

Since the very beginning Italy has been one of the main GEF supporters, in line with its commitment towards international environmental protection and sustainable development. The approach which brought to the setting up of the GEF, in 1991, has been fully shared in terms of the need to provide international financial support to cover the "incremental costs" required to ensure that development projects produce also global environmental benefits.

Following a three-year pilot stage, GEF has been "restructured" to become a permanent tool for international co-operation activities, and to act as a financial mechanism of the International Conventions on Climate Change and Biodiversity.

The second replenishment of GEF, covering the 1 July 1998 – 30 June 2002 period, was approved in March 1998 (GEF-2). Through this action, the GEF participants, including Italy, confirmed their will to support environmental protection activities at global level, guaranteeing the continuity and credibility of GEF as a financial mechanism of the Conventions on Climate Change and Biodiversity [Ministero del Tesoro, 2001].

Italy, which had contributed to GEF-1 with 128 US million dollars, supported the second replenishment of GEF with 90.5 US million dollars. With a 4.39% share of total contribution, Italy stands out as the sixth leading contributor of GEF, immediately after USA, Japan, Germany, France and Great Britain. GEF's action plan for the three-year period 2002-2004 establishes the continuation of the "programmatic" approach recently adopted. Italy supported the principles at the basis of this new strategy, committing GEF to the implementation of multiyear programmes in favour of beneficiary countries, in accordance with their national environmental plans and their implementation skills [Ministero del Tesoro, 2001].

set forth by articles 4.3, 4.4 and 4.5 of the Framework Convention on Climate Change, while also addressing preparatory actions for the launching of the flexible mechanisms (CDM and JI) foreseen by the Kyoto Protocol.
The aforementioned financial resources are provided for by the so-called "Carbon Tax", or ecological tax no. 448/1998 "aimed at the reduction of carbon dioxide emissions". Furthermore, the Italian Interministerial Committee for Economic Planning (CIPE), in its "Guidelines for National Policies and Measures to Reduce Greenhouse Gas Emissions" of 19 November 1998, established that national actions aimed at reducing greenhouse gas emissions must also be accompanied by international co-operation programmes.

The programmes financed by such financial resources satisfy multiple and integrated environmental co-operation objectives, reflecting the Italian Government's approach in promoting international co-operation in the environmental sector. Such approach is based on a *co-ordinated* and *synergic approach* among the initiatives undertaken in the framework of the different global Conventions. In this regard, the Italian Ministry for the Environment and Territory is implementing a series of biomass energy recovery projects in Central and Latin America, namely **Argentina** and **Cuba**, where it is also active with studies supporting the recovery of the local water pipeline network and energy-saving activities.
Italian development co-operation in the Environment sector has also distinguished itself for supporting the environmental institutions of some developing countries, particularly through a series of activities aimed at the transfer of know-how and the strengthening of institutional capacities. This support – provided also through co-financing schemes with some major international financial institutions, such as the World Bank, the GEF, the Multilateral Regional Development Banks – is essentially, but not exclusively, addressed to neighbouring regions, in order to reinforce their capacities to reach the objectives set forth by the global Conventions as a whole.

In particular, **Egypt**, **Tunisia** and **Lebanon** [MAE-DGCS, 2002] are the main beneficiaries of an effort specifically addressed to North-African countries: financial resources have been remarted in the framework of the UNCCD and for strengthening environmental protection institutions. Moreover, Italy is active in **Tunisia** with a series of initiatives aimed at the safeguard of natural resources, the protection of water resources and the establishment of a monitoring and assessment system for the implementation of the National Action Plan to combat desertification. Innovative co-operation instruments have also been utilized, such as the *Debt for Environment Swap*: in

ENVIRONMENT PROTECTION IN CROSS-BORDER ECOSYSTEMS AND PEACEBUILDING STRATEGIES

Italy's contribution to the process of peacebuilding in the Middle East is part of a wide-ranging strategy aimed at integrating the support towards a fair and sustainable management of cross-border ecosystems, with regional peacebuilding processes. This strategy has already been pursued also outside the Mediterranean area, through the implementation of a number of projects and programmes for sustainable environmental management and through the enhancement of shared ecosystems productivity, for instance in Southern Africa, between **Zimbabwe**, **South-Africa** and **Mozambique**; between **Zimbabwe**, **South-Africa** and **Botswana**; and, in Latin America, between **Peru** and **Bolivia** [MAE-DGCS, 2002].

this connection, the pilot agreement with **Morocco**, signed in 2000, provides for the debt conversion into funds in local currency, amounting to 100 US million dollars, to be devoted to environmental protection and socio-economic development programmes. Also with Morocco, the Italian Ministry for the Environment and Territory has started the first Joint implementation project aimed at the recovery and transformation of a coal power plant into a combined-cycle cogeneration plant. In **Libya**, a project has been launched for the removal of Second World War's residual ordnances from the Libyan territory and for the agricultural valorisation of such reclaimed areas. Still with **Libya,** in view of future activities to be carried out in the framework of the "Clean Development Mechanism", the Italian Ministry for the Environment and Territory is co-financing an agreement aimed at the implementation of joint pilot projects for the reduction of greenhouse gas emissions caused by the use of fossil fuels in the civil and industrial sectors.

A project of great significance to the region is concerning the creation of an Information System on Desertification, DIS/MED, in collaboration with the European Environment Agency, involving **Morocco**, **Algeria**, **Tunisia** and **Egypt**. The objective of the project is to enhance national and regional planning strategies in the Mediterranean region, strengthening national institutions' capacities in assessment and planning activities [MAE-DGCS, 2002].

Still in the Mediterranean area, Italy acts as the lead country in waste management activities, within the *Multilateral Working Group on Environment* in the framework of *the Peace Process in the* ***Middle East.*** In such role Italy is coordinating other donors' activities in the management of strategic environmental resources. Italy also supported the setting up of a Palestinian national environmental authority and the introduction of a Territorial Information System for territorial and environmental planning in the Hebron district [MAE-DGCS, 2002].

The Italian commitment in the sub-Saharan African region is targeted to the upgrading of large watersheds (**Sahelian Africa**) [MAE-DGCS, 2002]. In Latin America, the Italian development cooperation supported a series of activities enhancing and protecting water ecosystems with high levels of biodiversity in **Brazil** and **Peru**, and other projects supporting sustainable management and environmental resource conservation in the Galapagos Islands and in the Peruvian Amazon forest [MAE-DGCS, 2002].

4. Bilateral Co-Operation with Central and South-Eastern European Countries and the Community of Independent States

Italy is a member of the Trilateral Commission for the Protection of the Upper Adriatic and Coastal Areas, with Croatia and Slovenia. The Italian Ministry for the Environment and Territory takes part to the meetings of the Commission on a regular basis, ensuring that the issues related to climate changes are included in the Commission's activities. In particular, in the framework of the *Master Plan for the Adriatic Sea* of the Commission, in 1999 the Italian Ministry for the Environment and Territory funded a trilateral project called *"Anthropogenic Impact of Climate Change in the Northern Adriatic Sea – CAIEDAS"*. This project will be followed up by another project called *"ADRICOSM – ADRIatic sea integrated COastal areaS and river basin Management system pilot project"* supported by the Ministry for the Environment and Territory as well.

A series of co-operation initiatives are being launched in **Albania** and **Bosnia**, essentially aimed at supporting both institutions and policies for a sustainable use of forest resources. Furthermore, co-operation agreements are being stipulated with the **Bulgarian** and **Ukrainian** Ministries of the Environment in preparation of future *Joint Implementation* activities.

The Italian Ministry for the Environment and Territory is about to launch initiatives in South-Eastern Europe, financed in conformity with the funds provided for by the aforementioned Law no. 448/1998 (*Carbon Tax*): in **Bulgaria** for the updating of the Master Plan for

THE ENVIRONMENTAL CO-OPERATION PROGRAMME WITH CHINA TOWARDS SUSTAINABLE DEVELOPMENT: AN EXAMPLE OF PARTNERSHIP

The Italian Ministry for the Environment and Territory is particularly active, both qualitatively and quantitatively, with a programme promoting environmental co-operation with China. With a total amount of about 14.5 Million Euros, the programme aims to the implementation of pilot projects and feasibility studies for the development of scientific and industrial projects for environmental protection and the development and use of renewable energy sources.
The Ministry for the Environment and Territory, through its activities, intends to trigger further financing from Multilateral Development Banks and Funds. To this purpose, pilot projects and feasibility studies are developed in accordance with existing procedures for international financing, in order to facilitate successive project development phases.

Among such activities, particularly relevant to climate change are the following:

- Initiatives aimed at reducing energy consumptions and emissions in the industrial and building sectors, through the modernization of residential and industrial heating systems and heat and energy recovery in steel plants;
- Initiatives aimed at reducing energy consumptions and emissions in the transportation sector, including the production of low environmental impact engines and vehicles (natural gas and hybrids), local production and experimental utilization of water-oil emulsion for urban transportation, training of technical experts at the municipal level;
- The promotion of renewable energy sources, through pilot projects for biomass, waste and biogas, solar and wind energy;
- Testing and diffusion of best available technologies and practices for the development of sustainable agriculture, reducing water-resource consumption and promoting reforestation in semi-desert areas; studying the potential exploitation of renewable energy sources (solar, wind, small scale hydro-power) for the agricultural sector.

environmental protection and development of integrated water management services; in **Romania** with the implementation of a feasibility study for the reuse of solid urban waste for energy use; similarly with another initiative in **Slovenia**, for the recovery of industrial waste for energy use. Finally, several initiatives will be launched in **Croatia,** aimed to the exploitation of renewable energy sources and the implementation of a model of sustainable development and integrated environmental management in the Mljet island.

5. Scientific Co-Operation

The Directorate General for Cultural Promotion and Co-Operation of the Italian Ministry of Foreign Affairs, in co-operation with the Ministry of Education, University and Scientific Research, is supporting bilateral agreements promoting scientific and technological co-operation with 43 Developing Countries and Transition-Economy Countries. The agreements are mainly aimed to the exchange of information and researchers, methodologies and research approaches, as well as to the development of preliminary activities for the definition of joint projects to be submitted to bilateral or multilateral institutions. Many of these agreements also include environment-related issues, such as climate change, terrestrial, coastal and marine eco-systems and clean energies:

- A *Scientific and Technological Co-Operation Agreement for the Environmental Sector* was also ratified in October 1997 with **Argentina**. The agreement includes the support to co-operation activities coping with environmental conservation and recovery issues, particularly on joint investigations of the harmful effects of human activities on the environment. Among the sectors specifically supported by the agreement, note is given to the sustainable use of natural resources and technologies aimed at reducing the impact of waste on the environment as well as the rational use of energy resources and the development of non-polluting energy sources. Moreover, a *Framework Co-Operation Agreement in the Scientific and Technological Fields* was signed in December 1997. Such wider agreement has also further strengthened the cooperation between the two countries in sectors such as: new renewable energy sources, environment and global climate change. Finally, in the same period, the *Italian-Argentine Bilateral Agreement on Scientific Co-Operation in Antarctica,* originally signed in 1992, was complemented with an appropriate *Protocol for Measuring the Greenhouse Effect*.

- A series of co-operation activities are provided for with **China** for research and development of renewable or low environmental impact energy sources in the fields of geothermal and photovoltaic energy and of gasification of agricultural residues for electric generation[4]. An exchange of experience has also started on the testing of innovative technological models and tools for sustainable agricultural management[5].
- In the frame of the 1997 *Agreement on Cultural, Scientific and Technological Co-Operation* with **Tunisia**, the activities schedule for the years 2000-2003 includes, among others cooperation areas, the optimal use of renewable energy (in particular solar energy), the development of co-generation, the study and planning of electric energy demand, and the training of electricity management staff.
- The *1998-2001 Executive Protocol for Scientific Co-Operation Activities* with **Vietnam** includes a series of research activities on photovoltaic systems and wind generators, the study of hot-water supply, water distillation, and air conditioning through the exploitation of solar energy, the construction of hybrid power plants, the upgrading of small hydroelectric plants, the training of technical managers in public utilities for environmental policies implementation.

The scientific and technological cooperation programmes have also contributed to accompanying different initiatives such as the *Co-Operation Agreement on the sector of Energy Efficiency and Renewable Energy Sources* signed in February 1998 by the Italian Ministry of Industry and Trade (now Ministry of Productive Activities) with **Russia**. The agreement provided for the setting up of four Working Groups[6], in the frame of which four projects, out of 87 initial proposals, have been investigated in view of future activities to be included in the Joint Implementation mechanism[7]. Other Working Groups have identified a number of co-operation activities relating to such themes as the substitution of diesel generators, the use of aerogenerators, the reuse of wood waste for the production of electric energy, the electrification of villages through photovoltaic systems, the definition of indicators for the development and construction of high-efficiency solar collectors. Moreover, a *Joint Institute on Ecological Training and Research* was set up to promote research and exchange of researchers in the fields of ecology, environmental protection, rational use of resources and sustainable development.

The support to scientific and technological research and training activities in sectors relevant for the Convention on Climate Change is also included in the agreements signed with **Egypt**[8], **India**, **Pakistan**[9], **Romania** and **Hungary**.

Finally, some technical and scientific institutions such as ENEA and CNR support scholarship programmes for researchers from Developing and Transition-Economy Countries in the field of global environment issues. They also co-finance research projects on climate change-related issues, in co-operation with the EU.

6. Co-Operation Activities by the Private Sector

It must be noted that various Italian industrial and service companies are active in the transfer of low-impact technologies and the implementation of projects aimed to the introduction of integrated management schemes for natural resources or waste, also through co-financing arrangements supported by national and local public institutions.

The Interministerial Working Group for the implementation of the Kyoto Protocol, chaired by the Italian Ministry for the Environment and Territory, has set up a series of co-ordination and co-operation mechanisms among different Italian Ministries, Regions and industrial associations to create a synergic co-operation between technical and scientific activities in the environmental sector and the planning of specific co-operation activities in those countries which Italy considers as priority areas.

4 Research, development and utilization of Geothermal Resources (ENEL);
Solar Photovoltaic Technology (ENEA and Eurosolare);
Gasification of Agriculture residues for Electricity Generation (ENEA).

5 Exchange of experiences on the GIS application for the implementation and management of sustainable agriculture in China.

6 With the participation of ENEA, EDISON, ENEL and ENI, and the Italian Ministry of Industry.

7 Realisation of a co-generation thermal power station in Kaliningrad and a methane pipeline feeding the station and the district heating; realisation of thermal power stations in Krasnodar and Novgorod; completion of the fourth unit of a thermal power plant in Perm.

8 ENEA project for the energy upgrading of industrial residues (cotton) "Steam Explosion", and know-how transfer towards local research centres for testing new eco-compatible technologies.

9 Co-operation project between ENEA and the Pakistan Council of Appropriate Technologies "Utilization of City/Agro-Industrial Residues for producing energy and organic fertilizers".

Tab. 1 – Financial Contribution to the Global Environment Facility (GEF)

	Contributions(millions of US$)			
	1997	1998	1999	2000
GEF	–	17.3	–	3.6

Tab. 2 – Financial contributions to multilateral institutions and programmes

Institution or programme	Contribution (millions of US dollars)			
	1997	1998	1999	2000
Multilateral institutions::				
1. World Bank (IBRD)	15.47	5.18	4.67	13.77
IDA	5.39	326.67	295.96	-
2. International Finance Corporation	0.59	0.58	1.10	0.95
3. African Development Bank	-	-	0.28	3.18
- African Development Fund	-	33.90	-	-
4. Asian Development Bank	-	1.90	0.20	-
- Asian Development Fund	-	24.46	-	-
5. European Bank for Reconstruction and Development (BERS)	-	10.76	16.83	0.29
IFAD	3.68	3.56	3.40	19.86
6. Inter American Development Bank	1.35	18.59	6.40	10.99
7. Other Regional Banks	-	1.61	12.63	4.65
8. United Nations Development Programme	13.85	13.51	12.38	38.36
9. United Nations Environment Programme	0.31	0.45	0.61	0.73
- CCD	-	-	0,59	0,59
10. UNFCCC	0,38	0,44	0,52	0,58
11 Other				
CTI	-	-	50.08	-
FAO	9.25	8.64	8.25	17.37
Resarch - CGIAR	2.64	2.59	2.48	2.86
- International Union for the Conservation of Nature	-	0.23	0.17	0.24

Source: DAC-OECD, International Development Statistics.

Tab. 3 a) Bilateral and regional contributions related to the implementation of the Convention, 1997 (thousands of us dollars)

Recipient Country/Region	Agriculture	Waste Management	Energy	Water Resources	Capacity building	Total
AFRICA UNSPECIFIED					114	114
BOSNIA-HERZEGOVINA					395	395
BRAZIL				59		59
ECUADOR	423					423
EGYPT					1,494	1,494
ETHIOPIA			1,599			1,599
MOROCCO				9		9
NICARAGUA		30				30
PALESTINIAN ADMIN. AREAS				3	917	920
SOMALIA	80					80
TANZANIA			3			3
MADAGASCAR	14					14
SOUTH OF SAHARA.	893	96				989
BURKINA FASO			126			126
Total	1,410	126	1,728	71	2,920	6,255
					Total Bilateral APS	516,110
					% Total Bilateral APS	1.2%

Tab. 3 b) Bilateral and regional contributions related to the implementation of the Convention, 1998 (thousands of us dollars)

Recipient Country/Region	Agriculture	Waste Management	Forestry	Energy	Protection of Water Resources	Capacity building	Coastal zone management	Other vulnerability	Total
BOSNIA-HERZEGOVINA	69								69
CAMEROON				17					17
CHILE					20	237			257
EGYPT						1,332			1,332
ETHIOPIA				62	29	85			176
HONDURAS						6			6
KENYA						2,212			2,212
LEBANON		16							16
MALTA							593		593
MEXICO				12					12
MOROCCO	40	17	20		233			9	319
NORTH OF SAHARA UNALL.						221			221
PALESTINIAN ADMIN. AREAS		1			96	435			631
TANZANIA						7			7
TUNISIA	23								23
GUINEA	17								17
NIGER	2								2
CEECs/NIS UNALLOC.						373			373
Total	151	33	20	91	478	4,908	593	9	6,283
								Total Bilateral APS	677,750
								% Total Bilateral APS	0.9%

Tab. 3 c) – Bilateral and regional contributions related to the implementation of the Convention, 1999 (thousands of us dollars)

Recipient Country/Region	Agriculture	Waste Management	Forestry	Energy	Protection of Water Resources	Capacity building	Other vulnerability	Total
AFRICA UNSPECIFIED						569		569
ALBANIA	25		181					206
BOSNIA-HERZEGOVINA						133		133
BRAZIL						550		550
CIAD						199		199
CHILE						19		19
CHINA	1.007			7.066		2.014		10.087
CROATIA						1.211		1.211
CUBA						825		825
DOMINICAN REPUBLIC	191					58		249
ECUADOR	97		275					372
EGYPT						2.022		2.022
ERITREA						110		110
ETHIOPIA				2	100			102
HONDURAS						4		4
JORDAN						5		5
KENYA						1.023		1.023
LDCS UNSPECIFIED						180	17	197
MEXICO				24				24
MOROCCO		19	14		227		11	271
NICARAGUA	2						11	13
NORTH OF SAHARA UNALL.	875							875
PALESTINIAN ADMIN. AREAS	156	11			89	165		421
SENEGAL						611		611
SLOVENIA						165		165
SCOTH AFRICA						1.651		1.651
TUNISIA	73	2						75
ZIMBABWE						2		2
NIGER				17				17
BURKINA FASO	268			40				308
ARGENTINA	17							17
UGANDA				16				16
Total	1,704	32	470	116	416	3.724	39	22.350
						Total Bilateral APS		631.339
						% Total Bilateral APS		3,5%

Tab. 3 d) – Bilateral and regional contribution related to the implementation of the Convention, 2000 (thousands of us dollars)

Recipient Country/Region	Agriculture	Waste Management	Forestry	Energy	Protection of Water Resources	Capacity building	Other vulnerability	Total
AFRICA UNSPECIFIED						4		4
ALBANIA			98			16		114
CAPE VERDE						3		3
CHAD						120		120
CHILE					13			13
CROATIA	23							23
CUBA							14	14
DOMINICAN REPUBLIC	89							89
ECUADOR	5							5
EGYPT						1,735		1,735
ERITREA			34					34
ETHIOPIA		7						7
FRY-SERBIA & MONTENEGRO						10		10
HONDURAS						16		16
JORDAN						5		5
KENYA						433		433
LEBANON		5						5
MALI	7			15				22
MEXICO				3				3
MOROCCO	88		7		120		5	220
NICARAGUA	6		6		1		9	31
NORTH OF SAHARA UNALL.						20		20
PALESTINIAN ADMIN. AREAS						50		50
PERU			4					4
SENEGAL	4	10						14
TANZANIA				14				14
TURKEY	14							14
ZIMBABWE						14		14
SOUTH OF SAHARA UNALL.						590		590
NIGER	10			40				50
BURKINA FASO	107					57		164
ARGENTINA	350							350
ANGOLA	238							238
Total	941	22	149	72	133	3,073	38	4,428
							Total Bilateral APS	728,940,000
							% Total Bilateral APS	0.6%

CHAPTER VIII
Research and systematic observation

The last years have been characterised by the renewed engagement of the Italian research system in the study of the anthropogenic influences on climate, its variability and impacts on the environment. A National Research Plan on Climate has been launched, and it is being implemented in co-operation with the Ministry of the Environment and Territory and the Ministry of Education, University and Research. The Plan is part of the National Research Plan aimed at strengthening the strategic role of research in such a vulnerable country as Italy. The main fields of intervention of the Italian research on climate are the following:

7.1 Monitoring, observation and measuring activities

An efficient network (co-ordinated by the Meteorological Service and other bodies and institutions), to monitor the core properties of the atmosphere is being implemented in Italy along with the development of advanced instruments and data analysis techniques. The decrease in precipitation levels recorded in the last decades, and the increase in winter dryness phenomena over the 1950-2000 period have been evaluated in the course of these monitoring activities.

The Italian research system has also a number of oceanographic vessels used for research cruises. Some initiatives have been recently launched to upgrade the vessel fleet for research purposes. The Italian participation in Antarctica includes relevant studies and climate-related researches.

ENEA, the (Italian Agency for New Technologies, Energy and Environment) is collecting the historical data on Mediterranean temperature and salinity levels since 1982. The historical data start from 1900, and are one of the most extensive database for the Mediterranean area up to 1994, with about 12,000 profiles collected all over the Mediterranean. This data set has been included in the *Mediterranean Oceanographic Data Base* (MODB). Further data collected between 1996 and 2000 have been included in the *MEDAR/MedAtlas project*. Some data have been used to evaluate the changes of physical properties of the Mediterranean Sea, with particular reference to the temperature and salinity trends in the Levantine and Atlantic. Attention is given to inter-annual variability in the formation of dense waters in some critical areas, such as the Ligurian Sea.

ENEA, in co-operation with **ISAC-CNR**, (Institute of Atmospheric and Climate Sciences, - Italian National Research Council) conducts analyses of data of Sea Surface Temperature (SST), altimetric and sea colour data. Several surveys on seasonal and inter-annual variability have been carried out in the last decade. Comparisons with in situ data allow to assess the analyses of the satellite data, on the basis of the internal variability of the Mediterranean Sea.

Additionally studies have been carried out to assess possible trends in the precipitation field. The studies are based on the statistical analysis of the time-series of the observations distributed in space, but time series covering a sufficient period of time and well distributed in space are rarely available. In general, it is necessary to come to a compromise between good space distribution and good time series

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length. **Fig. 1** shows the percentage of winter dry days. An increase in the frequency of dry days can be observed over the 1951-1980 and 1981-2000 periods, with most noticeable increases in the Northern areas corresponding to the Padana Plane and the Alps. Less remarkable increases are recorded in the south and in the centre, and no increases are recorded in the islands. The short coverage of these data does not allow to evaluate a trend, which on the other hand can be obtained by means of climate models producing longer time series. **Fig. 2** shows the frequency of annual precipitation exceeding 25 mm/day in Northern Italy (*Brunetti et al., 2000*).

The aerosols effect on the global climatic system is one of the main sources of uncertainty in today's climate forecasts. Moreover, the aerosol effect plays an important role in the atmospheric chemistry, affecting the content of other important atmospheric components, such as ozone. Studies on the effects of aerosol chemical composition on the radiativi properties of clouds (aerosol indirect climatic effect) are in progress b CNR-ISAC.

Daily monitoring programmes of the tropospheric ozone content and programmes of systematic measurements for the chemical-physical characterization of the aerosol effects are carried out at two experimental stations, co-ordinated by ISAC-CNR. These stations are located at S. Pietro Capofiume (SPC, centre of the Padana Plane), and at Monte Cimone (MTC, the highest peak of the Northern Apennines). Also at MTC daily monitoring of CFC, HCFC, NO_2, stratospheric O_3, CO, Be-7, Pb210, and Rn-222 is carried out.

CESI the (Italian Electro-Technical Experimental Centre) manages a research project aimed to investigate the interactions between the electric system (power production, transport and distribution) and climate change. The project includes research activities based on: experimental measurements, laboratories, remote sensing instruments, climate data processing and modelling. CESI is also active in the monitoring of the greenhouse gases (GHG) concentrations at Plateau Rosa. CESI's monitoring station is hosted by the laboratory Testagrigia of CNR ICG on the Italian Western Alps (3,480 masl) nearby the Swiss border. It is one of the highest monitoring stations in Europe, and due to this peculiar feature, and to the fact of being placed outside of the planetary boundary layer, the surveys of the free-troposphere concentrations can be performed more easily. The main gases being monitored are: CO_2, CH_4, N_2O and O_3. Other variables are systematically analysed such as SO_2, NOX, total hydrocarbons and the main atmospheric variables (temperature, relative humidity, pressure, solar radiation and UVB, wind speed and wind direction). Most of the monitoring activity is carried out on a daily basis. Weekly air samplings are currently collected for analyses of CH_4 and N_2O, at the CESI laboratories in Milan. Surveys on some chlorofluorocarbons (CFCl3 e CF2Cl2) are carried out too. The main efforts are currently aimed at improving the analytical methodology for SF_6 measures. The main results achieved up to now are: the availability of a historical database of greenhouse gas measures and other parameters collected at the station; the production of quality measures in terms of precision, accuracy and comparability; the realisation of a web-site to supply information on the sampling and observation activity carried out at Plateau Rosa (for example, **Fig. 3** shows long-term trends of CO_2 and CH_4 free-troposphere contents to assess growth rates).

The Meteorological Service of the Italian Air Force measures carbon dioxide concentration since March 1979 almost uninterruptedly. Monte Cimone (2165 masl) is one of the stations measuring CO_2 concentration on daily basis by means of non-dispersive infra-red analysers (NDIR). Two spectrophotometers are also used at the Monte Cimone station to measure the ozone content in the stratosphere: the *Dobson* spectrophotometer (**Fig. 4**) and the *Brewer* spectrophotometer, both installed at the logistic base of Sestola (1020 masl). The former is operative since 1975, the latter since 1992.

ENEA also conducts studies on other several atmospheric parameters of climatic importance in three Italian stations and in Antarctica. ENEA manages a network of Antarctic meteorological stations (Terra Nova region, 73-77°S, 160-169°E) and measures meteorological variables at La Casaccia (42.1°N, 12.3°E), and in the island of Lampedusa (35.5°N, 12.6°E). The Lampedusa Laboratory is also active with long-term surveys on greenhouse gas concentrations, ozone, ultra-violet radiations, and aerosol effect. The Brasimone Station (44.1°N, 11.1°E) is active on studies on cloud formations in the upper troposphere, stratospheric aerosol, and average atmospheric temperature. Further programmes, essentially focused on the study of polar stratospheres, are carried out in co-operation with other Institutions.

A programme aimed at assessing greenhouse gas concentrations in the atmosphere was started in 1991 as a result of a co-operation between ENEA and CNR. In the context of this co-operation a laboratory for tuning gas-measuring methodologies and techniques has been developed at La Casaccia.
A Station for Climate Observations was set up by

ENEA in 1996 at Capo Grecale, along the northern-eastern coast of the Lampedusa island. Since 1999, daily measurements of CO_2 are also carried out at the same station, where the necessary instruments to measure this gas are currently installed. From the beginning of the project, this laboratory has used, and it is still using, the concentration standards provided by the World Meteorological Organization. The Lampedusa station is part of the *Global Atmosphere Watch* network of the World Meteorological Organization. The activities carried out at this Station focus mainly on the study of the radiative balance in the atmosphere, and they are currently divided into two main classes: a study on the evolution of greenhouse gas concentrations, and several surveys on solar radiation transfer.

The first activity is aimed to the long-term characterization of gas concentrations in the atmosphere (CO_2, CH_4, N_2O, CFC-11 e CFC-12), contributing significantly to the greenhouse effect (**Fig. 5**). Apart from emissions, the greenhouse gas distribution in the atmosphere depends on large-scale dynamic phenomena, on the exchanges between ocean, atmosphere and earth's surface, and on climate. Hence observations are also employed to study the interactions between atmospheric components, large-scale processes and climate.

The second line of activity focuses both on long-term measurements of some important parameters in terms of radiative balance (total ozone content, global solar radiation, spectral ultra-violet irradiance, aerosol optical range), and on the study of specific climate-related processes (**Fig. 6**). In this context, experimental campaigns are carried out also in co-operation with several international research Institutes. Additional instruments are installed in the course of the campaigns, and numerous geophysical parameters are measured to obtain a detailed description of both the atmospheric structure and the radiative field.

Experimental campaigns are also carried out to study specific processes of great importance for the climate. For example, the European campaign PAUR II (*Photochemical Activity and Ultraviolet Radiation modulation factors*) was carried out in 1999 in Lampedusa, in co-operation with different Institutions (University of Rome, NOAA, IFU, CNR-ISAC). A series of detailed activities to measure the radiative field and the properties of the atmosphere were carried out during ground and air observations using ultra-light aircrafts. The goal of the campaign was to characterise such factors as ozone content and aerosol effects, which can modulate ultra-violet radiation flows in the atmosphere. The campaign enabled a detailed description of the desert dust spreading over the Lampedusa island.
The activities at the Climatic Observation Station of Lampedusa are funded by the Ministry of the Environment and Territory, the Ministry of Education, University and Research, the European Union and the Italian Space Agency.

The future developments of the first line of activity involve an increase in the number of chemical species detected. ENEA intends to extend its investigations to some increasing compounds which, although in very low concentrations, show a high warming potential. As far as the second line of activity is concerned, several instruments are being acquired and developed to allow a more efficient characterization of the atmosphere and to survey the radiative features of some important properties, both in terms of direct effects and indirect interactions. In particular, a radio and ozone sounding programme will be launched, a *LIDAR Raman* will be developed to characterise the water vapour and aerosol profiles; and several spectrometers will be installed to measure the concentrations of some chemical species.

INGV (Italian Institute of Geophysics and Volcanology) has developed the prototypes of two geo-chemical multi-parameter stations (GMS1 and GMSII prototypes). Appropriate software and hardware packages have been devised in order to install monitoring geo-chemical stations for different logistic sites, such as aquifers, gas emissions and fumaroles of volcanic-tectonic and hydro-geological importance. The basic idea is to provide a daily, versatile monitoring system to be adapted to different logistic sites, different sensors, different on-line geophysical and geo-chemical instruments. The goal is to go from a research phase to a routine, multi-disciplinary monitoring phase.

These stations have allowed to carry on important research aimed at reducing the greenhouse effect through the sequestration of CO_2 emissions in geological traps. As a matter of fact, the strategic interest in the geological sequestration of CO_2 emissions caused by industrial and other activities has significantly increased in the last years. The goal of reducing the greenhouse effect, in fact, has caused the launching of several research projects at international level, aimed at developing technical and scientific techniques for setting up an innovative approach. In particular, the aim is to foster the implementation of this methodology at European level. Therefore, "CO_2 sequestration" would enable the rapid and safe "source" storage reducing greenhouse gas residence times in the atmosphere. Locally it is also important to estimate the feasibility of the effort and the cost/benefit ratio.

7.2 Numerical simulation of climate

Some Italian research groups - INGV, ENEA and **ICTP** (*Abdus Salam International Centre for Theoretical Physics*), are active and internationally recognized in the field of climate numerical simulations. Most of the global simulation activity is focused on global-scale simulations with coupled atmosphere-ocean models.

Some regional atmosheric and marine models are also operative among many research groups. Regional atmospheric models are used to study the dynamic downscaling of climate variability, short-term forecasts and process studies.

A successful ocean circulation model for the Mediterranean Sea has been developed in Italy and successively disseminated to several international research groups. It provides a realistic and detailed simulation of inter-annual variability in the Mediterranean. Also marine models for limited areas such as the Adriatic Sea and other areas are available.

Researchers in Italy are also active in the development of marine ecosystem models, which include a detailed description of the population dynamics in order to assess the influences of climate change on the ecosystems. There is also a strong tradition of theoretical studies focusing on the main characteristics of climate dynamics, the predictability and reproducibility of climate changes, and on the nature and origin of climate fluctuations statistics. Other groups are active on stratospheric simulations and, in particular, on the analysis of the complex chain of chemical reactions regulating trace components in the atmosphere.

In particolar INGV is active on the research on the atmospheric response to CO_2 emissions and its variability. In this study is used the ECHAM4 global atmospheric model, originally developed at the *Max-Planck Institute of Meteorology* (Hamburg, Germany), with resolution T106, and the sea surface temperature forcing derived from a mixed layer model. In particular, the goal is to evaluate the effect of CO_2 changes on global, European and Mediterranean atmospheric variability. The study focuses on two experiments: the first experiment consists of two simulations (the first one considers present-day CO_2 concentrations in the atmosphere, and the second one double CO_2 concentrations); the second experiment consists of two more simulations with different CO_2 concentrations that varied over time. These simulations started in January 1979 and keep the observed CO_2 concentrations until 2000. After 2000, the two simulations have been continued with different CO_2 concentrations, defined in conformity with the two CO_2 emission scenarios of IPCC (A2 and B2 of the *Special Report on Emissions Scenarios*).

Fig. 7 - Fig. 10 show the differences between sea surface temperature and total precipitation of the two simulations of the first experiment (simulation with present-day CO_2 concentrations and with double concentration). The doubling of CO_2 concentration in the atmosphere would cause a SST increase in polar areas up to 10°C in wintertime (**Fig. 7**). In the European area the summer would be characterized by an SST increase of about 6°C in the central region, while the winter would be characterized by a warmine located in the Eastern European region (**Fig. 8**). A significant change is observed in global variability of total precipitation due to the CO_2 variations (**Fig. 9**), which, in some areas, can be up to 200 cm/year. The changes in precipitation over the European and Mediterranean areas seem to be seasonal (**Fig. 10**).

INGV also conducts investigations on the tropical climate and its variability in which the Asian monsoon plays a major role as a widespread and complex phenomenon affecting, and being affected, by tropical circulation.

General circulation models allow investigating the monsoon and its variability through a series of experiments aimed at analysing the phenomenon reproducibility which is an essential element for providing reliable forecasts. The present-day capacity of general circulation models to reproduce the monsoon activity, also in terms of elementary representations, can be actually improved; monsoon precipitations, in fact, are an important evidence but they cannot be reproduced easily.

Two forced experiments with SST have been carried out at the INGV using the ECHAM4 general circulation model (Roeckner et al., 1996) for the period from 1956 to 1999 with two horizontal resolutions: the first experiment with the triangular horizontal resolution T30, and the second one with the horizontal resolution T106. **Fig. 11** shows the precipitation (averaged from June to September over the 1956-1999 period) of both experiments (first and second panel) recorded in summertime and from observations of Xie and Arkin's (1996). It is clear that the horizontal resolution allows more realistic simulation of the precipitation. Particularly, in the first low-resolution experiment (T30, central panel) the heavy precipitations in Western India (the so-called *Western Ghats*) are not simulated, whereas they are present, less intense than the observations, in the high-resolution experiment. In general, the high-resolution experiment shows similar precipitation patterns to observations in the Asian continent – an area

affected by monsoon phenomena mainly in summertime – and in the other regions of the globe, including the equatorial Pacific ocean, and the western coasts of Latin America.

The experiments with long time-series enable the study of the inter annual variability of the precipitation. To this purpose, several indexes are provided in literature to classify the years characterised by intense monsoons and the years characterised by weak monsoon phenomena. Among these, the DMI (*Dynamical Monsoon Index*) and the EIMR (*Extended Indian Monsoon Rainfall Index*) indexes are widely employed. The DMI index shows the difference between the seasonal anomalies of the zonal wind (averaged from June and September) at 850 mb and 200 mb, and averaged in the region included between the Equator and 20°N and between 40°E and 110°E. DMI is also adequately correlated to other precipitation indexes. Since it can be reproduced more easily from the circulation models, it is widely employed as an indicator of both intense and weak monsoon years. EIMR is a precipitation index, and it is the summer mean (from June to September) of the precipitation anomalies (with respect to the seasonal cycle) averaged in the region included between 70°E and 110°E and between 10°N and 30°N. This index was also introduced to represent the precipitation variability in the Indian regions. The two aforementioned indexes are represented for the ECHAM4 model in **Fig. 12.** The coefficient of correlation is 0.7, indicating a good correlation between DMI and EIMR. It also indicates that, using the ECHAM4 model, the monsoon inter-annual variability can be investigated both through characteristic circulation indexes and characteristic precipitation indexes. This is the first step forward in terms of general capacity of the circulation models and, in particular, of the ECHAM4 model, to simulate and, where possible, forecast such complex and crucial phenomena for the tropical areas as the Indian monsoon and the Asian monsoon.

ENEA (La Casaccia, Rome) is active on a research on the internal, decadal and multi-decadal variability of the Mediterranean Sea. The natural variability in the thermohaline circulation in the Mediterranean basin is affected by the boundary conditions at the interface with the atmosphere. The classical way to trigger this variability is conducting climatological simulations under restoring boundary conditions and mixed boundary conditions. The average duration of these simulations, using the MOM (*Modular Ocean Model*) model, is about 400 years. The investigation focused on the intermediate water formation area (Aegean Sea) in the Eastern basin, on the Sicilian Channel, and on the Western basin, in particular, west to Sardinia - an important area for the heat and salt meridional transport. The analyses have shown multiyear oscillations in the convective activity of the Aegean Sea, which moves toward the Western basin through the Sicilian Channel, and finally reaches the Sardinian coastline. The intermediate salt anomalies, generated in the Aegean Sea and successively transmitted to the Western basin through the Sicilian Channel, are organised as multiyear fluctuations. This variability affects the thermohaline circulation of the Mediterranean Sea. The dynamic response of the model to various forcing agents is in progress.

Moreover, ENEA (La Casaccia, Rome) is also active on a research on the variability of the convective phenomena in the tropical area. The atmospheric circulation in the extra-tropical area is significantly affected by the variability of the convective phenomena and, consequently, by the heat release in the tropical area. The most important phenomenon on intra-seasonal scale is the *Madden-Julian Oscillation* (*MJO*), characterised by the eastward propagation of the convective zone over the tropical area. In particular, the objective of this study is to evaluate the effects of vertical resolution on the representation of convective phenomena. Simulations with the high-resolution (T106) ECHAM4 model have been carried out using 19 and 31 vertical levels, by increasing resolution especially in correspondence with the tropopause. **Fig. 13** shows the average precipitations recorded over the January to April period using the two vertical resolutions (19 and 31 levels). **Fig. 14** shows the comparison between the zonal averaged precipitation, for the same period of the two experiments and the ERA15 data set (and the relating error band) between 60°E and 150°E. It is clear that the high-resolution vertical experiment represents both the position and the extension of the precipitation peak rates more efficiently. Further simulations specifically aimed at improving MJO simulation will be conducted with different vertical resolutions.

Moreover, the *Physics of Weather and Climate Group* of the ICTP is active with various climate researches. An analysis of broad regional scale patterns of climatic changes based on ensembles of coupled Atmosphere-Ocean General Circulation Model (AOGCM) simulations has been conducted. A set of 9 AOGCM simulations for each of two SRES/IPCC emission scenarios (the A2 and B2 scenarios) have been analysed in terms of summer and winter temperature and precipitation change over 22 land regions of the world. The study showed that these simulations are able to produce a consistent picture of temperature and precipitation change over a number of regions. These are illustrated in **Figures 15** and **16**, where regions are indicated in which agreement across models is

found in the simulated regional changes. Uncertainties in the simulation of AOGCM climate change simulations have been extensively studied, and in particular a method has been derived to estimate average, uncertainty range and reliability of regional changes based on ensembles of AOGCM simulations. This method, which is called "Reliability Ensemble Averaging", extracts the most reliable information from each model by accounting for the model performance in simulating present day climate and the inter-model degree of convergence of results.

ICTP is also active in the development and application of a regional climate modelling system (called RegCM) for application to regional climate change simulation. Recent developments include the addition of a new precipitation scheme and a sub-grid land surface scheme. The RegCM is used in a variety of applications, from paleoclimate to climate change simulations over a range of regions. In particular, the completion of a new set of climate change simulations for the European region is under way.

Finally at ICTP extensive studies have been conducted on the effects of anthropogenic sulfate and fossil fuel soot on the climate of East Asia, a region where pollutant emission has tremendously increased in recent decades due to economic development. These studies showed that anthropogenic aerosols have likely affected the climate of East Asia in a significant way, and in particular have caused regional cooling due to reflection of solar radiation and increased cloud albedo. The studies also indicated that aerosol effects might significantly affect agriculture.

7.3 Impact studies

The impact studies sector is active with a series of initiatives focusing mainly on the effects of the sea level variations, as a consequence of climate change, especially for coastal wetlands.These studies investigate not only local effects, but also the possibility to use the Mediterranean as a test area to monitor global changes. Several studies investigate the effects of climate changes on the territory and on the environmental risk. Italian research groups are actively engaged in assessing the risk by "slope instability", coastal erosion, and in identifying hydrological areas at risk due to a change in precipitation.

7.4 Ecosystem of the Italian seas

The numerical modelling of the ecosystems has taken a step forward in the last years, and Italy is one of the most advanced countries in this sector. A model of marine ecological system has been implemented in the Mediterranean by INGV, in co-operation with Dutch and Danish research groups. The model is used to evaluate the effects of climate change, due to the increasing of greenhouse gas concentrations, on the ecosystem of the Adriatic Sea (**Fig. 17**), by using the atmospheric values of a time-slice scenario obtained in co-operation with the Danish Meteorological Institute (DMI). The results indicate a possible reduction in water dissolved oxygen and the consequent increase of probability of anoxic events (Vichi et al., 2002). This model is particularly valuable to assess the carbon uptake from the sea system. This study indicates that the net transfer of carbon from the atmosphere to the Italian seas should be in the range of 1 Mton/year.

7.5 Desertification

Italy is active in this sector with international research projects on the reconstruction of the history of desertification in the Mediterranean area. Researches are also carried out to investigate the response to desertification and to explain the response and mitigation strategies for the management of water and agricultural resources under enhanced environmental, social and economic stress conditions.

7.6 Italian participation at research programmes

Italy continues to be active with the Framework Programmes of the European Union, in particular the "Environment" programme. The Italian research groups have been quite successful in getting European funding.

National projects

NITCAR

NITCAR (Nitrogen and Carbon Balance – Strategic Project CNR) aimed to investigate the most important determinants of carbon and nitrogen cycling in agricultural soils. The project focused on basic processes from the cellular to the ecosystem scale providing new information on mechanisms involved in the regulation and control of Nitrogen and Carbon uptake by crops as well as on ecosystem balance between sources and sinks of Carbon.

PianosaLAB

PianosaLAB, funded by *Agenzia 2000 – CNR,* is monitoring the C-balance of the Mediterranean terrestrial ecosystem of the Island of Pianosa, Central Italy. The project is using advanced technologies to

monitor gas exchange of a mosaic of land-uses including eddy covariance and CBL (Convective Boundary Layer) budgeting techniques. It is basically an integrated effort involving 4 Universities and 9 laboratories of the National Research Council.

SOMIT
SOMIT, (Soil Organic Matter in Italian Agricultural soils), funded by the Ministry of Education, University and Scientific Research, is bringing together scientists of several italian Universities (Pisa, Udine, Bologna, Padova, Perugia and Palermo) and Research Centres (Firenze, Foggia) that have access to the data of long-term agronomic experiments involving different rotations, fertilization schemes and cropping systems. The project has a strong component, aimed to simulate the trends of accumulation of Carbon in agricultural soils in response to the different treatments.

CLIMAGRI
CLIMAGRI (Climate Change and Agriculture) is co-ordinated by the Central Office of Agrarian Ecology in Rome, and it is funded by MIPAF (Ministry for Agricolture and Forest Policies). Research groups from CNR, UCEA, the Universities and the INGV are involved in the project. The objectives of the project are:
• to define climate variability on a national plan, in terms of supply of reliable quantitative data, with particular reference to the agricultural sector;
• to provide support to political management, both at national and international level, by increasing the objectivity of the Italian scientific assertions in several climate-related events;
• to promote public awareness in terms of environmental protection;
• to strengthen agro-meteorological structures with particular reference to agro-meteorological database and the MIPAF forecasting modelling.

Natural variability of climate
This project, co-ordinated by INGV and funded by the Ministry for the Environment and Territory, is active on investigations on natural variability and the effects of carbon dioxide increases by means of global high-resolution simulation models.

SINAPSI
This project is a co-operation among CNR, ENEA, INGV, the Universities, the Zoological Station and OGS for the interdisciplinary investigation of climate change with particular reference to marine ecosystems.

Study to define the interventions to combat desertification in a pilot area of the Sicilian region
This project is a co-operation between ENEA and INEA (National Institute of Agrarian Economy) in the frame of the activities set in the agreement between ENEA and the Ministry for the Environment and Territory. A map of the sensitivity on a regional scale of the territory to desertification has been developed in conformity with the available data. Further investigations have been carried out involving the inhabitants of two municipalities (Licata and Cammarata) through the adoption of the Social Involvement Laboratory methodology. Possible interventions to mitigate present-day phenomena have been presented and debated with the Municipal and Provincial Authorities for implementation.

AERORG
The AERORG project. (Climatic effects of the organic component of aerosols and clouds) financed by Agenzia 200 CNR, aims at evaluating the effects of the organic component, of aerosols and clouds on cloud microphysical and radiative properties. This interdisciplinary project is coordinated by CNR-ISAC and invalves 3 Universitles, 2 CNR Institutes and the Joint Rescarch Cencre of the European Commission.

International projects:

PREDICATE
PREDICATE (*Mechanisms and Predictability of Decadal Fluctuations in Atlantic-European Climate*) is funded by the European Union, and the INGV takes part in the project. This project aims at satisfying the need for a deeper understanding of the interactions between ocean and atmosphere, and to provide reliable forecasts on climatic fluctuations in the Atlantic-European area on a decadal scale.

DEMETER
DEMETER (*Development of a European multi-model ensemble system for seasonal to inter-annual prediction*) is funded by the European Union, and the INGV takes part in the project. The main objective of the project is to develop an European ensemble multi-model for seasonal and inter-annual climate forecasts. In particular a set of multi-model ensemble hindcasts will be created by using the re-analysis data for initialisation and assessment. The predictability of such phenomena as El Nino, the North-Atlantic Oscillation and other European weather seasonal events will be assessed too. The data produced by the project will be used as inputs in applicative models for forecasting the probability distributions of agricultural crop yield in Europe, and preventing diseases in the African tropical regions.

EARLINET
EARLINET (*A European Aerosol Research Lidar*

Network to Establish an Aerosol Climatology), is funded by the European Union. A statistical database on aerosol horizontal and vertical distribution on a continental scale is being generated through a network of advanced laser remote sensing stations located all over Europe. These data will significantly contribute to quantify aerosol content, radiative properties, large-scale transport, budget and forecasts of future trends. The Italian participation is guaranteed by the University of L'Aquila and the National Institute of Material Physics (INFM) in Lecce, Naples and Potenza.

FUTURE-VOC

FUTURE-VOC is funded by the European Union. The aim of the project is to predict changes in the emission of volatile organic compounds (VOCs) by the vegetation in response to changes in the climate and the increase in atmospheric CO_2 concentrations.

CARBOEUROFLUX

The CarboEuroflux project is funded by the European Union and it is part of the cluster of CarboEurope projects aimed at quantifying carbon budget in the European continent, including Eurasia and the Amazon region. The CarboEuroflux project focuses on daily monitoring activities, carried out in 30 monitoring stations, of the flows of carbon dioxide, water vapour and energy in different European ecosystems. The Italian monitoring network (**Fig.18**) is active since 1996, and it will be in operation until 2003 (further financing is being asked to extend the project until 2008). In Italy 7 permanent stations monitor the Italian forest ecosystems. In addition 2 stations will be installed by the year 2002 on grassland ecosystems in the Alps and in the Central Apennines. The parameters collected concern the carbon flows between natural vegetation and atmosphere, and the meteo-climatic and ecological parameters needed for the interpretation. A CD-ROM containing the data of the 1996 – 1999 time series is available.

CONECOFOR

CONECOFOR (Control of Forest Ecosystems) is funded by the European Union, and MIPAF (Ministry for Agriculture and Forest Policies) is responsible for Italy. The permanent areas are directly managed by the peripheral units of the Italian Forest Office or in co-operation with the Local Authorities; each area covers a 10-100 he surface, each one including two 5,000 m_2. parcels for investigation. The dominant species are the beech-tree *Fagus sylvatica* (10 areas), the turkey oak *Quercus cerris* (5), the red fir *Picea abies* (6), the evergreen oak *Quercus ilex* (4), the durmast oak *Quercus petraea* (1) and the English oak *Quercus robur* (1).

The Italian EU/ICP Forests network (**Fig.19**) has been created in 1995, when the first 20 areas were set up; 4 more areas have been installed in 1998, followed by the last area in 2000, whereas the last 2 areas are being set up in order to increase the overall national network to 27 areas. Since 1997, the areas where the most advanced investigations (10) are conducted are also included in the ICP-IM network! these sites are active with the most challenging research activities, and with the most interesting research for the achievement of long-term objectives. Three more sites, set up and managed since 1992/3 by the Provinces of Bolzano and Trento, which act independently from the Ministry for Agricultural and Forest Policies, support the 10 CONECOFOR areas, increasing the number of Italian sites involved in the international ICP-IM network to 13.

RECAB

RECAB (Regional Assessment of Carbon Balance within Europe) uses novel techniques to measure and simulate CO_2 fluxes at the regional scale.The Sky Arrows ERA (Environmental Research Aircraft), is used in this project, which is a new innovative aircraft capable of measuring surface fluxes using airborne eddy covariance technique. The ERA platform has been developed within a collaboration between NOAA-ATDD (USA), IB-CNR (Italy, Firenze) and a private firm of the General Aviation (Iniziative Industriali Italiane, Roma) and has been successfully used in a series of campaigns in Italy and in Europe.

PRISM

This project is funded by the European Union to set up an European network for the development and integration of global numerical models. The Italian partner is INGV.

MEDACTION

The Italian Institute of Agrarian Economy (INEA) takes part in this project for Italy. MEDACTION will develop an information and decision network on desertification-related issues in the Northern Mediterranean area to assist policy makers (both at local and European level) in their decision-making processes. The output of MEDACTION will be the result of a dialogue among different social entities, meaning that a large number of policy makers will be involved in the planning of land use change scenarios, management options and policies.

MWISED

MWISED (*Modelling within-storm soil erosion dynamics*), co-ordinated by CNR-IGES (Florence), has been developed by 8 research groups, 3 of which from Italy, and it investigates on soil erosion dynamics responsible for accelerating the desertifi-

cation phenomenon, which can be unsustainable in particular climate change and soil management/use conditions. The analyses of the scenario (with the combined use of a soil erosion model a the rain generating model) is a technical instrument to support monitoring activities, soil use and management options and to assess soil vulnerability to climate change.

The results of the project are partially summarised in the improvements of two erosion assessment models (EUROSEM and EUROWISE) and in an *applet Java* (SEI) for the evaluation of soil physical and hydrological properties in conformity with easily available soil profiles and a rain event simulation model. The erosion models operate on the single rain event and are useful for assessing the impacts of prevention and conservation activities on a detailed scale (small basin, basin-mountain-side, field). The activities refer to the data collected all over Europe (from the United Kingdom, to Spain and Italy). In particular, the new algorithms introduced in the aforementioned models are based on a series of reports developed in semi-arid environments, and tested in the Italian regions of Tuscany and Sicily.

MEDRAP

MEDRAP (Concerted Action of the European Commission) aims at supplying scientific support to the formulation of a Regional Programme to combat desertification in Northern Mediterranean countries. The project is co-ordinated by the University of Sassari.

PREDESODI

PREDESODI (*Integrated approach for sustainable management of irrigated lands susceptible to degradation/desertification*), co-ordinated by the University of Palermo, aims at assessing salinization and desertification risks in irrigational areas where high-salinity waters are used in clayey soils, susceptible to crevice formations. The project is based on the definition of measuring campaigns focusing both on the identification of endangered areas and on the determination of parameters and properties to validate models. These models can be very useful to prevent salinization and to set up a management plan to reduce such risks.

DESERTLINK

DESERTLINK is funded by the European Union with the participation of the University of Basilicata for Italy. The objective of the project is to revise and improve the use of desertification indicators, to develop and use a database of present-day indicators, and to select and apply desertification indicators in pilot areas. The Italian pilot area is the AGRI basin (Basilicata region). The project accounts for the participation of local stakeholders to identify most suitable soil management methods to combat desertification.

WEYBURN

WEYBURN is funded by the European Union with the participation of the INGV for Italy, which is responsible for the activities relating to groundwater and soil surveys. The project is also carried out in co-operation with the University "La Sapienza" of Rome, and the University "Ca Foscari" of Venice. It focuses on the study of CO_2 sequestration during enhanced oil recovery (*EOR*) activities carried out at Weyburn (Saskatchewan, Canada), and on the effects of CO_2 sequestration on the reduction of greenhouse gas emissions. It also attempts to promote greater international co-operation with regard to the research in the carbon management sector.

Italy-USA Bilateral Agreement

A co-operation will be carried out to promote scientific research on climate variability, its uncertainties, and ecological, technological and health implications in the frame of the Bilateral Agreement

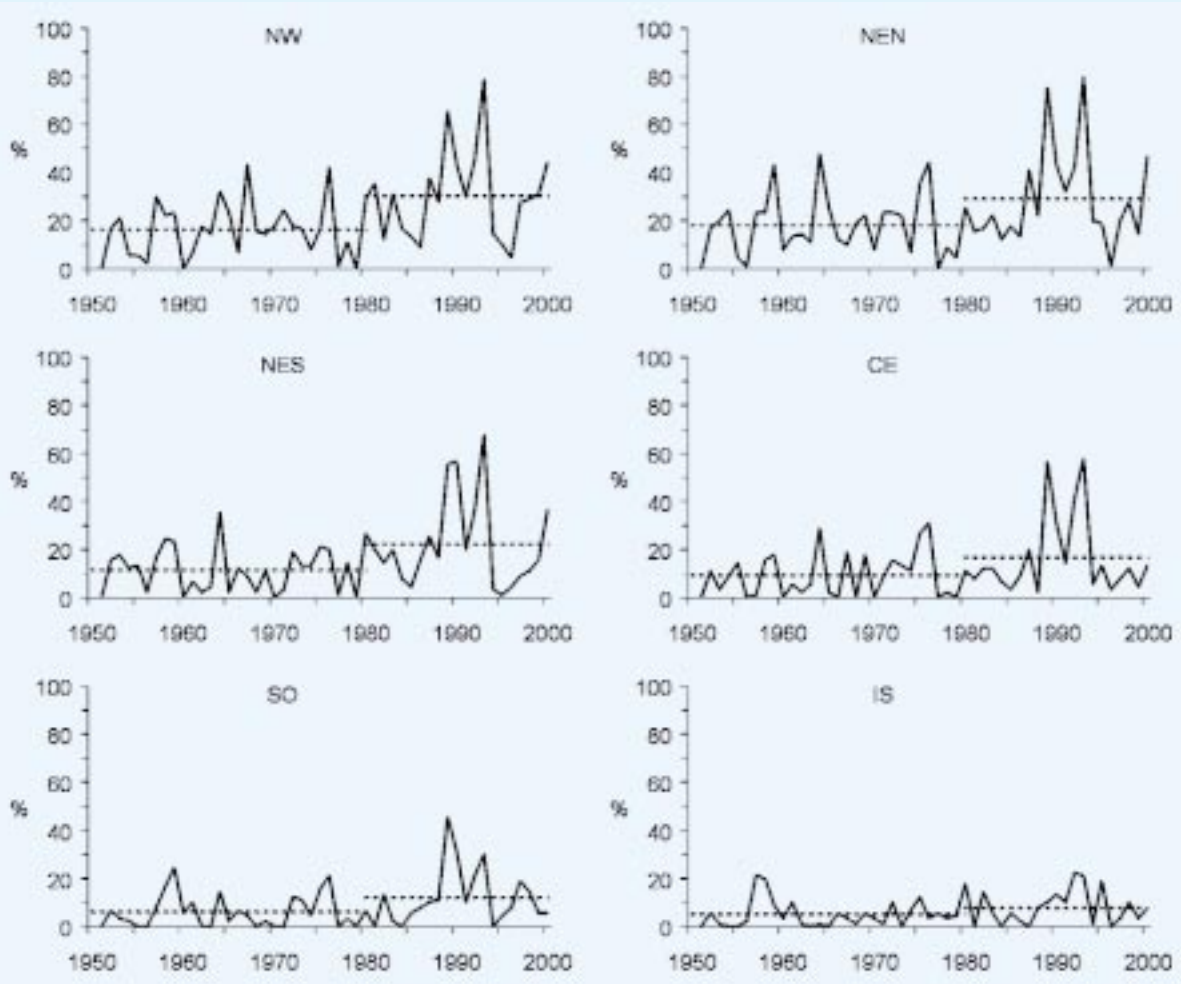

Figure 1: Proportion of dry days in wintertime for the six regions of the Italian peninsula. The average values for the 1951-1980 and 1981-2000 periods are indicated with dotted lines (Brunetti et al., 2001). A more remarkable increase is recorded in the northern areas (NW, NEN, NES), corresponding to the Padana Plane and the Alpine arc, a less remarkable increase is recorded in the South (SO) and the Centre (CE), and no increase is recorded in the islands (IS).

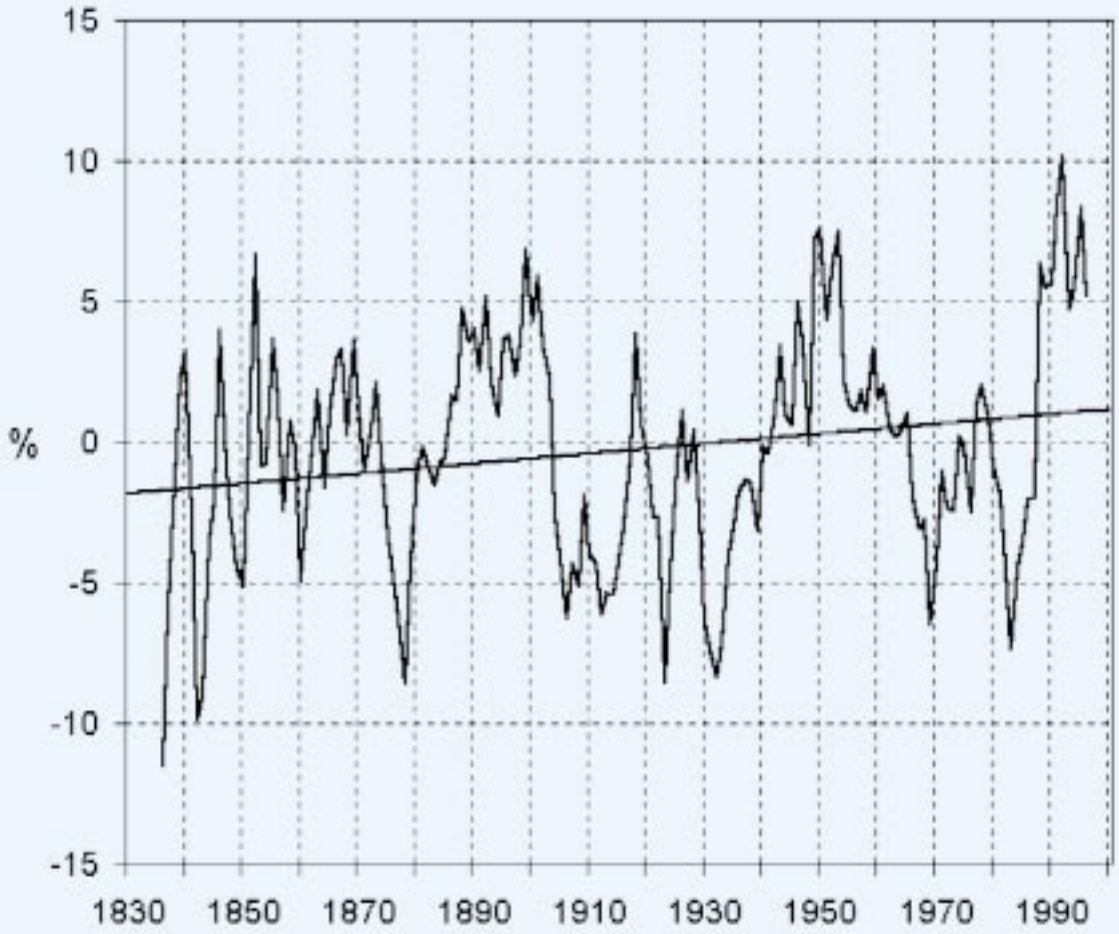

Figure 2: Annual precipitation frequency per precipitation exceeding 25 mm/day in Northern Italy. (*Brunetti et al., 2000*)

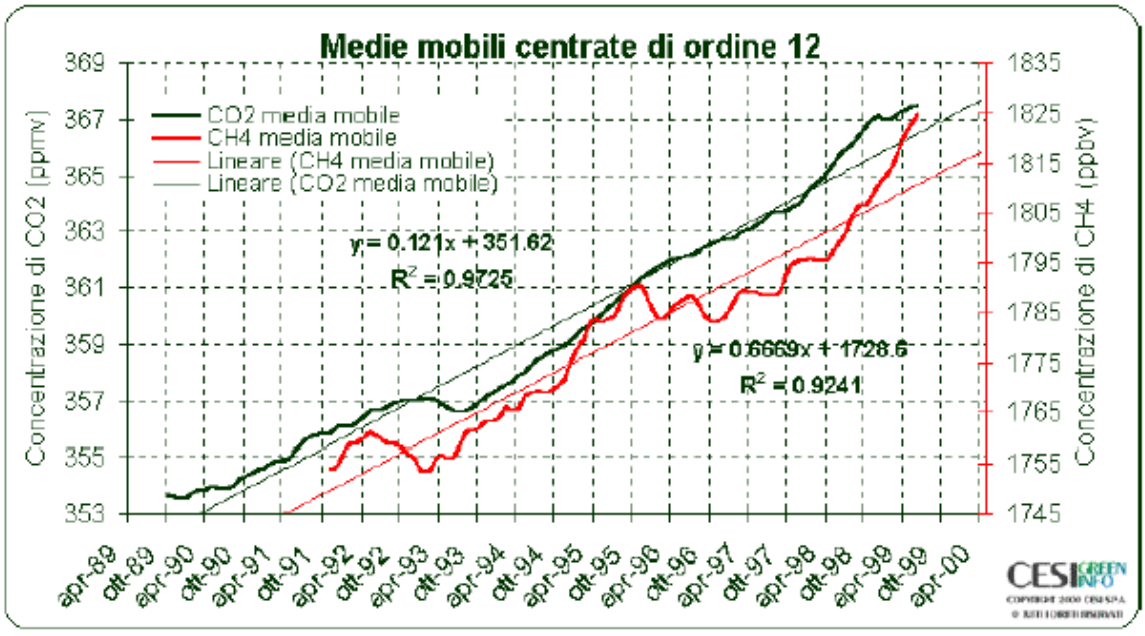

Figure 3: Centred moving averages (in the order of 12) of mean monthly CO_2 and CH_4 free-troposphere concentrations. The average monthly growth rate is calculated following a linear regression (from the monitoring station at Plateau Rosa, CESI).

between Italy and USA.

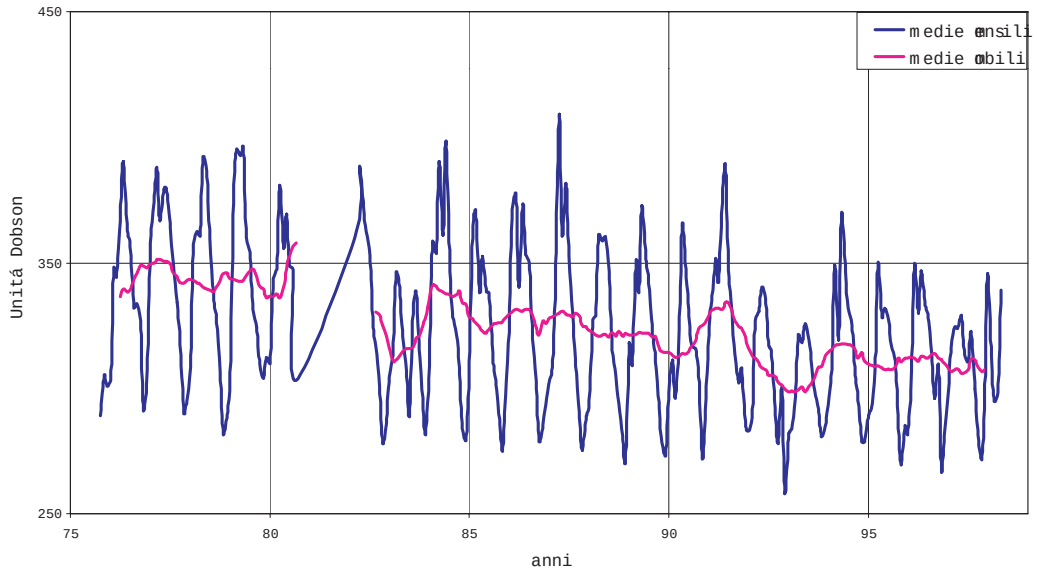

Figure 4: Ozone average monthly values measured at the Station 201 in Sestola by the Meteorological Service of the Italian Air Force.

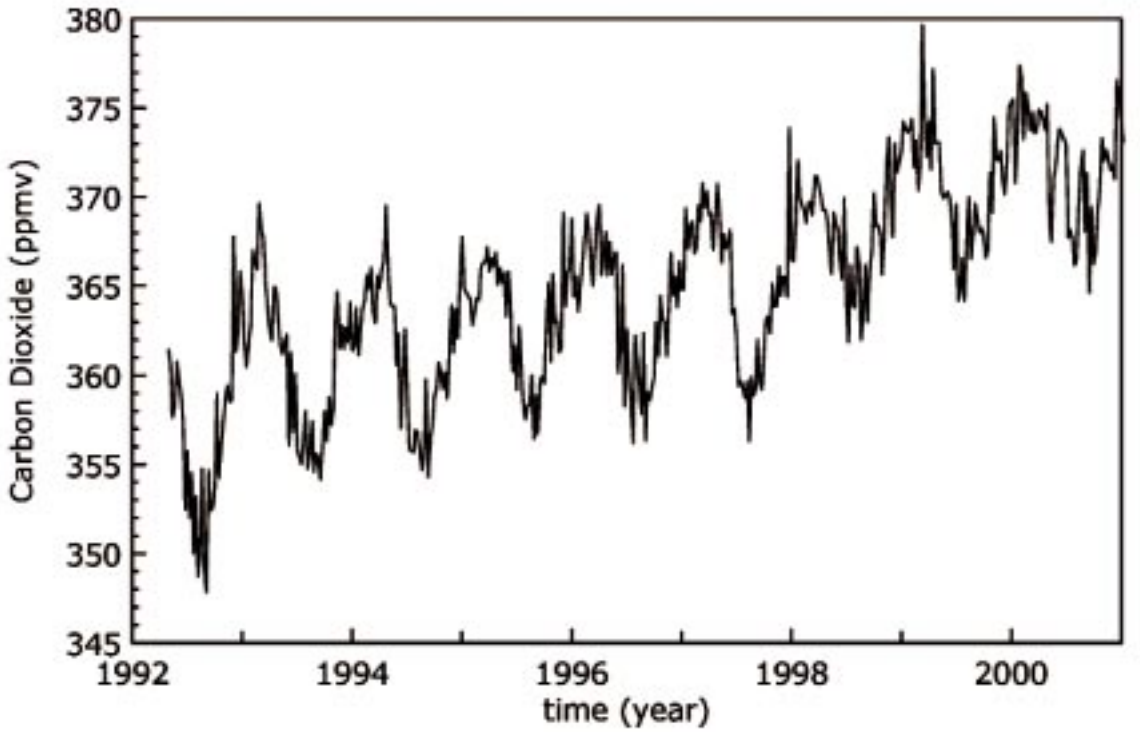

Figure 5: CO_2 concentration trend observed in the Lampedusa island from 1992 to 2000 during weekly samplings and observations. Weekly variability is mainly due to the formation of air masses at the time of the sampling. A 10 ppm large yearly oscillation, due to the photosynthetic cycle, and a progressive increase in CO_2 concentrations at the average rate of 1.5 ppm/year can be noted. The average rate is strongly affected by large-scale phenomena, such as El Niño/Southern Oscillation, and North-Atlantic Oscillation.

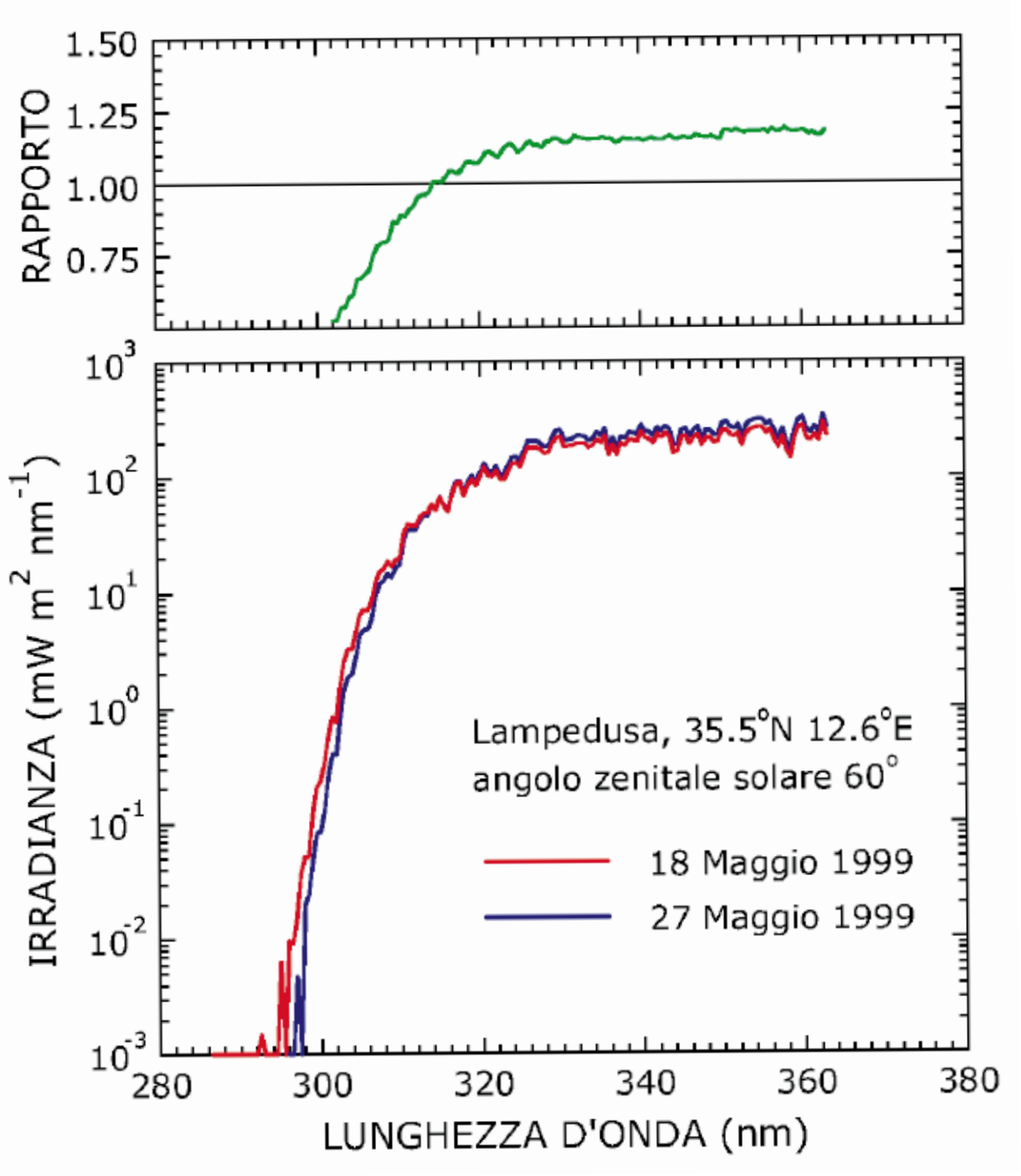

Figure 6: Lower graphic: ultra-violet irradiance spectra measured at Lampedusa on 18 and 27 May 1999 under clear sky conditions at a solar zenith angle of 60°, with total ozone values equal to 347 and 294 Dobson units, respectively. On 18 May, the aerosols optical depth at 415 nm was of 0.65, in the presence of desert dusts, and on 27 May of 0.23, with air masses from the North. Upper graphic: ratio between the two spectra recorded on 27 and 18 May. The differences between the two spectra at wave-length lower than 320 nm are due to ozone, and at higher wave-length are due to aerosols. The two effects are offset in the surrounding region at 315 nm. The aerosol influence on ultra-violet irradiance is clear.

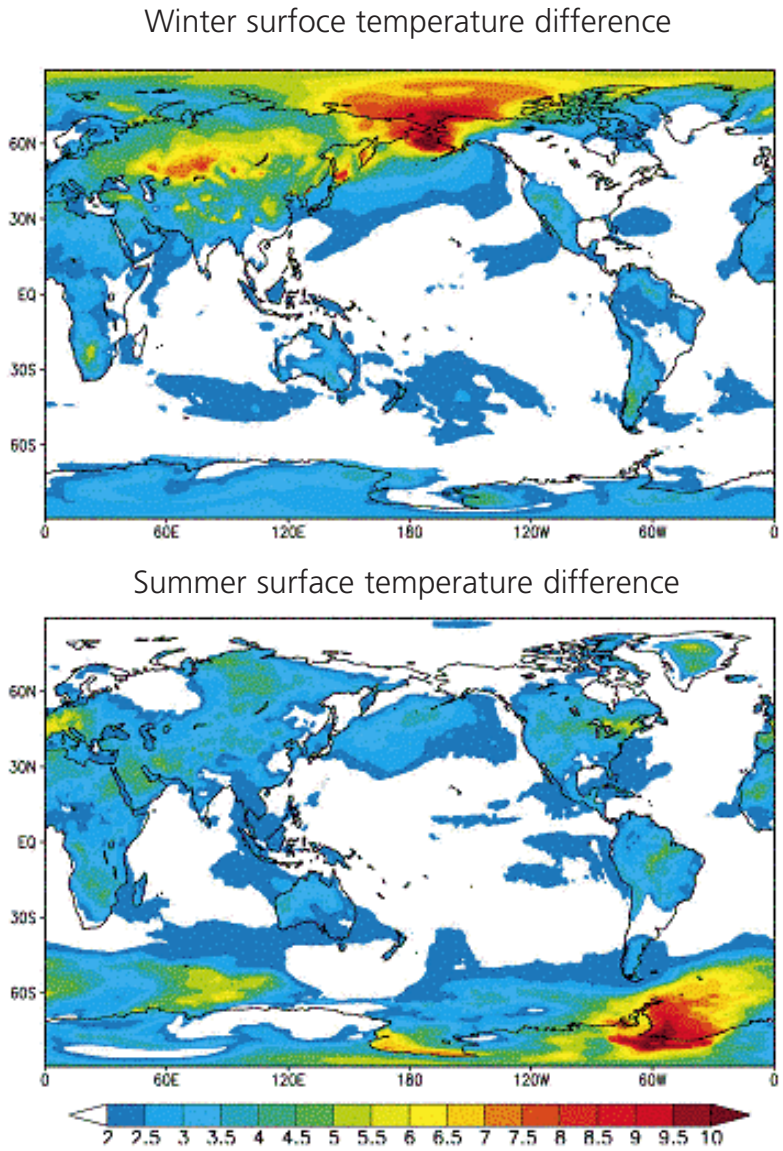

Figure 7: Difference in global sea surface temperature (SST) between simulation with present-day CO_2 concentrationin the atmosphere and with doubled CO_2 concentration (simulations carried out by the Dynamic Climatology Unit of INGV).

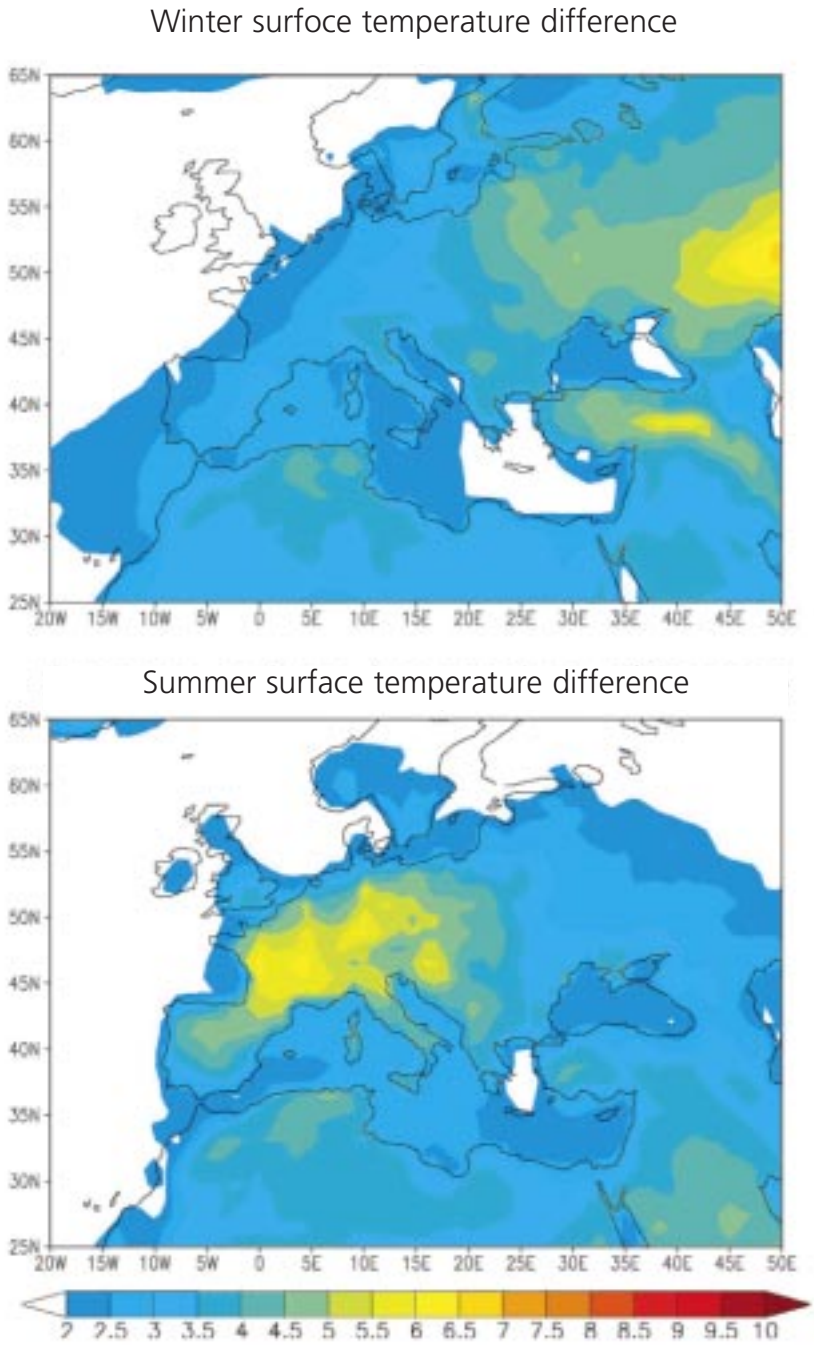

Figure 8: Difference in sea surface temperature (SST) of the European and Mediterranean areas between the simulation with present-day CO_2 concentration in the atmosphere and with doubled CO_2 concentration (simulations carried out by the Dynamic Climatology Unit of INGV).

Total ozone monthly averages
Meteorological Service of the Italian Air Force.
Station 201 Dobson - Sestola

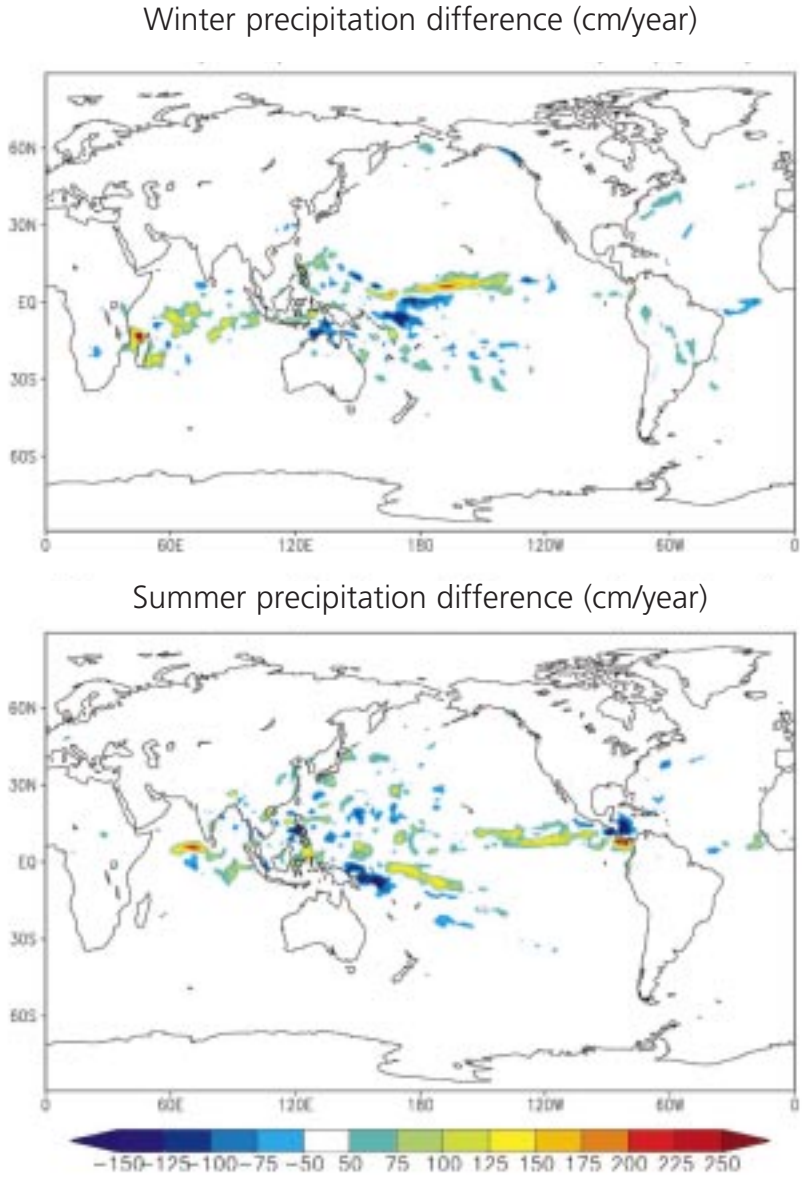

Figure 9: Difference in global total precipitation between the simulation with present-day CO_2 concentration in the atmosphere and with doubled CO_2 concentration (simulations carried out by the Dynamic Climatology Unit of INGV).

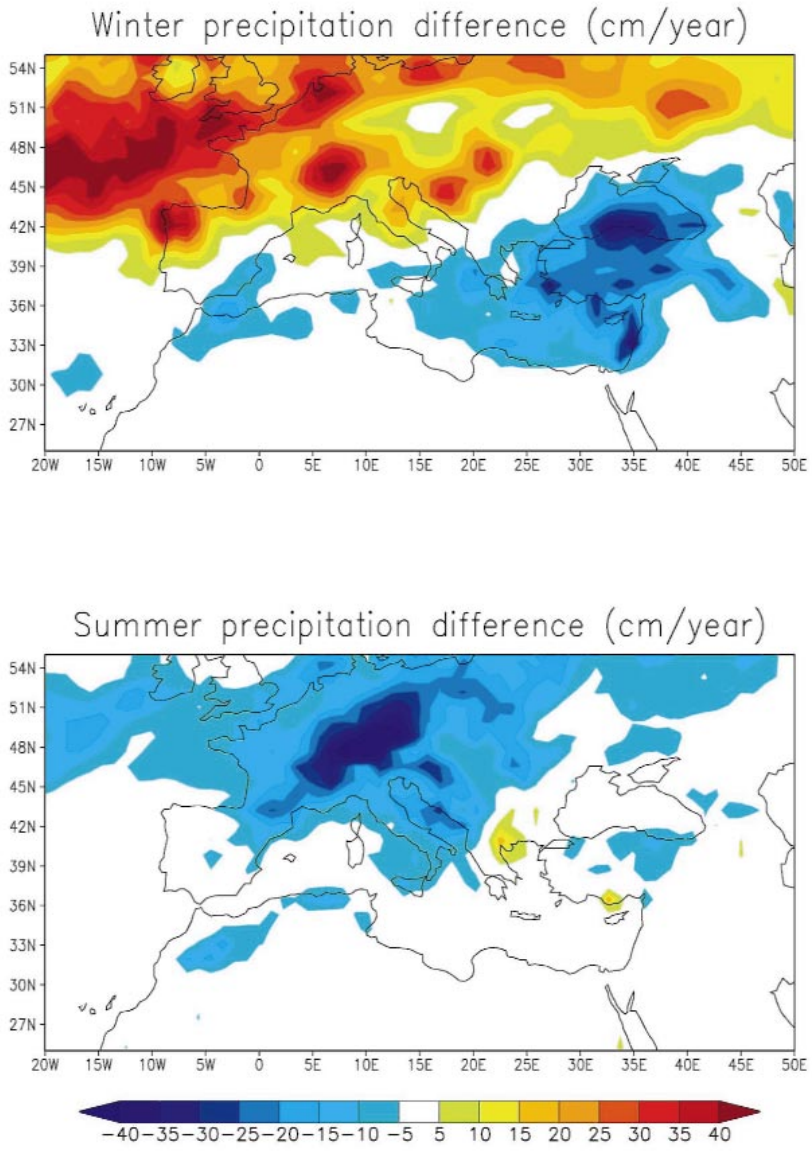

Figure 10: Difference in precipitation of the European and Mediterranean areas between the simulation with present-day CO_2 concentration in the atmosphere and with doubled CO_2 concentration (simulations carried out by the Dynamic Climatology Unit of INGV).

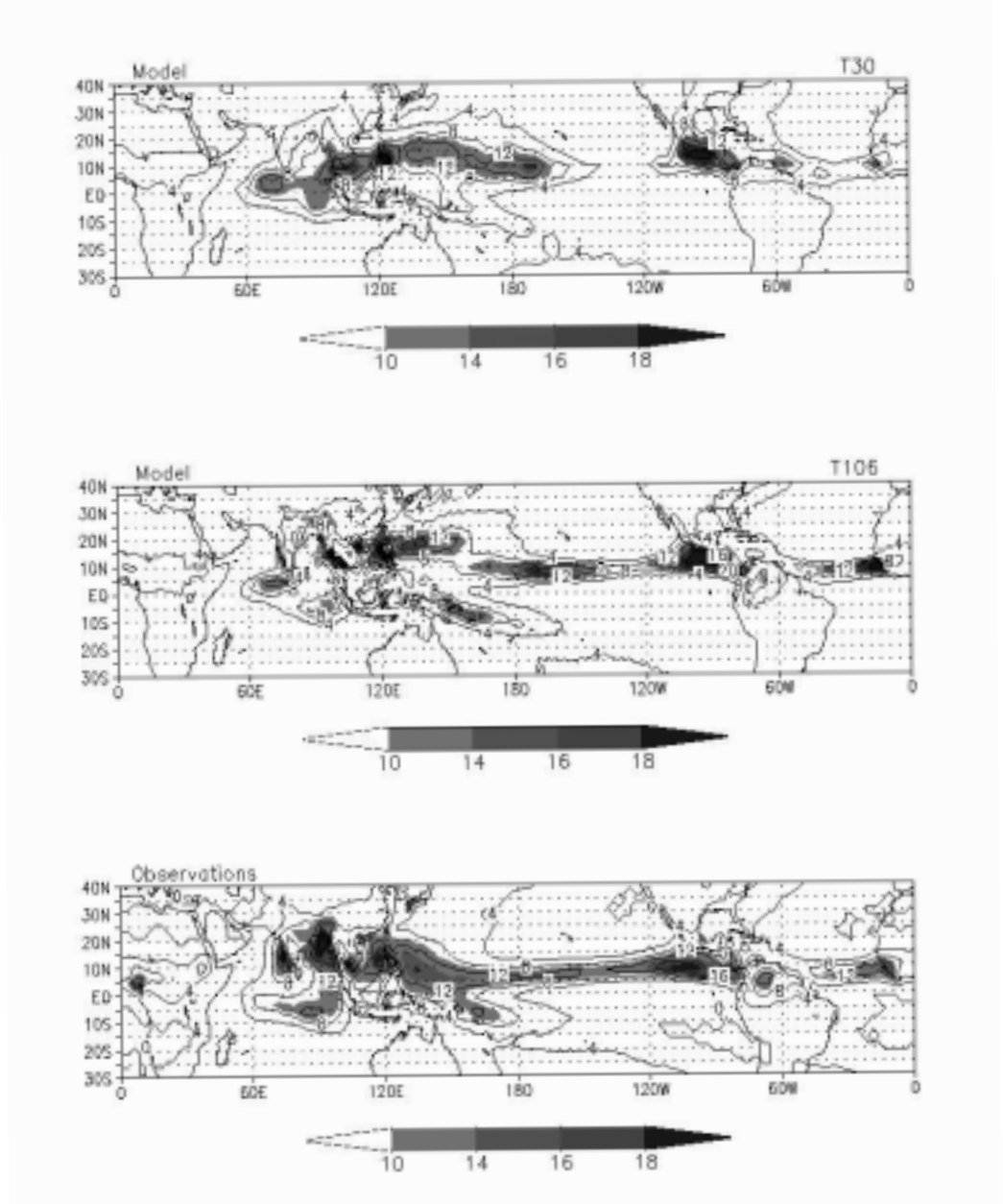

Figure 11: Mean precipitation for the june-august period (mm/day) for the ECHAM4 model with T30 and T106 resolutions, and for the observations by *Xie and Arkin* (1996).

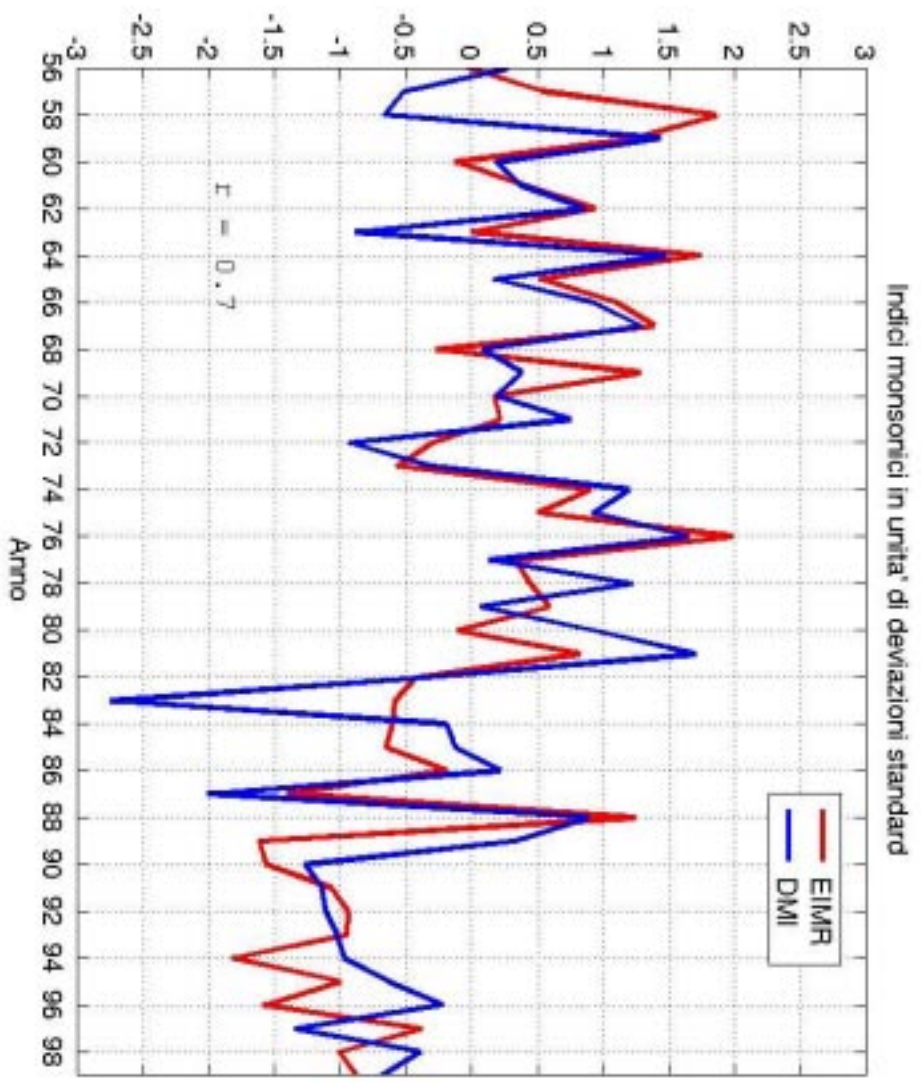

Figure 12: DMI (*Dynamical Monsoon Index*) and EIMR (*Extended Indian Monsoon Rainfall*) for the ECHAM4 model with T106 resolution (standard deviation units)

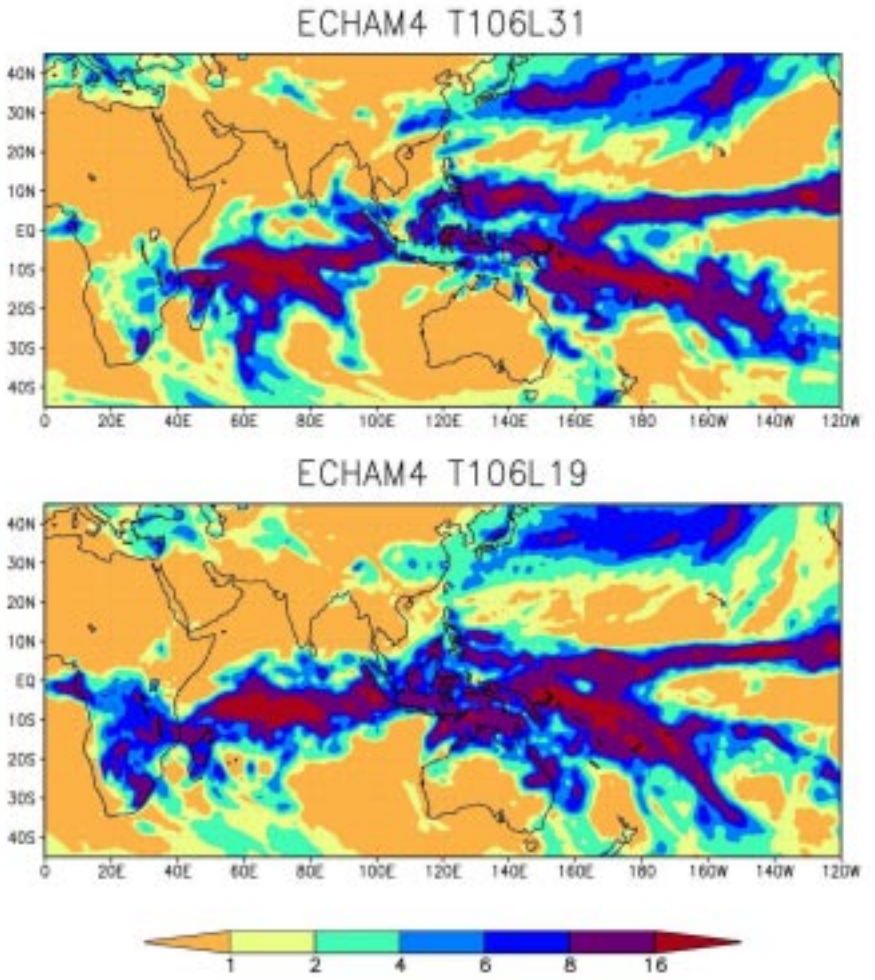

Figure 13: Mean Precipitation for january-april period (mm/day).

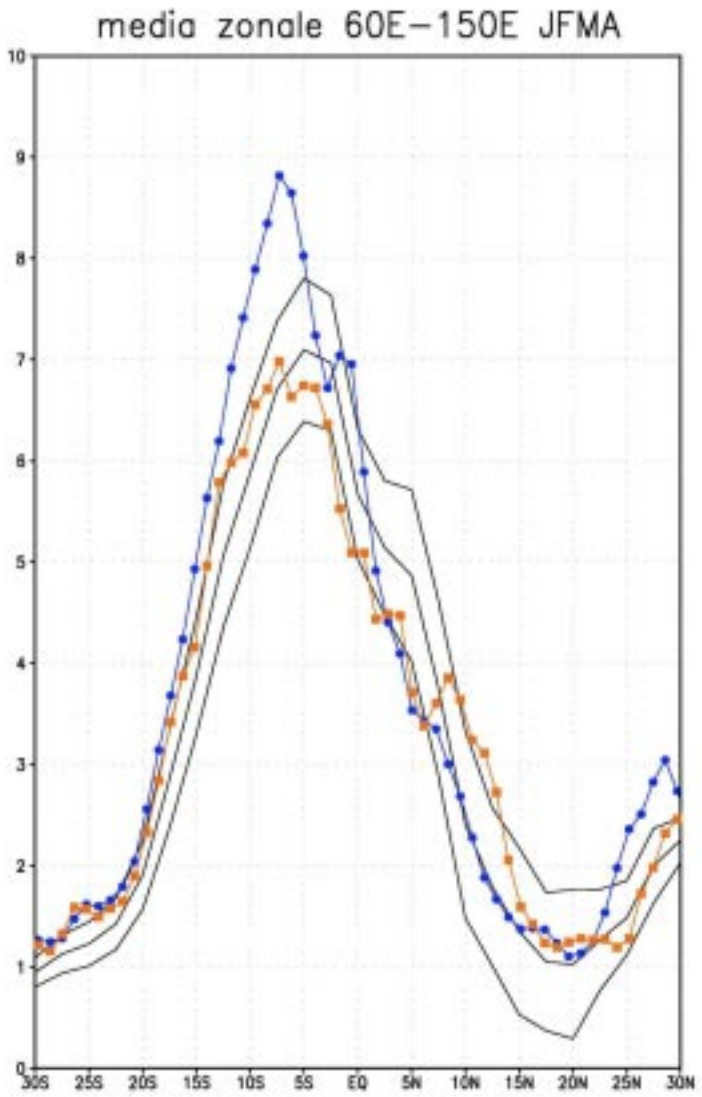

Figure 14: L19 precipitation (circle), L31 precipitation (square), and ERA15 precipitation (solid line).

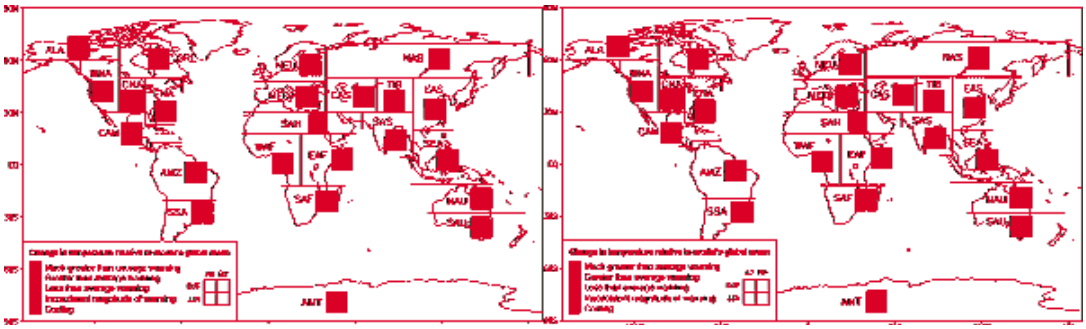

Figure 15: Inter-model agreement in regional temperature change relative to each model's global mean annual change for the A2 and B2 scenarios. Regions are classified as showing either agreement on warming in excess of 40% of the global average ("Much greater than average warming"), agreement on warming greater than the global average ("Greater than average warming"), agreement on warming less than the global average ("Less than average warming"), disagreement among model experiments on the magnitude of regional relative warming ("Inconsistent magnitude of warming") or agreement in cooling ("Cooling"). Agreement is defined by a consistent result from at least 7 out of 9 model experiments. The global mean annual change in the simulations spans 1.2 to 4.5 C for A2 and 0.9 to 3.4 C for B2, and therefore a regional amplification of 40% represents warming ranges of 1.7 to 6.3 C for A2 and 1.3 to 4.7 C for B2.

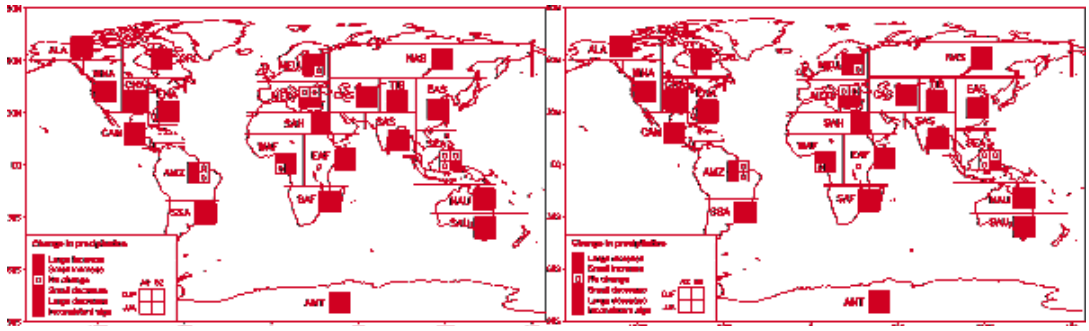

Figure 16: Inter-model agreement in regional precipitation change for the A2 and B2 scenarios. Regions are classified as showing either agreement on increase with an average regional change greater than 20% (of present day values) ("Large increase"), agreement on increase with an average regional change between 5 and 20% ("Small increase"), agreement on a change between -5 and 5% ("No change"), agreement on decrease with an average regional change between -5 and -20% ("Small Decrease"), agreement on decrease with an average regional change of less than -20% ("Large Decrease"), or disagreement ("Inconsistent sign"). Agreement is defined by a consistent result from at least 7 out of 9 model experiments.

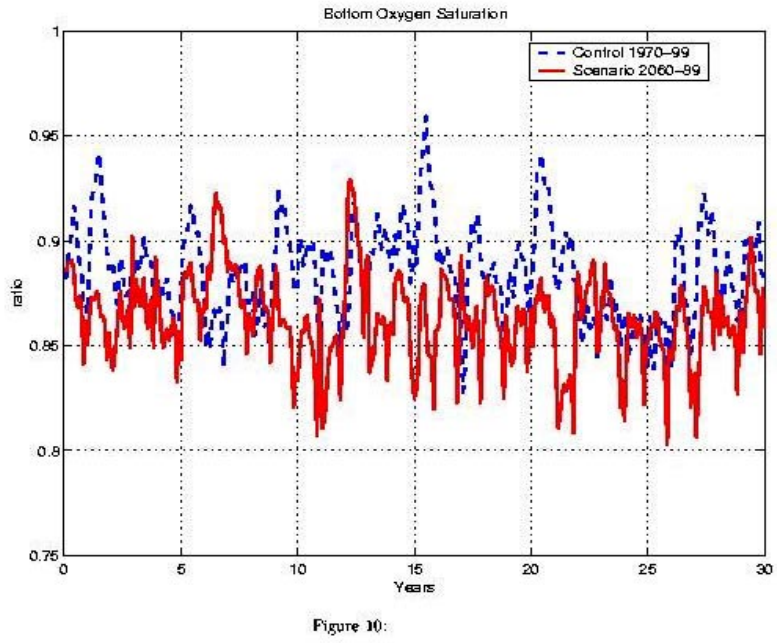

Figure 10:

Figure 17: Monthly mean values of the oxygen saturation at the bottom in the Control (dotted line) and Scenario (solid line) experiments carried out with the ecological model of the North Adriatic Sea. It is evident the lower oxygen content in the Scenario experiment.

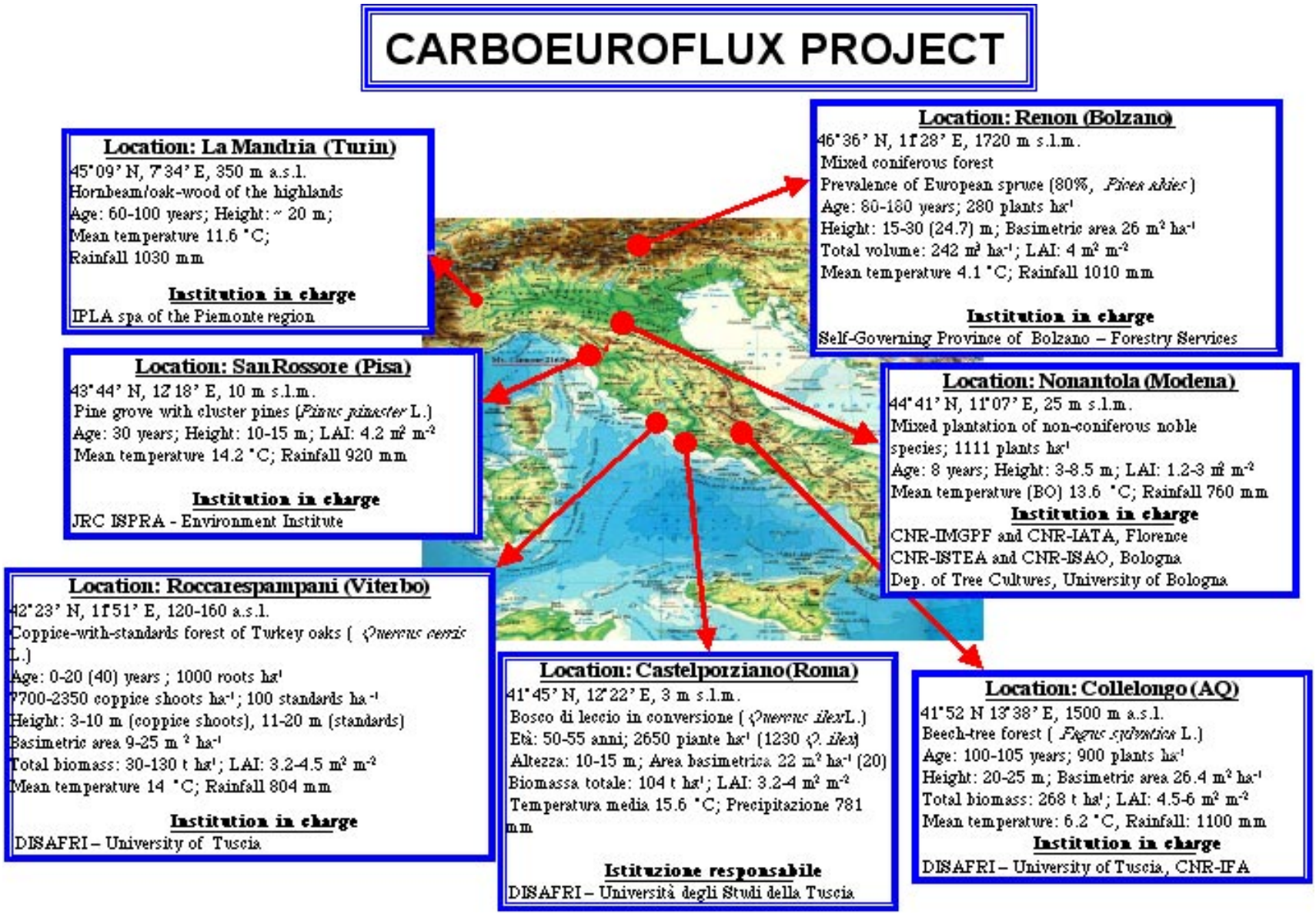

Figure 18: Italian sites of the CARBOEUROFLUX project.

Pecceta	foresta boreale a *Picea abies*	06 aree	*(spruce forest)*
Faggeta	foresta sub-atlantica a *Fagus sylvatica*	10 aree	*(beech forest)*
Cerreta	foresta medio-europea a *Quercus cerris*	05 aree	*(Turkey oak forest)*
Querceta	foresta acidofila a *Quercus petraea/robur*	02 aree	*(sessile/European oak*
Lecceta	foresta mediterranea a *Quercus ilex*	04 aree	*(holm oak forest)*

Figure 19: Geographical locations of the permenent areas of the National CONECOFOR network (green: ICP-IM sites; grey: areas to be set up).

CHAPTER IX
Education, training and public awareness

9.1. Environmental education in Italy

Environmental education has been defined in the Agenda 21, the strategic document prepared during the Earth Summit in Rio de Janeiro, in 1992. Following this definition, environmental education means "education for sustainable development which has been designed to explain the interrelations between the environment and the human activities", as for example economic activities, trade, agricultural and industrial production, and turism. Historical, economical and social factors play a key role in the management of environmental problems. Therefore, to obtain a comprehensive view of environmental issues, it is necessary to choose an integrated multidisciplinary approach, which helps to understand the interdependence of the physical and social environment.

The main objective of environmental education is to create a new sustainable development-driven model of cultural reference, which provides instruments to increase the environmental responsibility of citizens.
Education, both in schools and that of adults, plays an important role in fostering an eco-compatible behaviour. This applies to the actors of different political levels, the economic and social actors promoting more sustainable policies, production processes and consumption patterns.
Of particular importance is the application of environmental teaching to real contexts, which means that scholastic education must establish a close link with the surrounding territory, focussing primarily on problems affecting the local situation, which is part of the actual life experience of the students. Obviously, the focus on the local level has to be considered to be only the first step to increase the interpretative and critical capacities of the students, necessary to understand the environmental conditions of different geographical areas.

Along with the education, we must also take in consideration the world of information and communication, which is of fundamental importance for the promotion of programs or mechanism to increase the knowledge and awareness of the citizens with regard to new environmental challenges. The role of the media appears all the more important in the light of recent policy trends in the European Union, which are expressed in international treaties, designed to achieve a political governance model, able to serve as an expanded system of government that catalyses the resources and capabilities of the members of the community, calling for a higher level of participation from all the parties involved. This makes it possible to achieve negotiated solutions that tend to be more equitable than traditional ones, given that all the different interest groups have the same access to information and to the decision-making processes.
Within this context, the Aarhus Convention (the convention regards the access to information, public participation in decision-making and access to justice in environmental matters) represents a concrete international tool for the implementation of the principles of governance.

9.2. Climate change related activities of the Public Administration

9.2.1. The Deliberation of 21st December 1999 by the Interministerial Committee for Economic Planning

The deliberation of the *Interministerial Committee for Economic Planning* (no. 218/99 of 21 December 1999) contains the program for environmental information on climate change. The document has not yet been practically applied, given that it is part of a "package" of programs and initiatives related to the implementation of the Kyoto Protocol in Italy. The details of this package are currently being defined, in the wake of the Marrakech agreements. The deliberation of the *Interministerial Committee for Economic Planning*, in particular, identifies the

priority initiatives of the National Information Program on Climate Change for the three-year period 1999-2001:

1. Presentation and distribution of the ***"Second Assessment Report" (SAR) published by the IPCC (Intergovernmental Panel on Climate Change)***;
2. Presentation and distribution of the ***Kyoto Protocol and the programs and decisions of the European Union for its implementation***;
3. Presentation and distribution of the ***"Second National Communication of Italy to the Framework Convention on Climate Changes"*** and of the ***deliberation of the Interdepartmental Committee for Economic Planning of 19 November 1998, "Guidelines for National Policies and Measures for the Reduction of Emissions of Greenhouse Gases"***;
4. Presentation and distribution of the "***National Program for the Optimal Use of Agricultural and Forestry Biomass*** " from the ***"White Paper on the Optimal Utilisation of Renewable Energy Sources "*** and the ***"White Paper on Sustainable Mobility"***, based on the provisions of points 2.3, 2.4 and 2.5 of the resolution of the Interdepartmental Committee for Economic Planning of 19 November 1998;
5. Distribution of scientific information on the ***vulnerability of Italy in terms of future climate scenarios***;
6. Distribution of information on the ***energy efficiency of industrial processes and products, and of end uses***, in particular for:

a) Production and distribution of electric and thermal energy, as well as energy from biomass;
b) Standards of efficiency for home appliances, for lighting systems, air-conditioning and heating systems ;
c) Efficiency of different modes of transportation, as well as standards of specific efficiency for motor vehicles and motorcycles;
d) Efficiency of the various procedures for the recycling and disposal of waste;

7. Promotion of local information programs aimed to promote ***the best practices and techniques of energy-saving under the patronage of local government bodies***.

The resolution assigns to the Ministry of the Environment the responsibility for the implementation of these initiatives, which should have been concluded by the end of the year 2000, through the following actions:

- the organisation of a **service centre** at the ENEA, responsible for the preparation and distribution of information material in Italian language, subdivided by type of recipient, in agreement with the MIUR (Ministry of Education, University and Research);
- the presentation and distribution of texts in secondary schools and universities by 30 May 2001;
- the promotion of communication programs targeted at specific sectors by the press, radio and television;
- **coordination** of the initiatives referred to under points 5, 6, 7, in agreement with the Ministry of Industry and the MIUR, also through the signing of implementation agreements with universities, research organisations, regional governments, local and territorial government bodies, private enterprises and Non Governmental Organisations (NCOs).

9.2.2. The activities of the Ministry of Education

Courses for the education of scholastic personnel are organised on regional and provincial levels, as well as within the individual scholastic institutes. The realization of the majority of these courses has been assigned by the Ministry of Education to non scholastic organisations.
In 2001, for example, the National Technical Committee prepared a provisional list indicating 89 accredited organisations (only 2 of these, however, offer courses with environmental topics). As a result, the General Department of Education of the Ministry cannot supply the overall number of courses held, and in particular courses regarding environment issues. It may eventually be possible to procure this information on environmental activities in schools by running searches on the Internet sites of the regional and provincial scholastic offices and by contacting directly scholastic institutes. This situation corresponds to the indications of Directive no. 143 of the Ministry of Education on scholastic personnel for 2001. The directive stresses the importance of education of the teaching corps, especially during the current phase of the development of independence in teaching, organisation and research. In carrying out the training activities, considerations of functional independence and institutional decentralisation must be kept in mind. Within this context, the functions of the Central Administration are limited to the coordination and distribution of new types or training and assistance for pilot projects, including those held on local level.

As specifically regards courses on environmental issues , the Ministry of the Environment has officially acknowledged the training and educational activities carried out by numerous environmental organisations on issues such as: biodiversity, climate change, sustainable development, the raising of public awareness and measures against pollution.
Information on these activities has been collect-

ed in the "National Archive of Environmental Education" (ANDREA), developed under the implementing agreement signed by the Ministry of the Environment and the Ministry of Education in 1987 and renewed in 1996.
Without any intention of interfering with the autonomy of the local boards of education, it should nevertheless be noted that the Ministry of Education has no policy for promoting involvement of teachers, though a similar approach could prove extremely useful. The school could be the focal point for initiatives aimed to encourage eco-responsible forms of behaviour in families as well through the direct involvement of students, under the guidance of their teachers, in activities such as energy management in schools.

These objectives should be the central theme of the voluntary agreement between the Ministry of the Environment and the Ministry of Education.

9.2.3. Activities of the Government, the regional and local administration

The initiatives aimed to inform the public about climate change are occasional and can be mainly attributed to environmental associations and municipal organisations operating on the territory. There is no overall form of coordination for the determination of objectives involving information or the exchange of experiences currently underway.
Initiatives of interest promoted by the Ministry of the Environment, such as the campaign "Municipalities against the Greenhouse Effect", have not been subject to information campaigns, despite the fact that they received funding for the campaigns, and this has sharply reduced their potential outcome.

As for the regional, provincial and municipal governments, as well as the so-called intermediate organs (mountain communities, park authorities and water-basin authorities), they should work, beeng the organisations in closest contact with the citizens, to favour wide-ranging participation in discussion of the issues and in the specific choices which influence the emissions of greenhouse gases on a local level, through proposals that can include changes in lifestyles and economic strategies, always in accordance with the local perspective.

9.2.4. A number of initiatives of APAT and ENEA

The Gelso Database

APAT has established the **GELSO Database** for the local management of environmental sustainability. GELSO is **an online database on good practices** of local sustainability, which serves as an effective working tool for the Public Administration, business enterprises, environmental associations, technical experts, environmental consultants and citizens interested in the latest innovations in the field of sustainable development. Gelso is designed to promote good practices by serving as an incentive for a process leading towards sustainable local development through the support of exchange of information, participation at projects, integration and planning, as well as the publicising of innovative projects that have reached objectives of sustainability. The database may also give rise to a new way of understanding the administration of public affairs, in addition to providing an occasion for future partnerships between cities and towns or local actors. In short, the Gelso database represents an important instrument for the promotion of initiatives and activities in line with the climate policy.

The Living Museum of Environmental Technology

Among its activities designed to promote an increase in public awareness of climate change, issues the ENEA has established the first climate museum, which has been inaugurated in Arenzano in 2002.
The Living Museum of Environmental Technology is characterized by its innovative structure which leads the visitors through the different interactive sections of the museum entertaining them with multimedia games, scientific experiments and fascinating film shows.

ENEA contributed with its technical scientific support to the realization of the section "climate and energy" aiming to facilitate the understanding and the approach of issues that are considered difficult and complicated.
The aim is to explain to the public the meaning and the significance of "climate change" and "energy related issues". In this way, it should be easier to raise the awareness of unsustainable developments and of the related individual and collective responsibilities.

9.3. Climate change related activities of non-governmental organisations

The NGOs, together with other groups operating in Italy under the direct sponsorship of associations that deal with environmental matters, have assumed an important role in informing the citizens and promoting their partecipation in decisions about initiatives to mitigate the effects of climate change.

Reinforcement and financing, eventually through the supply of expertise, in support of campaigns designed to raise awareness, similar to those carried out by ICLEI, Climate Alliance and the Coordination of the Local Agenda 21, seem to be necessary.
In addition, NGOs have a fundamental role in defining programs aimed to promote energy savings,

the creation of sinks and changes in lifestyles. Synergy must be created between such programs and the general objectives to be defined for the purpose of implementing the Kyoto Protocol.

9.3.1. Activities involving education and the raise of awareness by NGOs

For years now, the leading environmental associations have placed climate issues at the centre of their activities.

The ecological footprint promoted by the WWF, for example, though its objective is to "calculate the availability of environmental resources per citizen", winds up addressing topics of energy and energy consumption that unquestionably play key roles in climate change policies.

For its part, Legambiente, or Italian Environmental League, proposes a new model for energy policy that tends to rationalise consumption and utilise alternative sources. Obviously, the results of such actions have repercussions on the reduction of greenhouse gas emissions.

The friends of the Earth are tackling the argument from two sides: on one side they build up a network, that should be able to influence the educational system and on the other side they are proposing measures designed to limit energy consumption.

The following paragraphs contain a summary of the NGO initiatives .

9.3.1.1. WWF- Italy

WWF-ITALY organised as part of the Climate Change Campaign of the International World Wild Fund for Nature during 1999 the following initiatives with the objective to raise public awareness:
22 Eco-Recommendations during the "Giro d'Italia" to Improve the Air quality: a pamphlet, containing 22 recommendations for reducing the reader's personal impact on the climate, has been distributed from a camper that followed the bicycle race in 1999. The eco-recommendations, one at each stage of the race held throughout Italy, were published in the **"Gazzetta dello Sport", a daily sports paper, and presented during the daily RAI public radio broadcast. Let's give the climate some breathing space, educational approaches leading to a sustainable future:** educational materials on the environment for elementary and secondary - school children, consisting of one notebook for the students and another for the teachers (1999).
A joint campaign with the National Transportation Federation on sustainable mobility: an advertising campaign during which posters were placed in the buses of a number of Italian cities to promote the use of public transportation (1999, 2000, 2001).
Exhibition on climate change: which consists of 8 panels depicting the situation, the terrestrial temperature, what is happening at present?, where does the energy we use come from? impacts, different scenarios, ecosystems in danger, the responses. The exhibition can be visited on the site www.wwf.it (2001).
The Greenhouse Planet, an agenda for action: a pamphlet on climate change distributed during public events. (2001)
Insertions in the newspaper "La Repubblica": prior to the COP6 in Bonn (July 2001)
Postcard campaign: postcards sent to the Prime Minister requesting the ratification of the Kyoto Protocol (2001)
Don't Let the Future of the Planet Go up in Smoke: a campaign of street posters, July 2001
Petition: calling for ratification of the Kyoto Protocol; signatures were also collected at the website www.wwf.it (2001)
Climate change and extreme meteorological events: by P. Vellinga and W.J. van Verseveld. A dossier published as an insertion in the magazine "Attenzione", issue no. 20, January 2001.
The fever of the planet is raising:: Summary of the 3rd Report of the IPCC, published as a dossier included in the magazine "Attenzione", issue no. 22, July 2001, in addition it has been distributed separately from the magazine.
In 2002, the following initiatives were planned by the association:
The Climate Bank: Establishment of an operating structure able to involve institutions, local government bodies, companies and Italian families in their efforts to reduce emissions of greenhouse gases and to deal with the problem of climate change. Major national enterprises in the energy industry have already agreed to participate at the initiative currently being planned.
Ethical fund for the climate: establishment of an investment fund involving companies and activities which permit significant reductions in greenhouse gases. Currently in an advanced stage of planning.
Seminar on the negative efect of the liberalisation of the energy market on the emission level: to be held in collaboration with the CNEL (National Council of Economy and Labour), based on a report which has been commissioned from the Eco-Institute of Freiburg by the European Policy Office of the WWF.
Report on Climate and Energy: which shall be published by the end of June 2002.
Initiative to raise public awareness in support

of renewable sources of energy
Kyoto Campaign: an international campaign by the WWF to raise the awareness of citizens and institutions regarding the need for prompt ratification of the Kyoto Protocol (first half of 2002).

9.3.1.2. Legambiente

In recent years, Legambiente, has undertaken numerous initiatives as part of a policy designed to defend the climate and the environment. A number of these, such as "Stop the Greenhouse Effect, Cure the Planet's Fever", together with the related petition, which was sent to the G8 in Genoa in July of 2001, were tightly focused efforts.
But attempts to achieve the objectives proposed under the Kyoto Protocol have also produced "fall-out" (and continue to do so) on less specific campaigns, such as *Green Train, Bad Air, Save-the-Art and Clean Waters.*
Noteworthy is the continuous monitoring of political activities, as well as ongoing protests against acts of the Parliament and the Government which are in contrast with the objectives of the Protocol. Naturally, these protests do not always lead to a reversal in policy, but at least they perform a key function: that of attracting the attention of the massmedia .

The initiatives undertaken in support of the climate and the Protocol are summarised below.

The campaign "climate and poverty"

The campaign consists of information initiatives, days of mobilisation and concrete acts of solidarity. The purpose of the campaign is to spread information on the consequences of climate change.
The increase in the greenhouse effect and the resulting risk of climate change is closely intertwined with poverty and issues development issues. Poor countries generate a small share of emissions of carbon dioxide and other greenhouse gases, but the effects of an increase in temperatures on the Earth — the progressive expansion of deserts and arid zones, increases in the incidence of endemic diseases, such as malaria — have an especially violent effect in the south, further undermining the already precarious living conditions of hundreds of millions of people who must already fight a daily battle against hunger, needs and illness. For this reason, underdevelopment is one of the factors that triggers activities such as deforestation, which only make the climate risk more acute.
Stopping the increase of the greenhouse effect is a necessary step to defeate poverty, and a step that must first be taken by the rich countries, which are responsible for the overwhelming majority of emissions that are changing the climate. To carry out a similar effort, reductions must be achieved in the consumption of oil and fossil energy sources (by far the principal cause of greenhouse-gas emissions) at the same time as the poorer countries have access to new technologies, necessary for a sustainable development.

DEAR OIL, OUR ENERGY PROPOSAL
The initiative planned by Legambiente involves activities aimed to stimulate increases in the capacity of renewable sources, with projections until 2002; innovations in the production of electric energy from fossil-fuel sources, as for example *macro-cogeneration* and *micro-cogeneration;* actions designed to change the underlying structure of the transportation system; increased use of biofuel especially in agriculture; activities in the construction sector.

9.3.1.3. Amici della Terra

Climate change: Since 1996 the Amici della Terra, a member of Friends of the Earth International (FoE) have been engaged in international and national campaigns against climate changes. In the course of these initiatives, their members have taken part in the highly visible and peaceful demonstrations organised by FoE International in the Hague (2000) and in Bonn (2001) in occasion of the two Conferences of the Parties of the United Nations Framework Convention on Climate Change (COP 6 and 6-bis). For these events ("The Dike" and "The Lifeboat"), the organisation has prepared and distributed press releases, information material and leaflets for the mass media and the public and dedicated a special sector on its website to this topic.
Starting in 2000, an environmental education effort was also undertaken for secondary schools. The project, entitled "***The Wager*** ", aims to instil in students a sense of responsibility for the energy consumption of their schools, with the objective of achieving at least an 8% reduction in CO_2 emissions in this sector, in line with the commitment of the European governments. A manual, specifically prepared for this initiative, allows teachers and students to determine what actions and initiatives should be taken, basing the decision on the evaluation of the potential of emissions reduction (the evaluation method has been developed in collaboration with ENEA). During the first year, the schools, which there participating at the project achieved CO_2 savings up to 17%.
Energy: The energy sector is an area where the Friends of the Earth Italy are particularly active.
The association prepared a study of evaluation of the advantages of cogeneration and district heating for

some municipalities in 2000 on behalf of the Lombardy Region. This activity is part of the European Project EASE (Alternative Energies for a Sustainable Europe), which has been implemented by the Friends of the Earth Europe with the support of GD 11 of the EU. More recently, the association has completed a new and significant research project that will be published soon. The project focuses on the use of hydrogen, which does not release greenhouse gases in the atmosphere and which unlike other renewable energy sources, is not affected by intermittences, as possible solution for the energy problem.

Transportation: In occasion of the campaign for sustainable mobility, three studies on the external costs of transportation in Italy, have been carried out in collaboration with the Italian State Railways. A fourth study has just been completed.

The same methodology (which considers external costs generated by CO_2, air pollution, accidents, noise and congestion) was applied to:

- evaluating the advantages of transporting freight by sea, carried out in collaboration with the Confitarma shippers' confederation;
- evaluating the advantages (in terms of air pollution) of the use of recycled aluminium for the construction of vehicles, performed in collaboration with the aluminium industry;
- evaluating a project for the expansion of the subway in Rome, promoted by the Province of Rome and the University of Rome, "La Sapienza".

Another campaign undertaken by the association involved the promotion of LPG (liquefied petroleum gas) for motor vehicles.

9.3.2. Associations of local environmental organisations

In Italy, there are operating some associations which declared climate initiatives as their specific objective. The Climate Alliance and the International Council for Local Environmental Initiatives (ICLEI), both part of an international network, are the most active associations in this sector. Their specific objective is the promotion of a network of cities and towns, both at national and international level, committed to undertake a series of activities ranging from information initiatives to the development of local energy planning in order to reduce the greenhouse gas emissions at urban level.
Nevertheless, many of the initiatives put forwards by the Italian coordinating committee for the local Agenda 21's include the establishment of a forum whose obiective is to increase public awareness on sustainability issues. Such action obviously has a positive impact on the supply of information regarding climate change as well. For its part, the Ministry of the Environment has promoted a public competition which is referred to in the section on institutions.

9.3.2.1. The Climate Alliance

The Climate Alliance, was founded in 1990. Its members are European municipalities and native peoples of rain forests. This organisation represents today, with the membership of approximately 1000 European municipalities, the largest network for the protection of the climate, acting on local level.
The objectives are expressed in the program and in the statute of the organisation, and they include, a 50% reduction of CO_2 emissions, a ban against using tropical woods and support for the native peoples of the Amazon in their efforts to defend the rain forests, the demarcation of their territories and the sustainable use of their territories.
The fields of activity include: energy, traffic, tropical wood, cooperation with native peoples, environmental training, protection of biodiversity and the Agenda 21. The main focus of the Alliance for the Climate are municipal initiatives and potential actions that can have a global effect.
Transferring experience and solutions is one of the primary tasks of the Alliance. The European and national coordinating committees promote direct exchanges of experience between municipalities in the course of national and international conventions and seminars. The wide-ranging research regarding the strategies and effects of municipal activities provides the information needed to public positive examples and positive strategies to recommend to its members.

In the field of climate change, the Alliance has developed the "Method Alliance for the Climate", together with a set of indicators. The Alliance has also developed a method of analysis and communication for dealing with the topic of climate change in various urban settings.

9.3.2.2. ICLEI (International Council for Local Environmental Initiatives)

Many cities and towns are responding to the problems of climate change by coordinating their efforts under the campaign "Cities for Climate Protection" promoted by ICLEI. The campaign is an innovative project that falls within the framework of the initiatives promoted by the Italian government for the implementation of the Kyoto Protocol, with the objective to assist local governments in their efforts to reduce emissions of greenhouse gases. Local government bodies can promote important initiatives to reduce effectively emissions of greenhouse gases in the fields of transportation, energy, waste

management and in the construction sector. Municipal administrations are able to influence activities which are responsible for almost 50% of the national greenhouse gas emissions.
The Italian campaign is realized in close collaboration with the European secretariat of the ICLEI, which coordinates the campaign "Cities for Climate Protection-Europe". In Italy the campaign is promoted and coordinated, by the Energy Agency of the City of Turin and, with regard to technical and scientific aspects, by the Energy Agency of the Province of Leghorn, both agencies are supported by the Ministry of the Environment and the Italian Institute of Environmental Research. The campaign shall supply the participating cities and towns with the technical support needed to create and manage their own registries of CO_2 emissions, in addition they are needed to provide assistance in developing municipal programs for the reduction of greenhouse gases. The campaign will make it possible to obtain from the participating cities and towns uniform data that can be used to set up comparisons.

9.3.2.3. Local Agenda 21's

The Italian coordinating committee for the local Agenda 21's is working with 331 municipalities and provinces from all over the national territory. It should be remembered that the initiatives contemplated for those endorsing the local Agenda 21's are undertaken on two levels.

The first level, which can be referred to as "technical", involves the elaboration of the state of the local environment. The second level, on the other hand, deals expressly with information, citizen participation and raising public awareness on issues regarding environmental sustainability. This subdivision was foreseen in the notification of the competitive procedure made by the Ministry of the Environment in 2001, and it was proposed once again in 2002 for the activities related to the development of the local Agenda 21's.

The coordinating committee of the local Agenda 21's has undertaken initiatives regarding climate changes, especially from the perspective of raising public awareness on this subject.
In the course of 2001, 5 projects with focus on the climate issue have been realized:
1. Climate change. Open Provinces (January 2001)
2. Climate Change Globally. The Municipalities Defend it Locally (Ancona, February 2001)
3. Towns and Cities against Climate Change: tools of action (Leghorn, February 2001)
4. Wetlands: integrated management (Comacchio, May 2001)
5. The Contribution of Urban Areas to the Kyoto Protocol (Genoa, June 2001).

APAT and ENEA, in collaboration with the coordinating committee of the local Agenda 21's, have proposed a survey, to be carried out with a questionnaire, on the activities, in which the topic of climate change has been addressed, planned and already performed during the last three years. The survey aims to measure the percentage weight of the climate in terms of the overall activities of the coordinating committee for the local Agenda 21's.

9.4. Mass media

The important role of the mass media in modern societies in informing the public about environmental risks is well known. Nevertheless, press and broadcasting prove unable to assume the role which, at least in theory, should be played by the media, that is that of spreading ideas. There are a number of reasons for this shortcoming:

- the relationship between the primary sources of information (for example, research institutes, scientists, technicians, government agencies etc.) and the mass media on these topics is lacking in terms of quality.

The difference in language between the journalists and the primary sources prevents an efficient transmission of the information: it is difficult for the journalist to present news of the environment and technology in a clear and understandable way:

- journalists have the tendency to concentrate on emergencies and not to treat environmental issues such as the problems related to the lack of sustainability in a in depth discussion.
- newspaper editors, as well as the directors of TV news, give the environment a marginal role in medium and long-term planning activities.

In the case of the daily press, these underlying motives are further exacerbated by using continually a TV type approach that, in practice, prevents more in-depth treatment of topics such as the environment.
All the above points regarding the role of the media in spreading information on topics related to climate change, underline the need to analyse the way newspapers and television deal with the subject of the greenhouse effect.
ENEA has undertaken a survey designed to analyse the behaviour of the media – newspapers, Internet and television – with regard to the greenhouse effect. Analyses are currently underway on the two most widely circulated national newspapers – **La Repubblica** and **Il Corriere della Sera**, for the period of 1999-2001. In the case of television, a census of all the transmissions which addressed the topic during the same period has been undertaken.

The objective is both quantitative, with regard to the percentage weight of the topic, and qualitative, with regarding to the way in which it is dealt with.
The analysis shall be performed by means of a questionnaire consisting of 27 questions designed to gauge the fundamental characteristics of each article:

1. morphological characteristics;
2. modes of presentation of the topic considered;
3. modes of communication.

The final goal of the research is to identify indicators for the quality of information transmitted to the general public on the topic of the greenhouse effect and environmental risks, so as to orient the sense and the direction of communications on the climate.

9.5. Conclusions

The raised awareness of the scientific aspects of climate change has not been reflected, in the organs of mass media, by a discussion of the relations between the phenomenon and the initiatives to be undertaken. In fact, the majority of the information on the environment is received from non-institutional organs, making it subject to interpretation. All too often, therefore, information on climate change is provided by international bodies, necessarily placing a distance between the subjects addressed and the state of matters in Italy.

In order to overcome these obstacles, priority must be given to the development of a detailed, non-technical review of the possible impacts of climate change on Italian territory, especially in terms of potential economic and social consequences. Examples include winter tourism in the Alps, farming in Southern Italy and frequent flooding in the northern part of the country.

The activities, promoted by the Ministry of the Environment, could be carried out by the national research agencies and organs that handle the topic. At the same time, the Ministry could sponsor initiatives designed to supply the public with information on climate change, given that such efforts are currently carried out on a sporadic basis and generally assigned to environmental associations and municipal agencies operating at local level.
There is no coordinating body in charge to set the goals for information while making an exchange of current experiences possible.

Interesting initiatives promoted by the Ministry of the Environment, such as the campaign entitled "Towns and Cities against the Greenhouse Effect", were not subject of information campaigns, and this reduced sharply their effectiveness.
Another topic is scholastic education. Though the independence of the local boards of education must be preserved, the Ministry of Education has no policy designed to promote involvement of teachers, despite the fact that this could prove extremely useful.

Schools could be the focus of initiatives for the popularisation of eco-responsible forms of behaviour within families through the direct involvement of students, under the guidance of their teachers, with possible initiatives including a sustainable energy management.
These objectives should be the central points of the voluntary agreement between the Ministry of the Environment and the Ministry of Education.

For their part, the regions, the provinces, the municipalities and the so-called intermediate bodies (mountain communities, park authorities and water-basin authorities) should attempt, to favour wide-ranging participation in decision making processes which influence emissions of greenhouse gases on a local level. This includes proposals for changes of lifestyle and the introductional economic activities, which are best suited to the territorial focus of these bodies, which should be familiar with such issues.

Therefore , it would appear necessary that programs regarding energy savings, sinks and changes in lifestyles are developed with precise, communicable objectives, especially by environmental associations. What is needed is synergy between these programs and the general objectives which have to be set for the implementation of the Kyoto Protocol.

International experience demonstrates that objectives of sustainability can be reached only in agreement with local populations. A significant example is the recent French legislation on "concertation".

Tools such as public debate on major public-work projects in France, negotiations in the Anglo-Saxon countries and focus groups in Germany are considered to be a basic ingredient in the hoped-for changes in the area of environmental sustainability.

These methods should be developed in Italy not only, as is currently being done, for items regarding specific delimitated areas, such a desertification, but also for global topics, such as climate change, in order to promote greater awareness of environmental risks.

The first step to be taken, as a direct result of the deliberation of the Interministerial Committee for

Economic Planning, addressed in the first part of this Text, is the establishment of a Permanent Observatory on Climate Change aimed to serve as the central source of reliable information for people who are working on climate issues and other professionally interested operators such as journalists.

The Observatory should:

- Collect informations in national and international media on the issue;
- Supply information on the activities of the central government and local government bodies regarding climate change;
- Supply information on Italian participation in negotiations on climate change and on the major scientific publications regarding the subject;
- Present updated reviews of scientific literature and of the results of international activities on the subject in a format suitable for increasing the spread of such information among the public;
- Provide support for institutions which intend to promote, on local level, activities designed to raise awareness of climate change.

Annex 1: Revised guidelines for national policies and measures regarding the reduction of greenhouse gas emissions (Law 120/2002)

The Interministerial Committee for Economic Planning

IN VIEW of Decision 93/389/CEE of the Council of the European Union, modified by Decision1999/296/CE establishing the monitoring mechanism for CO_2 and other greenhouse gases of anthropic origin within the Community;

IN VIEW of Communication COM (2000)88 of 8 March 2000 of the European Commission establishing the lines of development of European policies and measures for the implementation of the Kyoto Protocol, with particular reference to energy, transports, agriculture, industry and fiscal measures, as well as to scientific research, to the development of new technologies and to the use of flexibility mechanisms

IN VIEW of law 65 of 15 January 1994, ratifying the UN Framework Convention on Climate Change, made in New York in 1992, concerning the "stabilization of greenhouse-gas concentrations in the atmosphere to such levels as to prevent dangerous interferences of human activities on the climate system";

IN VIEW of Decision2002/358/CE of the Council issued on 25 April 2002, concerning the ratification, in the name of the European Community, of the Kyoto Protocol annexed to the UN Framework Convention on Climate Change, and the fulfilment of the relating commitments, establishing that Italy is bound to reduce greenhouse-gas emissions up to 6.5% with respect to the levels of 1990, within the period 2008-2012;

IN VIEW of decisions1513/2002 of the European Parliament and of the Council of 27 June 2002 providing for the adoption of the "Sixth Framework Programme of Community Actions of research, technological development and demonstration" identifying, among seven priority research themes included in the specific programme "Integrating and strengthening the European Research Area", the priority action for "Sustainable development, global change and ecosystems " (sixth priority), which also includes a series of research activities in the energy and transport sectors;

IN VIEW of decree law 112 of 31 March, providing for the transfer of additional duties and competences to the Regions and the Local Authorities, also concerning environmental and energy issues;

IN VIEW of law 388 of 23 December, providing for the establishmentof a "Fund for the reduction of atmospheric emissions and for the promotion of energy efficiency and sustainable energy sources" in article 110;

IN VIEW of decree law 227 of 18 May 2001 concerning "Guidelines and modernization of the forestry sector";
IN VIEW of law 39 of 1 March 2002 which delegates the Government to implement the Community Directive 2001/77/CE concerning the promotion of electricitygenerated from renewable sources on the domestic electricity market;

Annex 1: Revised guidelines for national policies and measures regarding the reduction of greenhouse gas emissions (Law 120/2002)

IN VIEW of law 120 of 1 June 2002, upon ratification of the Kyoto Protocol of the UN Framework Convention of Climate Change, with particular reference to article 2, paragraph 1, providing for the Minister of the Environment and Territory to present, in agreement with the Economics and Finance Minister and other involved Ministers, to the Interministerial Committee for Economic Planning, a national action plan for reducing the emissions of greenhouse gases and improving their removalwith the aim of reaching the objectives of emission reduction at the lowest cost;

IN VIEW of its own Deliberation137 of 19 November 1998 ratifying the "Guidelines for national policies and measures regarding the reduction of greenhouse-gas emissions";
IN VIEW of the following resolutions, in compliance of which this Interministerial Committee has approved the national programmes described hereunder, in agreement with the aforementioned Guidelines;
-"National Programme for the Valorisation of Agricultural and Forestry Biomasses" (resolution 217 of 21 Dec 99)
- "National Programme on Bio-fuels (PROBIO)" (resolution 27 of 15 Feb 2000)
- "National Programme on Information on Climate Change" (resolution 50 of 21 Dec 99)
- "National Programme on Climate Research" (resolution 226 of 21 Dec 99);
- "White Paper on Renewable Sources" (resolution 126 of 6 Aug 99);

IN VIEW of its own Deliberation35/2002 of 19 April 2002 ratifying the Government Guidelines on scientific and technological policies providing for the environmental, energy and transport sectors to be of great socio-economic relevance with reference to programmatic directions and priorities;

IN VIEW of Communication COM (2001) 581 of the European Commission, concerning the proposal of a directive to be issued by the European Parliament and the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and modifying directive 96/61/CE of the Council;

HAVING CONSIDERED the results of the Seventh Conference of the Parties to the Framework Convention on Climate Change (COP 7), held in Marrakech on 29 November 2001, where the Parties have taken steps toward the implementation of the Kyoto Protocol, and have:
a) reconfirmed the commitments of "Annex I" Countries (Industrialised Countries and Countries with Economies in Transition) for reducing the emissions of six main greenhouse gases not controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFC), Perfluorocarbons (PFC) and Sulphur Hexafluoride (SF_6);
b) established the unlimited resort to three flexibility mechanisms provided for by the Kyoto Protocol in order to support national interventions through joint actions to be undertaken by "Annex I" Countries (Joint Implementation - JI), or through co-operation activities with the "Non Annex I" developing Countries (Clean Development Mechanism - CDM), or through the international trading of emission credits (Emissions Trading - ET);
c) recognized the role of managing forest resources, farmlands and grazing lands and revegetation for achieving the objectives of the Kyoto Protocol, provided that these management activities are additional, result from human activities and that they have started after 1990. In particular, the limits to the useof credits resulting from forest management activities for each country have been fixed at 15% of the net increase of carbon reservoirs in managed forests. Such values are referred to in Annex Z of the political agreement of Bonn (COP6bis); with regard to Italy, such limit has been fixed at 0.18 Mt carbon per year (equivalent to 0.66 Mt of CO_2);
d) recognised, without any restriction, the role of carbon removalcapacity attainable through national afforestation and reforestation activities carried out from 1990 (basic year of the Kyoto Protocol), for reaching the objectives of the Kyoto Protocol;
e) recognised the role of afforestation and reforestation activities in the frame of the JI Mechanism;
f) recognised the role of afforestation and reforestation activities in the frame of the CDM, provided that such activities are additional and they have started after 2000. A 1% limit with respect to 1990 emissions is applied to such activities, which, for Italy, corresponds to about 5 MtCO_2.
IN VIEW of note GAB/2002/10007/C of 8 October 2002 and following its execution, the Minister of the Environment and Territory has transmitted the Plan provided for in art. 2, paragraph 1 of law 120/2002;

ACKNOWLEDGES
the programmatic reference framework of, outlined in the Plan preparedby the Minister of the Environment and Territory, and, in particular:

A. the values of greenhouse-gas emissions relating to the years 1990 and 2000, indicated in Tab. 1. The values have been estimatedin conformity with the data transmitted to the Secretariat of the UN Framework Convention on Climate Change and to the European Commission in the frame of Decision93/389/CEE of the Council, referred to in the premises:

B. the "trend" scenario of greenhouse-gas emissions, elaborated by assuming an average GNP growth of 2% and taking into account the measures that have already been implemented or, at least, established. According to this scenario, the emission levels to 2010 will be equal to 579.7 Mt CO2 eq. as referred to in Table 2;

Tab. 1 – GHG emissions in 1990 and 2000 by sector of emission.

	GHG Emissions [Mt CO_2eq.]	
	1990	2000
FROM ENERGY SOURCES, of which:	**424.9**	**452.3**
- Energy industries	147.4	160.8
- thermoelectric	*124.9*	*140*
- refinery (direct consumption)	*18.0*	*17.4*
others	*4.5*	*3.4*
- Manufacturing and construction industries	85.5	77.9
- Transportation	103.5	124.7
- Residential and tertiary	70.2	72.1
- Agriculture	9.0	9.0
- Others (fugitives, military, distribution companies)	9.3	7.8
FROM OTHER SOURCES	**96.1**	**94.5**
Industrial processes (mineral and chemical industry)	35.9	33.9
Agriculture	43.4	42.6
Waste	13.7	14.2
Others (solvents,fluorinated)	3.1	3.8
TOTAL	**521.0**	**546.8**

C. the measures identified on 30 June 2002 by the Ministry of the Environment and Territory, on the basis of the actions, the programmes and the initiatives undertaken by the sectors involved, to be carried out during the Plan, referred to in the following Table 3. The implementation of these measures should enable a greenhouse-gas emission reduction equal to 51.8 Mt CO2 eq./year in the period 2008-2012.

D. the reference scenario outlined by assuming an average GDP growth of 2% and taking into account the effects of the measures described in previous point C, as well as the implementationof projects aimed at reducing emissions in the frame of the JI and CD mechanisms. According to this scenario, the levels of greenhouse-gas emissions in 2010 will amount to 528.1 MtCO2eq. as indicated in Table 4;

Tab. 2 –"Trend" emission scenarios 2010

	Year 2010 (Mt CO_2 eq.)
FROM ENERGY SOURCES	**484.1**
- Energy industries, of which:	170.4
- thermoelectric	*150.1*
- refinery (direct consumptions)	*19.2*
- others	*1.1*
- Manufacturing and construction industries	80.2
- Transportation	142.2
- Residential and tertiary	
Residential andd and tert and tertiary Residential and tertiary	74.1
- Agriculture	9.6
- Others (fugitives, military, distribution)	7.6
FROM OTHER SOURCES	**95.6**
Industrial processes (mineral and chemical industries)	30.4
Agriculture	41.0
Waste	7.5
Others (solvents,fluorinated)	16.7
TOTAL	**579.7**

Tab. 3 – Specified measures included in the "reference" scenario

	Reduction (Mt CO_2/year)
Electric industry	**26.0**
Combined cycle expansion for 3200 MW	8.9
Import expansion capacity for 2300 MW	10.6
Further growth of renewable sources for 2800 MW	6.5
Civil	**6.3**
Decrees on the efficiency of end uses	6.3
Transportation	**7.5**
Buses and private vehicles running on fuels with low carbon density(LPG, methane)	1.5
- Optimisation and collectivisation systems for private transportation	
- Tax reformulation	
- Activation of computer-telematic systems	2.1
Development of national infrastructures and incentivization of combined road transport and coasting navigation	3.9
Total national measures	**39.8**
Carbon credits from JI and CD mechanisms	12
TOTAL MEASURES	**51.8**

Tab. 4 – "Reference" emission scenarios in 2010

	Year 2010 (Mt CO_2 eq.)
FROM ENERGY SOURCES	**484.1**
- Energy industries, of which:	170.4
- thermoelectric	*150.1*
- refinery (direct consumptions)	*19.2*
- others	*1.1*
- Manufacturing and construction industries	80.2
- Transportation	142.2
- Residential and tertiary	
Residential andd and tert and tertiary Residential and tertiary	74.1
- Agriculture	9.6
- Others (fugitives, military, distribution)	7.6
FROM OTHER SOURCES	**95.6**
Industrial processes (mineral and chemical industries)	30.4
Agriculture	41.0
Waste	7.5
Others (solvents,fluorinated)	16.7
TOTAL	**579.7**

Tab. 5 – Emission scenarios and reduction objectives in 2008-2012 established by Law 120/2002 (Mt. CO_2 eq.)

Trend scenario	579,7
Reference scenario	**528,1**
Emission target	487,1
Further reduction necessary for reaching the objective	41,0

Tab. 6 – Maximum national potential of carbon removal

	Removal (Mt CO_2 eq.)	Public investment (Meuro) 2004/2012
Art 3.4 of the Kyoto Prot.: Forest Management	4.1[1]	10
Art 3.4 of the Kyoto Prot.: Farmlands, grazing lands, revegetation	0.1	4.2
Art 3.3 of the Kyoto Prot: Natural reforestation	3.0	6.5
Art 3.3 of the Kyoto Prot.: Afforestation and Reforestation (old plants)	1.0	6.0
Art 3.3 of the Kyoto Prot.: Afforestation and Reforestation (new plants)	1.0	200[2]
Art 3.3 of the Kyoto Prot.: Afforestation and Reforestation (new plants) on areas subject to hydrogeological instability (Law 183/89)	1.0	300[3]
Total	**10.2**	**526.7**

Tab. 7 – Options for the adoption of additional emission reduction measures

	Potential reduction (Mt CO_2 eq /year)
A) OPTION FOR THE ADOPTION OF ADDITIONAL NATIONAL REDUCTION MEASURES	
Use of energy sources	
Industrial sector	
Replacement of industrial engines with high-efficiency engines with saving between 2-7,2 TWh	1-3.6
Replacement of the fleet of transformers	1.0
Standard COSFI with saving of 1 TWh	0.5
Cogeneration of small/medium size plants with production capacity between 10-20 TWh	0.8-1.5
Energy production from biogas generated by municipal waste and residuesof agricultural and agro-alimentary processing equal to 750 – 1.300 MW	0.9-1.9
Waste recycling in cement works	0.9-1.1
Renewable sources	
Increase in energy production from renewable sources between 500-1200 MW	1.5-3.1
Diffusion of thermal solar energy	0.2
Research and development in the photovoltaic sector with employment of "niche" products	0.1
Residential and tertiarysector	
Extension of decrees on end-use efficiency (MICA 24/4/01) and regional measures with savings between 1.5-2.9 Mtoe/year	3.8-6.5
Agricultural sector	
CO_2 reduction from energy consumptions	0.28-0.34
Transport sector	
- technological measures	
Replacement of circulating vehicles with low-consumption, low-emission vehicles (120 g CO_2/Km) with savings between 1.5-2.5 Mtoe	3.5-6
Gains in energy efficiency for heavy transport means with savings between 0,1-0,3Mtep	0.3-0.8
Up to 5% blendingof oil and bio-diesel used as fuels for motor propulsion	4
Revision of tax calculation method for vehicles and correlation with periodical overhauls	1.3
- infra-structural measures	
Reorganization of urban traffic	0.8
Promotion of regional railway networks and connections with exchange park areas	0.6
Urban mobility plans (PUM)	1.5-3
Telematic solution for transports	0.5
- research and development	
Pilot projects for the utilisationof hydrogen-propelled, and cell-combustion systems, for energy production, for railcars and for car engines	0.1-0.3
Experimental development and use of materials enabling to reduce vehicles and trains mass	0.2-0.6
Realisation and diffusion of direct-injection mono-fuel natural gasand mono-fuel GLP optimised engines	0.5-1.2
From other sources	
Industrial sector	
Reduction of N_2O emissions resulting from adipic and nitric acid production	6.20
Agricultural sector	
Reduction of CH_4 emissions from manure management	0.15-0.83
Reduction of N_2O emissions from agricultural soils	0.46
Waste	
Stabilization of the organic fraction	0.64
Others (solvents,fluorinated)	
Reduction of PFC emissions through aluminium recycling	0.05
Installation of abatement devices and adoption of low GWP substancesin the production of semiconductors	0.02
Reduction of HFC leaks from mobile air conditioners	0.65
Reduction of SF_6 leaks from electrical equipment	0.04
B) OPTIONS FOR THE USE OF THE JI AND CDM MECHANISMS	
- Carbon removal	
JI projects	2-5
CDM projects	3-5
- Projects in the energy sector	
JI Project to improve the efficiency of electricity generation and industrial activities	3-10
CDM projects for the production of energy from renewable sources	1-5
CDM projects to improve the efficiency of electricity generation and industrial activities	1.5-3
JI and CDM gas-flaring and gas-venting projects in oil wells	10-20

D E C R E E S

1. The National Action Plan preparedby the Ministry of the Environment and Territory, in compliance with art. 2 of law 120 of 1 June 2002 aimed at reducing greenhouse-gas emissions and improving their removalis approved and it is annexed to thisDeliberation.

2. Maximum emission levels assigned to each sector for the period 2008-2012, calculated as average yearly emissions as of Table 8, are established in conformity with the reference scenario, that is to say, on the basis of the results attainable through the implementation of the measures established on 30 June 2002 and through the implementation of actions, programmes and initiatives in the sectors of electricitygeneration, transportation, energy consumption in the residential and tertiary sector as well as in the international co-operation sector.

Tab. 8 – Maximum GHG emission levels for the period 2008-2012 (Mt. CO_2 eq.)

	1990 emissions	Max GHG emission levels 2008-2012
ENERGY USES, of which:	**424.9**	**444.5**
- Energy industries	147.4	144.4
- thermoelectric	*124.9*	*124.1*
- refinery (direct consumptions)	*18.0*	*19.2*
- others	*4.5*	*1.1*
- Industry	85.5	80.2
- Transportation	103.5	134.7
- Residential and tertiary	70.2	68.0
- Agriculture	9.0	9.6
- Others (fugitives, military, distribution)	9.3	7.6
NON ENERGY USES	**96.1**	**95.6**
Industrial processes (mineral and chemical industry)	35.9	30.4
Agriculture	43.4	41.0
Waste	13.7	7.5
Others (solvents,fluorinated)	3.1	16.7
TOTAL	**521.0**	**540.1**

3. The establishment of a Technical Committee on Greenhouse-Gas Emissions (CTE), chaired by a representative of the Ministry of the Environment and Defence of the Territory and composed by the representatives of the Ministries of Economics and Finance, Production Activities, Infrastructures and Transports, Agricultural Policies, Education, University and Research, Foreign Affairs and Regional Affairs as well as by the Conference of Regional Presidents. Before 30 September of each year from 2003, this Technical Committee on Greenhouse-Gas Emissions will:
3.1 arrange, in conformity with the information provided by the administrations involved, a report on the state of implementation of the measures specified in point 2, and on the trend of emission levels compared to the levels included in the reference scenario; furthermore, it is bound to formulate possible modifications to maximum emission levels established in Table 8, in agreement with the progresses already made or to be made to comply with the commitments established in law 120/2002, to be sub-

mitted to the aforementioned Commission for examination enabling further evaluations and calculations by this Committee;
3.2 propose, having taken into account the pilot projects specified in art. 2 paragraph 3 of law120/2002 and the options for obtaining further emission reductions as of Tab. 7 – to be confirmed on the basis of specific feasibility and cost/benefit analyses to be carried out by the administrations involved – to the Commission for Sustainable Development instituted by this Committee, a programme of additional measures necessary to comply with the objective specified in law 120/2002.

4. Within October 30th of each year, in conformity with the results of the activities carried out by the Technical Committee on Greenhouse-Gas Emissions, the Minister of the Environment and Territory proposes to this Committee the adoption of additional measures necessary to comply with the objective specified in law120/2002, having taken into account the priority criterion of reaching the best result at the lowest cost.

5.In order to ensure the promotion and the co-ordination of the projects carried out in the frame of the JI and CDM mechanisms as well as the Italian participation to the international and Community emissions trading (ET), the Ministry of the Environment and Territory, will have to take measures to organize, using ordinary human and instrumental resources, its own offices in such a way as to enable, in agreement with the Ministries of Production Activities, Agricultural and Forestry Policies, Foreign Affairs and Economics and Finance:

- the arrangement, within 31 May 2003, of the census of the Italian public and private initiatives, already accomplished or under execution, in the "Annex I" countries and in the Developing Countries, capable of generating emission credits, according to the decisions taken at Community and international level;
- the starting, before 30 June 2003, of registration procedures at the competent institutions stipulated under the Framework Convention on Climate Change, of the projects that have already been implemented or are in progress, with the aim of issuing the emission credits;
- the starting, before 30 June 2003, of preliminary activities enabling the Italian companies to take part to the international and Community trading of emission credits;
- the promotion of additional projects in the frame of the JI and CDM mechanisms, with the aim of reaching the best possible result in terms of generation of emission credits at the lowest incremental cost. To this end, the Ministry of the Environment and Territory shall provide full access to the Italian enterprises to complete and updated information systems showing all the opportunities offered by the JI and CDM mechanisms on possible incentive mechanisms provided for the national provisions and on possible funds made available by the World Bank, the Global Environment Facility, the Regional Development Banks, the European Investment Bank, as well as funds provided by International Financial Institutions;

6. To the purpose of enabling the sectors to comply with the emission levels specified in Table, they will be allowed resorting to the mechanisms provided for by the Kyoto Protocol and to the trading of emission credits within the Community, in conformity with the decisions taken at international, Community and national levels.

7. Further emission reductions can be achieved through afforestation and reforestation activities, management of forest resources, farmlands and grazing lands and revegetation according to point G of Table 6 annexed this document.
7.1 Before 30 April 2003, the Ministry of the Environment and Territory, in agreement with the Ministry of Agricultural and Forestry Policies and with the Conference of State-Regions, presents to this Committee the detailed plan referring to the first three-year period 2004-2006, for the realization of the national activities specified in Table 6 in the frame of public resources purposely devoted.
7.2 Before 30 July 2003, the Ministry of the Environment and Defence of the Territory, in agreement with the Ministry of Agricultural and Forestry Policies, takes measures to identify among the regional, national and international provisions in force in Italy from 1990 to date, all regulations contemplating the defence of the Italian forest stand, with the aim of certifying "natural reforestation" activities carried out on the national territory in the period 1990-2012, as a direct consequence of human activities and, consequently, eligible to the purpose of achieving the emission reduction objective established by law 120/2002.
7.3 Before 31 May 2005 the Ministry of Agricultural and Forestry Policies, in agreement with the Ministry of the Environment and Territory, prepares the National Forestry Inventory on Carbon and other Carbon Reservoirs in order to start the procedure to revise the limit of use of the credits deriving from the mana-

gement of forest resources, assigned to Italy
7.4 Before 31 December 2006, the Ministry of Environment and Territory, in agreement with the Ministry of Agricultural and Forestry Policies, prepares the National Register of agro-forestry carbon reservoirs, in order to certify the carbon flows deriving from the sectors of afforestation, reforestation, deforestation, forest management, management of farmlands and grazing lands and revegetation from 2008 to 2012.

8. By the year 2003, the expenses resulting from the implementation of items included in points 7.3 and 7.4 of this resolution will be coped with using the budget appropriations provided by the Ministries involved.

9. As from 2003, in arranging the yearly Document of Economic and Financial Planning (DPEF), the Ministry of Economics and Finance will include a section devoted to this Plan, including the necessary tools for reaching the established objectives.

10. The implementation of the interventions included in the Plan will be guaranteed, for the part within the jurisdiction of the State, within the limits of the resources available, devoted to the relating budget documents.

1 The parameter takes into account the revision contemplated in resolution 11 of COP 7
2 Total cost of investment against which, at the end of the plant operation period, it will be possible to generate carbon credits equal to 20 Mt CO2 (the removal capacity indicated in the table refers to 2008-2012). The investment also includes resources committed to Community planning activities for 2000-2006
3 Total cost of investment against which, at the end of the plant operation period, it will be possible to generate carbon credits equal to 10 Mt CO2 (the removal capacity indicated in the table refers to 2008-2012)

Annex 1: Revised guidelines for national policies and measures regarding the reduction of greenhouse gas emissions (Law 120/2002)

Annex 2: Mitiligation and adaptation adopted in Italy since 1998

NOTE: The present table indicates, in chronological order, the national initiatives taken to **adapt** to climate change and to **mitigate** emissions of greenhouse gases. The main initiatives classifiable as adaptation efforts are considered from the year 1985 on, while 1998 is the year from which mitigation initiatives are considered.

The following ***Legend*** should be used in reading the table.

Sector		**Type of initiative**	
Inter-sector	*IS*	*Mitigation*	*M*
Agriculture and Forests	*AF*	*Adaptation*	*A*
Energy	*E*		
Industry	*I*		
Transportation	*T*		
Waste	*R*		
Air	*A*		
Water Resources	*RI*		
Land and Subsoil	*SS*		
Nature and Landscape	*NP*		

Sources:

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- Second Reporting Process on UNCCD Implementation – Italy – National Report for 2002
- Various official Internet sites (Parliament, the Ministry for the Environment and Territory, the Ministry of Production activities ENEA etc..)

Edited by: Orietta Casali and Simonetta Pasqualini

Date	Type of law	TITLE	Responsibility of	Notes	Sector	Type of initiative
1985-08-08	Law 431	Conversion into law, with modifications, of Decree 312 of 27 June 1985 regarding urgent measures for the safeguarding of zones of particular environmental interest	Ministry of Cultural and Environmental Resources	This is one of the most important laws for the protection environment. It is a package law potentially able to cover all instances of aggression against the environment. It serves as a systematic link which, in addition to protection the territory as part of an initial response, makes it possible to establish a common logical-operative denominator with all the remaining environmental measures.	SS NP RI	A
1989-05-18	Law 183	Norms for the organisational and functional reformulation of the defence of the land	Ministry of the Environment	Framework measure on the subject of the land protection, the management of water resources and the protection of environmental. Has restructured the system of jurisdictions in the sector of the environment. Sets the roles and responsibilities of both central and local entities. Establishes the jurisdictions of the Ministry of Infrastructures and Transportation and of the Ministry of the Environment and the Territory. National technical services are reorganised, and basin authorities are established. The entire national territory, including the smaller islands, is divided into national, inter-regional and regional basins. The basin authorities must draw up the basin plan, an informative, regulatory and technical tool used to plan and program initiative and norms of use to preserve, protect and upgrade he land as well as the proper use of water, based on the physical and environmental characteristics of the territory.	RI SS NP	A

1994-01-05	Law 36	Measures regarding water resources	The Ministry of the Environment and Territory The Ministry for Public Works	Governs the utilisation of water resources, stipulating that the use of water must be geared towards saving and renewing resources, in order to avoid jeopardising water stocks, the quality of life within the environment, agriculture, aquatic fauna and flora, geo-morphological processes and the hydro-geological balance. Devolves to the regions identification of the Optimal Territorial Settings (ATO) for the management of water services according to criteria of operating and economic efficiency.	RI	A
1997-09-08	Presidential Decree 357	Regulations for the implementation of Directive 92/43/EEC regarding the preservation of natural and semi-natural habitats, as well as wild flora and fauna.	Ministry for the Environment and Territory	Governs the procedures for the adoption of the measures contemplated under the “Habitat” Directive, 992/43/EEC, regarding the preservation of natural and semi-natural habitats, as well as wild flora and fauna, for the purpose of safeguarding biodiversity through the preservation of natural habitats.	NP	A
1998-03-09	Presidential Decree 107	Regulations containing measures for the implementation of Directive 92/75/EEC regarding information on the energy consumption of home appliances.		Requires that consumers be informed of the energy consumption of appliances, reduce energy consumption.	E	M
1998-04-30	Legislative Decree 173	Measures regarding the limitation of production costs and the structural reinforcement of agricultural enterprises, in accordance with art. 55, paragraphs 14 and 15, of Law 449 of 27 December 1997.		Establishes the general rules, as well as the procedures for the tto grant and take direct of direct action in accordance with national and European-Union policies in the sectors of agriculture, energy and the environment, in line with the Kyoto Commitments of 11 December 1997 involving the production and use of biomass for energy purposes and the spread and use of renewable energy sources in agricultural and agro-industrial sectors.	IS	M

1998-06-18	Law 207	Ratifies and implements the protocol to the 1979 convention on long-distance, cross-border pollution, calling for a further reduction in emissions of sulphur, with appendices, drawn up in Oslo on 14 June 1994.			IS	M
1998-08-03	Law 267	Conversion into law, with modifications, of Legislative Decree no. 180 of 11 June 1998, containing urgent measures for the prevention of hydro-geological risk and in favour of areas struck by landslide disasters in the Campania Region.	Ministry for the Environment and Territory	Programs are approved for urgent initiatives in the most vulnerable hydro-geological zones. These programs are determined by the Government, through a Committee established by the Prime Minister's Office for the purpose, based on the proposals drawn up by the Region and by the Basin Authority	SS RI	A
1998-10-19	Law 366	Measures for the financing of cycling mobility			T	M
1998-11-19	Resolution 137/98	Guidelines for policies and national measures for the reduction of greenhouse gases	Inter-Ministerial Committee for Economic Planning	Ensures that cycling lanes are created and that inter-modal transportation is established together with train travel and public or publicly licensed transportation Contains the six national initiatives for emissions reduction: - increasing the efficiency of the pool of thermoelectric facilities - reducing energy consumption in the transportation sector - increasing energy production from renewable sources - reducing energy consumption in the industrial, residential and service-sectors - absorption of CO2 emissions by forests - reduction of emissions in non-energy sectors	IS	M
1998-12-09	Law 426	New environmental initiatives	Ministry for the Environment and Territory	Calls for initiatives involving the environmental restoration and reclamation of polluted sites, including land and bodies of water in sea, lake, river and lagoon areas, under government authorisations, or eventually following their divestiture. Twenty-year spending limits are authorised at 27 billion Lire starting from 1998, 5.6 bil-	IS R	M A

				lion Lire starting from the year 1999 and 16.2 billion Lire starting from the year 2000. An amount of 130 billion Lire for the year 2000.		
1998-12-15	Law 464	Ratification and implementation of the convention on preparatory measures and initiatives designed to fight pollution from hydrocarbons, as well as cooperation in this sense, together with the final document and resolutions, included as annexes, drawn up in London on 30 November 1990			IS	M
1998-12-23	Law . 448, tied to the 1999 budget law	Public financing measures to promote stabilisation and development	Ministry of Finance, Ministry for the Environment and Territory	Art. 8 ("Carbon Tax"): Reformulate the taxation of energy consumption originating from fossil fuel, so as to avoid increasing overall tax pressure through compensatory measures (involving sectors, such as incentives for the reduction of polluting emissions, or increasing energy efficiency and the use of renewable sources of energy) Art. 31: authorises the municipal authorities to adopt, on an experimental basis, a tax on solid urban waste in order to pay for the service, as an alternative to the fee schedules of 1998.	E R	M
1999-02-19	Resolution 9/99 of the Inter-Ministerial Committee for Economic Planning	Distribution of the 1998 funds referred to under art. 1, paragraph 3, of Law no. 423/1998 for public initiatives in the sectors of agriculture and forestry.		Allocates funds for organic agriculture.	IS	M
1999-02-19	Resolution 12 of the Inter-Ministerial Committee for Economic Planning	Distribution among the regions and the autonomous provinces of Trent and Bolzano, for the year 1998, of the funds referred to under articles 8, 10 and 13 of 9 January 1991, containing rules and regulations for the implementation of the national energy plan regarding the rational use of energy, as well as energy savings and the development of renewable sources of energy			E	M

1999-02-25	Resolution 27	Procedure for controlling fulfilment of the pre-condition of similarity to a renewable source in order to receive the economic treatment contemplated under resolution no. 6/92 of the Inter-Ministerial Committee for Planning.	Authority for Electricity and Gas		E	M
1999-03-16	Legislative Decree 79	Implementation of Directive 96/92/EC containing common rules and regulations for the internal market for electric energy	The Ministry of Industry, the Authority for Electricity and Gas, ENEL SpA	The decree contemplates mechanisms and provisions which can favour programs and initiatives for the reduction of greenhouse gases, including: art. 11, paragraphs 1, 2 and 3: obligation of producers and importers of non-renewable energy to include in the their supplies to the energy system a share of 2% produced by renewable sources, with the possibility of purchasing such energy, from other producers; art. 11, paragraph 2: the exemption of electricity produced through cogeneration from calculation of the share accounting for the 2%; art. 11, paragraph 4, art. 3, paragraph 3: dispatching priority given to energy from renewable sources and cogeneration; art. 4, paragraph 2: commitment by the Grid Regulator “to guarantee the diversification of energy sources, eventually through the implementation of renewable energy and energy produced through cogeneration”; art. 9, paragraph 1: obligation for distribution companies to draw up “measures for increasing the energy efficiency of the final uses of energy, based on quantitative criteria”.	E	M

1999-03-26	Law 107	Ratification and implementation of the agreement between the government of the Italian Republic and the Secretariat of the Convention of the United Nations to combat desertification, enacted in Paris on 14 October 1994, and the FAO, for the first conference of the parties to the convention, held in Rome on 30 June 1997.			IS	A
1999-04-08	Ministerial Decree 322	Regulations updating the ministerial decree of 21 March 1993 regarding the standards for the hygiene of packaging, recipients and utensils that come into contact with foodstuffs or with substances meant for personal use.	Ministry of Health		R	M
1999-04-19	Ministerial Decree	Approval of the Code of Proper Agricultural Practices.	Ministry for Agricotural and Forestry Policies Ministry for the Enviroment and Territory	The Code complies with EEC Directive no. 676/91 on the protection of water from nitrate pollution originating from farming activities.	AF RI	M
1999-04-21	Ministerial Decree 163	Regulations governing the determination of the environmental and health-care criteria on the basis of which mayors adopt measures for limiting traffic.	Ministry for the Environment, and Territory Ministry of Health	The regulations indicate the environmental and health-care criteria on the basis of which mayors of municipalities with more than 150,000 residents, as well as municipalities with fewer residents but high levels of pollution, adopt measures limiting the circulation of traffic in urban areas.	T	M
1999-04-27	Presidential decree 158	Regulations governing the formulation of the normalised method for setting the fee for the management of the cycle of urban waste.	Ministry for the Environment and Territory		R	M

1999-05-11	Law 140	Standards governing production activities.		Art. 6: Measures on refinancing and the extension of incentives. The incentives for the purchase of new mopeds and motor vehicles are extended.	T	M
1999-05-13	Ministerial Decree	Endorsement of Directive 98/77/EC, which was issued by the Commission on 2 October 1998 to bring in line with subsequent technical progress Directive 77/220/EEC of the Council regarding air pollution from the emissions of motor vehicles.	Ministry of Transportation and Navigation		T	M
1999-05-15	Legislative Decree 152	Measures on the safeguarding of waters from pollution and endorsement of Directive 91/271/EEC on the treatment of urban waste waster, as well as of Directive 91/676/EEC on the protection of water from pollution caused by nitrates originating from agricultural sources, following the corrective and supplementary measures contained in Legislative Decree no. 258 of 18 August 2000.	Ministry for the Environment, and Territory Ministry of Public Works, Ministry of Agricultural Policies	Sets the general rules for the protection of surface, marine and underground waters. In articles 2 and 3 of art. 20 the regional governments and the basin authorities are assigned the task of controlling, in the territories under their jurisdiction, whether there exist areas subject to or threatened by instances of drought, deterioration or desertification, designating them as “areas vulnerable to desertification” and adopting specific safeguards to protect them.	AF RI R	A M
1999-05-21	Memorandum 111	Tax for the processing of urban and similar refuse. Modifications of art. 1 of Law no. 426 of 9 December 1998, art. 31 of Law no. 448 of 23 December 1998 and art. 1 of Legislative Decree no. 8 of 26 January 1999, converted into Law no. 75 of 25 March 1999.	Ministry of Finance		R	M
1999-05-22	Legislative Decree 209	Implementation of Directive 96/59/EC on the disposal of polychlorobipehyls and polychlorotriphenyls	Ministry for the Environment and Territory		R	M

1999-05-27	Law 177	Endorsement by the Italian Republic of the protocols amending the conventions of 1969 and 1971 regarding civil liability for damages resulting from pollution by hydrocarbons, plus the establishment of an international fund to provide indemnities for such damages, adopted in London on 27 November 1992, plus their enactment.			IS	M
1995-05-28	Decree	Granting of loans to local government bodies by the Italian Savings and Loan Institute for the financing of environmental initiatives, as per Law 426 of 9 December 1998.	Ministry forthe Environment, Ministry of Transportation, Ministry of Treasury	Granting of financial aid for the purchase of vehicles with low or zero emissions to public authorities and private companies that supply public services in urban areas with more than 150,000 residents.	T	M
1999-06-08	Resolution 81	Updating of the prices for the sale of electric energy and the subsidies granted for new energy produced by plants utilising renewable and similar sources of energy, as per the provisions of art. 20, paragraph 1, and art. 22, paragraph 5, of Law no. 9 of 9 January 1991.	Authority for Electricity and Gas		E	M
1999-06-30	Memorandum 708	Implementation of Decree 163, issued on 21 April 1999 by the Ministry of the Environment, acting in concert with the Ministry of Health, for the "identification of the environmental and health-care criteria on the basis of which mayors adopt criteria limiting traffic".	Ministry for the Environment, and Territory Ministry of Health	Regulations are issued for: - the procedures and operations necessary for mapping concentrations of benzene, polycyclic aromatic hydrocarbons and the PM 10 fraction of suspended particles in the municipal territory, based on the levels indicated in the laws currently in force; - the criteria for determining the measures planned for the limitation prohibition of traffic on account of pollution from urban traffic.	T	M

1999-08-04	Legislative Decree 351	Implementation of Directive 96/62/EC on the evaluation and management of air quality.			A	M
1999-08-04	Legislative Decree 372	Implementation of Directive 96/61/EC on the integrated prevention and reduction of pollution.		Contains measures designed to prevent or reduce emissions in the air, water and soil, including wastes, for the protection of the global environment.	IS	M
1999-08-06	Resolution 157 of the Inter-Ministerial Committee for Economic Planning	Law 183 of 16 April 1987: financing of the program of initiatives regarding the protection of forests against fires for the year 1999, as per EEC Regulation no. 2158/92, modified by EC Regulation no. 308/97.	Ministry for Agricultural and Forestry Policies and Regional Governments	Financing of ten projects approved by the European Commission for the protection of forests from fires.	AF	M, A
1999-08-06	Resolution 126 of the Inter-Ministerial Committee for Economic Planning	White Book on the energy optimisation of renewable sources.	Ministry of Production Activities	Approves the White Book which identifies specific objectives to be reached for each source and outlines appropriate strategies and approaches.	E	M
1999-09-11	Ministerial Decree 401	Regulations governing the measures for the implementation of art. 1, paragraphs 3 and 4, of Legislative Decree no. 173 of 30 April 1998 on the granting of aid in favour of the production and utilisation of renewable energy sources in the agricultural sector.	Ministry for Agricultural and Forestry Policies	Sets general rules and procedures for the endorsment of external measures into national legislation for the purpose of granting aid and taking direct action in line with national and European policies in the sectors of agriculture, energy and the environment, as well as the commitments made at the Kyoto Conference on 11 December 1997 regarding the production and use of biomass for energy purposes and the spread and use of renewable sources of energy in the agricultural and agro-industrial sectors.	AF E	M
1999-10-14	Law 403	Ratification and implementation of the Convention for the Protection of the Alps, Salzburg 7 November 1991.	Ministry of Foreign Affairs		IS T	A M

1999-12-20	Ministerial Decree	Implementation of Directive 97/68/CE of the European Parliament and Council of 16 December 1997 regarding measures to be adopted against the emission of gaseous pollutants with particular reference to polluting particles produced by internal combustion engines designed for installation on non-roadway mobile machines	Ministry of Transport and Navigation		T	M
1999-12-21	Resolution 218 of the Interministerial Committee for Economic Planning	National programme on information on climate change: Priority initiatives	CIPE		IS	M A
1999-12-21	Resolution 299 of the Interministerial Committee for Economic Planning	National programme against drought and desertification	CIPE		IS	A
1999-12-21	Resolution 226 of the Interministerial Committee for Economic Planning	National programme on climate research. Priority research themes	CIPE		IS	M A
1999-12-21	Presidential decree 551	Regulation bearing modifications to Presidential decree 412 of 26 August 1993 regarding the designing, installation, management and maintenance of thermal plants in buildings, to the aim of limiting energy consumptions	Ministry of Industry ENEA		E	M
1999-12-23	Law 488	Instructions for the preparation of the national yearly and multiyear budget		Art. 33: regulations on management of urban-waste stocks Art. 59: development of organic farming	AF R	M
1999-12-23	Law 499	Intervention rationalization in the agricultural, agro-alimentary, agro-industrial and forestry sectors		Finances forest interventions within the general frame of agricultural policies	IS	M
2000-01-25	Ministerial Decree	“Ecological Sundays”	Ministry for the Environment and Territory	Co-financing of projects designed to heighten public awareness of sustainable transportation, plus initiatives designed to reduce the impact of urban traffic while promoting systems of sustainable transport.	T	M
2000-01-26	Ministerial Decree	Identification of costs involving the electricity system. Citizens awareness and supply of information on ecological Sundays.	Ministry of Production Activities	Art. 11: creation of a research fund for activities involving technical and technological innovation of interest to the electricity sector in general.	E	M

2000-01-26	Ministerial Decree		Ministry of Production Activities	Within the context of this initiative, under which the participating municipalities place restrictions on private traffic, the Ministry of the Environment co-finances projects proposed by municipalities and by consortiums of municipalities for the purpose of heightening awareness among the general public of sustainable transport and ensuring the success of the effort.	AF	M A
2000-02-15	Resolution 27 of the Inter-Ministerial Committee for Economic Planning	Approval of PROBIO national "bio-combustible fuel" program.	Ministry for Agricultural and Forestry Policies	The objective of the program is to carry out demonstration activities on a territorial basis for the purpose of motivating local authorities, agricultural enterprises and producers to engage in the development of bio-combustible fuels.	AF	M
2000-02-17	Ministerial Decree	Financing of the "Ecological Sundays" initiative	Ministry for the Environment and Territory	Financing of programs designed to: - create or complete integrated public transportation systems with low or zero emissions, including electric and/or hybrid vehicles, fuelled by natural gas or LPG, with bio fuels, including motorcycles and bicycles running on assisted or pedal locomotion; - regulate and control downtown urban traffic through computerised systems charging roadway fees. - promoting the use of fuels with low environmental impact.	T	M
2000-02-17	Memorandum 25	Tax for the disposal of domestic solid urban waste. Art. 33 of Law no. 488 of 23 December 1999. Clarification of deferral of the timing for operational implementation of the fee, as per art. 499 of Legislative Decree no. 22 of 5 February 1997.	Ministry of Finance	Law no. 488 of 23 December 1999, article 33 (2000 Budget Law) has modified Legislative Decree no. 22 of 5 February 1997, article 49 – regarding the establishment of the "Ronchi charge" for the management of urban waste – Presidential Decree no. 158 of 27 April 1999 – on the formulation of a standard method for determining the charge.	R	M

2000-02-18	Law 27	Conversion into law, with modifications, of Legislative Decree no. 484 of 20 December 1999, containing modifications of Law 454 of 23 December 1997 on initiatives for the restructuring of motor vehicle transport and the development of inter-modal transport.	Ministry of Transportation	Promotes the ongoing development of the national, roadway transport system towards a more advanced and competitive model of service, together with the development of combined transport. Promotes the reduction of environmental impact, in accordance with the EU regulations on the subject.	T	M
2000-02-25	Law 33	Conversion into law, with modifications, of Legislative Decree 500 of 30 December 1999, containing urgent measures regarding its extension in terms of the processing of waste at dumping sites and the and notifications involving PCBís, as well as the immediate use of the financial resources needed to implement the Kyoto Protocol.	Ministry for the Environment and Territory	Authorisation of spending of 300 million Lire for the year 1999 in order to achieve the objectives referred to under Law 448 of 23 December 1998 (art. 8, paragraph 10, letter f).	R	M
2000-03-16	Ministerial Decree	Endorsement of Directive 1999/100/EEC, issued by the Commission on 15 December 1999 to update, in line with technical progress, Directive 80/1268/EEC of the Council on carbon dioxide emissions and the consumption of fuels by motor vehicles.	Ministry of Transportation and Navigation	Reduces the limits on carbon dioxide emissions and on the consumption of fuel as a result of technological progress.	A T	M
2000-04-12	Ministerial Decree	Project netitled “Solarised Municipality”	Ministry for the Environment and Territory	Contemplates a series of measures to be adopted against air pollution from motor-vehicle emissions, including installation of an anti-pollution computer on automobiles.	E	M
2000-04-13	Ministerial Decree	Endorsement of Directive 1999/102/EEC, issued by the Commission on 15 December 1999 to update, in line with technical progress, Directive 70/220/EEC of the Council on the measures to be adopted against air pollution from motor vehicle emissions.	Ministry of Transportation and Navigation		T A	M

2000-05-23	Legislative Decree 164	Implementation of Directive no. 98/30/EC containing common rules and regulations on the internal market for natural gas, in compliance with art. 41 of Law no. 144 of 17 April 1999.	Ministry Production Activities	Contains a number of instruments which can favour initiatives to reduce greenhouse gases, such as: - art. 16, paragraph 4: distribution companies must pursue energy savings and the development of renewable sources; - art. 22, paragraph 1: assignment of the ranking of "ideal customer" to companies that use cogeneration plants, regardless of the quantity of gas consumed.	E	M
2000-05-29	Ministerial Decree	Continuation of the "Ecological Sundays" initiative.	Ministry for the Environment and Territory	Additional co-financing to supply information and heighten the awareness of citizens on the topic.	T	M
2000-06-07	Agreement Protocol	Agreement protocol between the Ministry for the Environment and Territory and and the Ministry of Cultural Affairs.	Ministry for the Environment and Territory and Ministry of Cultural Affairs	The ministries undertake to promote more widespread use of renewable sources, including bio-climatic projects, for the purpose of safeguarding historic, artistic, architectural and archaeological resources, as well as the countryside and the environment.	E	M
2000-06-06	Ministerial Decree	Allotment of the subsidies contemplated under art. 2, paragraph 5, of Law no. 194 of 18 June 1998 in favour of the regions with ordinary statues for the contribution of the State to the replacement of buses used in the public transport of individuals and in service for more than 15 years, as well as for the purchase of electrically-driven vehicles for the transportation of individuals in historic downtown areas and in zone reserved for pedestrians, plus other equipment for the public transportation of individuals by land, in lakes and lagoons and by means of cables.	Ministry of Transportation and Navigation Ministry for the Environment and Territory		T	M

2000-06-07	Ministerial Decree	Distribution of funds for cycling mobility under the provisions of Law no. 366/1998.	Ministry of Transportation and Navigation Ministry of Public Works		T	M
2000-06-16	Ministerial Decree	Criteria for the presentation and selection of projects for initiatives meant to improve environmental procedures and conditions in urban downtown areas, together with identification of the financial resources available for use.	Ministry of Transportation and Navigation Ministry of Public Works	Financing of projects designed to improve the local transportation system, achieve energy savings, reduce emissions of CO2 and reduce air and noise pollution.	T	M
2000-07-20	Ministerial Decree 337	Regulations stipulating criteria and procedures for the use of resources allocated for the year 1999 for the purposes referred to under art. 8, paragraph 10), letter f), of Law no. 448 of 23 December 1998.	Ministry for the Environment and Territory	Stipulates that the resources generated by the carbon tax, equal to 240 billion Lire, be devoted to finance activities and programs to reduce emissions of greenhouse gases, in enactment of the Kyoto Protocol. Specifically, a sum of 85 billion Lire is to be used to finance programs of national importance, and a sum of 155 billion Lire to finance the programs of the regions and the autonomous provinces. An amount of 50 billion Lire is allocated for the co-financing, with the Ministry for the Environment making capital contributions as well, of investments for environmental safeguards involving renewable energy sources, while the remaining 10 billion Lire, allocated to the Ministry of Finance, are earmarked for the granting of a subsidy in the form of a tax credit of 20 Lire for each kilowatt hour ((kWh) of heat supplied, to be transferred to the sales price paid by the final user, through the operation of district-heating networks fuelled with biomass in municipalities located in climatic zones E and EF.	IS	M

2000-09-04	Legislative Decree 220	Urgent measures to fight forest fires.		Calls for more severe minimum sentences for those who cause forest fires, with the option of increasing the punishment on the basis of the actual damage caused.	AF	A M
2000-10-06	Law 275	Conversion into law, with modifications, of Legislative Decree no. 220 of 4 August 2000, containing urgent measures for the fighting of forest fires.			AF	A M
2000-11-02	Resolution 113 of the Inter-Ministerial Committee for Economic Planning	General transportation and logistics plan.	Ministry of Transportation and Navigation Ministry of Public Works Ministry for the Environment and Territory	Contains proposals for a series of measures for the stabilisation of CO2 emissions in 2010 at 1990 levels.	T	M
2000-11-21	Law 342	"Tax measures".		Art. 9 – "Tax treatment of operating surpluses of the CONAI and of the packaging consortiums.	R	M
2000-11-21	Law 353	Framework law on forest fires	Regional governments, Civil Defence Agency	Identily criteria for regional plans of activities involving the forecasting, prevention and active fighting of forest fires.	AF	A M
2000-11-23	Prime Minister's Decree 434	Regulations for endorsment of Directive 98/70/EC regarding the quality of gasoline and diesel fuel.	Ministry for the Environment and Territory Ministry of Public Health, Ministry of Finance, Ministry of Industry	Stipulates the technical specifications for the combustible fuels to be used in vehicles powered by spark ignition or compression ignition motors.	T	M
2000-12-20	Ministerial Decree	Incentives provided to municipalities for national car-sharing program.	Ministry for the Environment and Territory	Promotes the integration and completion of the project for the creation of a coordinated and integrated system of local car-sharing services designed to reduce the environmental impact of urban traffic through the implementation of policies of sustainable mobility.	T	M

2000-12-20	Ministerial Decree	Financing to municipalities for the government of sustainable mobility.	Ministry for the Environment and Territory	Promotes the undertaking of initiatives for the organisation and management of the demand for mobility of both individuals and goods, with the objective of achieving structural and lasting reductions in the environmental impact generated by urban traffic, through the implementation of policies of sustainable mobility.	T	M
2000-12-21	Ministerial Decree IAR Department	Programs for sustainable mobility (5-10 cities).	Ministry for the Environment and Territory	Promotes the undertaking of structural initiatives for the purpose of reducing the environmental impact of urban traffic through the implementation of models of sustainable mobility.	T	
2000-12-21	Resolution 150 of the Inter-Ministerial Committee for Economic Planning	National Research Program 2001-2003		Calls for the enactment of the Strategic Program for Sustainable Development and Climate Change. Answer to a demand for research covering a wide range of themes, including: seasonal and inter-annual climatic variability, climatic changes over decades and centuries, the direct and indirect effects of climatic changes in the make-up of the atmosphere, changes in the uses of soil and in aquatic and terrestrial ecosystems, strategies of response and measures of mitigation. Calls for the creation of a Euro-Mediterranean Centre for Research on Climate Change to support the network of centres and research laboratories involved in the program.	IS	A M
2000-12-22	Decree	Financing to municipalities for the use of methane gas and LPG to fuel motor vehicles.	Ministry of the Environment	Favours the use of fuels offering low environmental impact, in particular LPG and methane.	T	M
2000-12-22	Decree	Financing to municipalities and to gas companies for the installation of systems for the production of heat at low temperatures.	Ministry of the Environment		E	M
2000-12-22	Ministerial Decree	Approval of standard conventions under Legislative Decree 79 of 16 March 1999, paragraph 8.	Ministry of Production Activities	Approves the standard conventions between ENEL and the companies that possess transmission networks for the pur-	E	M

				pose of regulating activities involving the maintenance and development of the national transmission network, as well as instruments for interconnection with other networks.		
2000-12-23	Law 388	Measures for the formulation of the annual and multi-year balance-sheet of the State. 2001 Budget Law.	Ministry of Finance Ministry of Production Activities Ministry for Agricultural and Forestr y Policies	Contains several measures and initiatives involving sustainable development. Articles of relevance to the environment include: art. 6 “Measures on the taxation of corporate income”, paragraphs 13-19. The portion of the income of small and medium-size enterprises earmarked for environmental investments is not counted towards determining taxable income for the purposes of corporate taxation. Resources available 2001-2002: 307.7 billion Lire. art. 21 “Measures on exemptions from the excise tax for bio-diesel fuel”. art. 22 “Reduction of excise taxes on a number of products for the purpose of environmental defence”, the excise tax is reduced on the following products used as fuels: bio-ethanol manufactured from agricultural products, additives and alcohol for unleaded gasoline and diesel fuel, with the exception of bio-diesel. Art. 29 “Rules and regulations on geothermal energy”: users who connect to a remote-heating network that operates with geothermal energy or is fuelled by biomasses receive a subsidy (tax credit) of 40,000 Lire for each kW of power used. Art. 109 Initiatives involving the promotion of sustainable development. Incentives supporting measures and initiatives of sustainable development (wastes, energy innovation, cities, agriculture, seacoasts).	IS	M A

				Art. 110 Fund for the reduction of emissions in the atmosphere and for the promotion of energy efficiency and sustainable sources of energy. Financing of national and regional programs for the reduction of atmospheric emissions, promotion of energy efficiency, renewable sources and agricultural and forestry programs for the absorption of carbon dioxide. Plan for the installation of solar panels, with a priority focus on Southern Italy, calling for: incentives of 80% on solar panels. Support for manufacturers of solar collectors. ENEA assignment in support of "Solarised Municipality". Art. 115, paragraphs 6 and 7: benefits for vehicles that pollute less.		
2000-12-29	Law 422	Provisions for fulfilment of obligations arising from Italyís membership in the European Communities – Community Law 2000.		Article 12: Criteria for the implementation of Community Directive no. 31 of 26 April 1999 on dumping sites.	R	M
2000-12-29	Law 409	Payment of Italyís obligatory contribution to the Multilateral Fund for the Montreal Protocol for the protection of the ozone layer.	Ministry for the Environment and Territory		IS	M
2001-01-31	Ministerial Decree	The "Ecological Sundays" campaign.	Ministry for the Environment and Territory		T	M
2001-02-17	Law 35	Ratification and enactment of the amendments to the Montreal Protocol on substances that reduce the ozone layer, adopted during the 9th Conference of the Signatories in Montreal on 15-17 November 1997.	Ministry of Foreign Affairs		IS	M
2001-03-02	Italian Cabinet Resolution	General Transportation and Logistics Plan.	Ministry of Transportation and Navigation	The authorisation from the government cabinet concluded the final approval procedure for the new General Transportation and Logistics Plan. This will be the transport planning policy tool for the next ten years. Based on the principle of subsidiarity, it involves all the different levels of government. Taken as a whole, the pro-	T	M

				posals, which regard organisational matters, taxes, fees and infrastructures, could lead to as turnaround in the trend towards environmental deterioration observed to date, aiming, by 2010, a reduction in CO2 emissions to the levels of 1990.		
2001-03-15	Ministerial Decree	Transposition into Italian legislation of Directive 2000/25/EC of the European Parliament and Council of 22 May 2000 regarding measures against the emission of gaseous pollutants and polluting particles from by-products of engines meant for the propulsion of tractors used in agriculture or forestry, plus modifications of Directive 74/150/EEC of the Council.			T A	M
2001-03-29	Ministerial Decree 106/SIAR/2001	Formulation and start-up of the Photovoltaic Ceiling Program.	Ministry for the Environment and Territory, ENEA	Aimed to the construction, in the years 2000-2002, photovoltaic plants with a power of from 1 to 50 kWp connected to the low-voltage electric distribution network and built-in or installed inside building structures.	E	M
2001-03-03	Law 93	Measures regarding the environment.	Ministry for the Environment and Territory	Art. 4 Emissions of greenhouse gases Programs of bilateral cooperation involving Italy and the nations of Central-Eastern Europe, as well as developing countries, must include a preliminary evaluation of their effect on of greenhouse gases emissions.	IS	M
2001-04-03	National Project on Renewable Fuels	"Solarised Municipality" program.		A program designed for local government bodies and regional governments of Central and Southern Italy to install solar plants for hot water production in public buildings. Also calls for training of young people to be employed in the solar sector.	E	M

2001-04-03	National Project on Renewable Fuels	"Solar Thermal" program.		Allows municipalities with more than 50,000 inhabitants gas-distribution companies owened by municipally to present, starting from 3 April 2001, applications for financing for heat production at low temperatures.	E	M
2001-04-21	Tender announcement	Tender announcement issued by the Ministry of the Environment for the development of renewable energy savings, as well as for energy savings and sustainable mobility on Italyís minor islands, in compliance with Executive Decree no. 94/2000.	Ministry for the Environment and Territory	Funding of 12 billion Lire was allocated, with seven billion going to initiatives involving renewable energy sources and energy savings, and five billion to be spent on sustainable mobility.	T E	M
2001-04-24		Endorsement of Directive 2001/1/EC of the European Parliament and Council, issued on 22 January 2001 as a modification of Directive 70/220/EEC of the Council regarding the measures to be adopted against air pollution caused by the emission of motor vehicles. Published in the Official Gazette of the Italian Republic, issue no. 103 of 5 May 2001.			T	M
2001-04-24	Ministerial Decree	Determination of the quantitative objectives for increasing energy efficiency in final uses, under the provisions of art. 9, paragraph 1, of Legislative Decree 79 of 16 March 1999.	Ministry of Production Activities Ministry for the Environment and Territori	Determines, in accordance with the commitments stipulated under the Kyoto Protocol, the national quantitative objectives for energy savings and the development of renewable energy sources to be pursued by companies that distribute natural gas; sets the principles for evaluating the results obtained by measures and initiatives for energy savings and the development of renewable energy sources; formulates the procedures for the control of the implementation of the aforementioned measures and initiatives.	E	M
2001-04-24	Ministerial Decree	Determination of the national quantitative objectives for energy savings and the development of renewable energy sources, as per art. 16, paragraph 4, of the legislative decree of 23 May 2000.	Ministry of Production Activities		E	M

2001-05-09	Ministerial Decree	Approval of the rules and regulations governing the electricity market, as per art. 5, paragraph 1, of Legislative Decree no. 79 of 16 March 1999.	Ministry of Industry, Commerce and Crafts		E	M
2001-05-18	Legislative Decree 227	Regulation and modernisation of the forestry sector, under the provisions of article 7 of Law 57 of 5 March 2001.		Regulates agricultural and forestry development in keeping with objectives of sustainable development.	AF	A
2001-05-21	Ministerial Decree	Distribution of financing to the regional "Carbon Tax" programs.		Appendix 1 of the decree lists the subdivision by regions of the financing for the programs.	IS	M
2001-05-25	Ministerial Decree	Endorsement of Directive 1999/96/EC of the European Parliament and Council of 13 December 1999 regarding the establishment of uniformity in the legislation of the member states governing the measures to be taken against the emission of gaseous pollutants and particles produced by spontaneous ignition motors and the emission of gaseous pollutants produced by spark ignition motors fuelled by natural gas or liquefied petroleum gas used for the propulsion of the vehicles, issued as a modification of Directive 88/77/EEC of the Council.	Ministry of Transportation and Navigation		T	M
2001-06	Inter-Ministerial Agreement	Agreement between the Ministry of the Environment and the Ministry of Justice on the National Program for the Solarisation of Italian Penitentiaries.	Ministry for the Environment and Territory Ministry of Justice		E T	M
2001-06-01	Ministerial Decree	Endorsement of Directive 1997/68/EC of the European Parliament and Council of 16 December 1997 regarding the measures to be adopted against the emission of gaseous pollutants and polluting particles produced by internal combustion motors designed for installation on mobile, off - road machinery.	Ministry of Transportation and Navigation	Shall result in the installation of 3,000 m2 of collectors in 5 years.	T	M

2001-06-04	Ministerial Decree	Programs of national significance involving emissions of greenhouse gases, in implementation of art. 3 of Ministerial Decree no. 337 of 20 July.	Ministr for the Environment, Ministry of the Budget and Economic Planning, Ministry of Production Activities	Appendices 1 and 2 to the present decree indicate the public entities responsible fto implement national programs, as well as their presumed time periods of implementation, and the elements identifying the programs of national and international cooperation.	IS	M
2001-07-10	Ministerial Decree	Endorsement of Directive 98/11/EC, stipulating the procedures for application of Directive 92/75/EEC of the Council on labelling indicating the energy efficiency of light bulbs.	Ministry of Production Activities		E T	M
2001-07-25	Ministerial Decree	The “Ecological Days 2001” campaign.	Ministry for the Environment Territory	Criteria for the financing to the municipalities participating in the “Ecological Days” for the following types of initiatives: - campaigns to increase awareness and provide information to the general public; - opinion polls before, during and after the performance of the initiatives to control that the objectives have been met; - initiatives directly designed to increase knowledge among citizens of the problems of sustainable mobility; - initiatives directly geared to a more efficient organisation of the “Ecological Days”.	T	M
2001-09-07	Prime Minister’s Decree 395	Endorsment of Directive 99/32/EC on the reduction of the level of sulphur in a number of liquid combustible fuels. Published in the Official Gazette of the Italian Republic, issue no. 255, on 2 November 2001.			A	M
2001-10-03	Ministerial Decree	Recovery, recycling, regeneration and distribution of halons.	Ministry for the Environment and Territory	In compliance with the agreements reached for the protection of the ozone layer in the stratosphere, generically prohibits the use of halons, apart from the cases specifically indicated.	IS	M

2002-01-25	Ministerial Decree	Endorsement of the Directive 2001/27/EC, issued by the Commission on 10 April 2001 to update on the basis of intervening technical progress Directive 88/77/EEC of the Council regarding measures to be taken against the emissis of polluting gases and particles produced by spontaneous ignition motors and the emission of gaseous pollutants produced by spark ignition motors fuelled with natural gas or with liquefied petroleum gas for the propulsion of vehicles.	Ministry of Infrastructures and Transportation		T	M
2002-02-20	Law 30	Ratification and implementation of the Convention on the cross-border effects of industrial accidents, with annexes, drawn up in Helsinki on 17 March 1992.		Sets rules and regulations for the cross-border effects of industrial accidents that can damage the environment.	IS	M
2002-03-18	Ministerial Decree	Modifications and additions to the decree of the Ministry of Industry, Commerce and Crafts, issued in concert with the Ministry of the Environment on 11 November 1999, regarding “directives for the implementation of the rules and regulations on electric energy from renewable sources, as per paragraphs 1, 2 and 3 of art. 11 of Legislative Decree no. 79 of 16 March 1999.	Ministry of Production Activities	Cogeneration plants, given that they make possible energy savings and a lower environmental impact than would be the case with separate production of the same amounts of electric energy and heat, receive certain benefits, such as: dispatching priority on networks and exemption from the obligation of supplying to the national electricity system energy produced from renewable sources and equal to 2% of the energy produced with co generation plants.	E	M
2002-03-19	Resolution 42/02 of the Authority for Electric Energy and Gas	Conditions for granting of the status of combined production of electrici and heat under the provisions of art. 2, paragraph 8, of Legislative Decree no. 79 of 16 March 1999.	Ministry of Production Activities		E	M
2002-03-26	Ministerial Decree	Implementation of Directive 2000/55/EC of the European Parliament and Council regarding the energy-efficiency standards for the startes of fluorescent lights.	Ministry of Production Activities		E	M

2002-04-02	Ministerial Decree	Endorsement of Directive 1999/30/EC, issued by the Council on 22 April 1999, regarding the limit levels in the air of the environment sulphur dioxide, nitrogen dioxide, nitrogen oxides, particles and lead, as well as Directive 2000/69/EC on the limit levels of environmental air quality for benzene and carbon monoxide.	Ministry for the Environment and the Territory		T A	M
2002-05-06	Law 82	Conversion into Law, following modification, of Legislative Decree no. 22 of 7 March 2002 containing urgent measures for the setting of rules and regulations on the use of petroleum coke in combustion plants.		Stipulates the rules and regulations for reducing polluting emissions from production plants that utilise petroleum coke.	E	M
2002-06-01	Law 120	Ratification and implementation of the Kyoto Protocol to the framework convention of the United Nations on climatic changes, drawn up in Kyoto on 11 December 1997.	Ministry of the Environment and Defence of the Territory	In addition to the ratification of the Kyoto Protocol, it also includes a series of regulations aimed at achieving the objectives of greenhouse-gas emission reduction. MATT, in agreement with MEF and other ministries involved, is bound to present to the Interministerial Committee for Economic Planning, within 30 September 2002, a national action plan aimed at reducing greenhouse-gas emissions and increasing their absorption capacity, a report comprising the state of execution, the revision proposal to resolution 136 of 19 November 1998 issued by the Interministerial Committee for Economic Planning and its state of execution, financed by MATT in application of decree law 500.	IS	M
2002-06-13	Ministerial Decree	Re-modulation of national programmes established by Ministerial decree 467 of 4 June 2001 (carbon tax)	Ministry of the Environment and Defence of the Territory	With reference to art. 1, paragraph 3 of Ministerial decree 467 of 4 June 2001, the Decree redefines the International Cooperation Programme in the frame of the "Kyoto Mechanisms"	IS	M
2002-06-14	Resolution 41 of the Interministerial Committee for Economic Planning	Guidelines for the national programme on sustainable development and water supply in the agricultural sector			AF	A

2002-06-16	Law 118	Conversion into law, following modifications, of Legislative Decree no. 68 of 19 April 2002 containing urgent measures for the zootechnical sector and for the fight against forest fires.			AF	M
2002-06-20	Ministerial Decree	Endorsement of Directive 2001/63/EC, issued by the Commission on 17 August 2001 to update, in line with intervening technical progress, Directive 97/68/EC of the European Parliament and Council regarding measures to be adopted against the emission of gaseous pollutants and polluting particles produced by internal combustion motors designed for installation on off-road mobile machines.	Ministry of Infrastructures and Transportation		T	M
2002-07-31	Law 179	Regulations in the environmental sector		Finances programmes aimed at reducing polluting emissions	IS	M
2002-08-01	Law 166	Regulations in the infrastructure and transport sector		Rules for updating the general plan on transports	T	M
2002-09-03	Decree	Guidelines for the management of sites Natura 200. Defence of nature and biodiversities. Directives 92/43/CEE and 79/409 CEE	Ministry of the Environment and Defence of the Territory		NP	A
2002-10-08	Presented by the Ministry of the Environment	National plan to reduce greenhouse-gas emissions	Ministry of the Environment	Reduction of 93 million tonnes of C02 emissions by 2008-2012. Identifies three modalities of intervention to comply with the emission reduction objectives individuated in the Kyoto Protocol: a) Implementation of measures already adopted and implemented in the energy sector b) Implementation of measures in the agricultural and forestry sector to increase carbon absorption capacity and reduce emissions to 10,2 Mt c) Implementation of additional measures in the energy, transportation and economic and technological co-operation sectors (a wide resort to the mecha-	IS	M

				nisms established by the Kyoto Protocol is provided); the application of such measures will allow filling the residual gap of 30 Mt, which is necessary to attain the emission reduction objective. The financing of the plan will focus on three main interventions: a) Internal re-modulation of excise taxes on fuels, devoting 1 cent. Euro/litre to cover the costs of measures implemented in the agricultural and forestry sector, at no additional cost to end users; b) Utilization of the “Fund for reducing atmospheric emissions and promoting energy efficiency and the efficiency of sustainable energy sources ” c) Use of revenues generated by the application of art. 21 of the Reformation decree for the energy sector, presented by the Minister of Production Activities in July 2002.		

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