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Foreword

I am pleased to present the Italian Fourth National Communication under the United Nations Framework Convention on Climate Change. This Communication summarised domestic and international actions Italy is taking to meet its commitments under the UN Framework Convention on Climate Change and its Kyoto Protocol.

The Fourth Assessment Report from the UN Intergovernmental Panel on Climate Change confirms the evidence of the negative impacts of climate change and demonstrates that such impacts are increasingly posing a serious risk to ecosystems, food production, the attainment of sustainable development and of the Millennium Development Goals as well as to human health and security.

The current Government, which took office in May 2006, has strongly reaffirmed the political will to achieve the emission reduction commitment under the Kyoto Protocol and has launched a review of the Government's strategy, which is currently still ongoing because the huge delay accumulated by the inaction of the previous years where it was suppose to update first the National Plan of greenhouse gas (GHG) emissions Reduction, CIPE 123/2002 Act, and than to deliver the IV Communication by the end of 2005.

Nevertheless, after a deep investigation on scenarios, data collection and analysis re-started in the second half of 2006, we are now in the process of reviewing the National Plan of GHG emissions Reduction, CIPE 123/2002 Act, to update Italy's polices and measures to meet Kyoto Protocol target by the first budget period 2008 – 2012, with the implementation of domestic policies and measures for at least 80% of the reduction effort and in the use of the Kyoto mechanisms up to 20%.

Considering the existing status quo found, we will identify the cost-effective measure to cover the emission additional gap of 20 Million of tonnes of CO_2 equivalent that will result after the effect of the implemented and planned measures, subtracted by the trend emission scenario (included the contribution of LULUCF sector, CDM, JI, and Emission Trading) and any further adjustment in terms of measures needed to cover potential other gap caused by past inactivity with measure adopted but not fully implemented.

The Government's strategy review is also needed to Italy to contribute concretely to the achievements of the new EU commitments, agreed by EU Heads of Governments during the Spring Council of 8-9 March 2007, to reduction of at least 20% GHG emission, to achieve the mandatory target of 20% of primary energy consumption as contribution from renewable energy source and to implement energy efficiency measures to reduce of 20% primary energy consumption.

However the climate change challenge requires further long-term global efforts. The window of opportunity to act is rapidly closing and delaying action will increase the risks of dangerous climate change. In such respect Italy hopes that climate change negotiation could move forward in order to reach a global agreement for the post-2012 period by 2009 and is ready to play its role in a future climate change regime to achieve significantly more ambitious greenhouse gas emission reductions.

Alfonso Pecoraro Scanio
Minister for the Environment, Land and Sea

Foreword

Italy ratified the Climate Change Convention in 1994. Following the ratification, the National Programme for the Containment of Carbon Dioxide Emissions by 2000 at 1990 levels was approved (1994) and since that time Italian Government has regularly updated the national programme to reduce greenhouse gas emissions.

In 2002 Italy ratified the Kyoto Protocol (Law, 1 June 2002, n. 120). The ratification law commits our country to reduce greenhouse gas emissions by 6.5 per cent below base-year levels, on average, over the first commitment period, 2008-2012. According to the provisions of the ratification law, an overall national strategy to meet the Kyoto target was developed and approved by the Inter-ministerial Committee for Economic Planning (CIPE) with deliberation n. 123 in 2002. Such strategy was aimed not only to reduce greenhouse gas emissions, but also to fulfil other commitments in climate policy, for example setting the administrative frameworks.
In addition, law 1 June 2002, n. 120 provides financial assistance to developing countries in the climate change field, in particular allocating 68 millions Euro/year, by 2003.

In the framework of the current revision of the national strategy, the general approach to achieving the Kyoto Protocol target consists in the implementation of domestic policies and measures for at least 80% of the reduction effort and in the use of the Kyoto mechanisms up to 20%. In such respect the review mainly concerns the update of national greenhouse gas emissions projections and the identification of additional policies and measures to be implemented to meet the Kyoto Protocol target.

In the process of reviewing the national strategy, Italy will have also the opportunity to assess its contribution to the achievements of the 2020 EU commitments set by EU Heads of Governments at the Spring Council of 9 March 2007 (an independent reduction of at least 20% of greenhouse gas emissions, a mandatory target of 20% for the contribution of renewables to the overall energy consumption and a 20% reduction of energy consumption through energy efficiency improvements).

As the fourth National Communication was elaborated before the conclusion of the review of the Government's strategy, the information presented in this report, in particular the one related to policies and measures, could not be fully consistent with the one contained in the revised national strategy which will be approved at the end of the review process. As far as policies and measures are concerned, the Communication reports a review of all the implemented sectoral measures up to the latest set trough the Financial Law 2007, an evaluation of their effects and an evaluation of the effects at 2010 and 2020 of all planned measures.
When the effect of the implemented and planned measures is subtracted by the trend emission scenario and also the contribution of LULUCF sector and flexible mechanism is accounted for, a gap of about 20 Mt CO_2 *relatively to the Kyoto target is still present. The additional measures needed to close this residual gap are still under investigation in the process aimed to review the Government's strategy.*

Considering that Italy has one of the lowest energy intensities among OECD countries in terms of energy use per unit of GDP, meeting the Kyoto Protocol commitment represents a real challenge. However, Italy has decided to commit to such an ambitious goal because it recognises that if climate change is not tackled seriously, the consequences will be quite serious for the global environment, the economy and security. Progress in decarbonising our economy has already been done, but much still need to be done. We are ready to make the needed further efforts to meet the goals already committed and play our role in the protection of the climate in the future.

Corrado Clini
UNFCCC national focal point

CHAPTER 1

EXECUTIVE SUMMARY[1]

National circumstances relevant to greenhouse gas emissions and removals

In Italy, the Government has overall responsibility for the implementation of the Kyoto Protocol, although a range of policies are the responsibility of regions, provinces and municipalities. At central level, the Ministry for the Environment, Land and Sea is responsible for overall climate policy coordination, while the Ministry of Economic Development is responsible for national energy policy.

From the demographic point of view, the situation is stable. Only the aging trend of population was keeping on increasing. The national emissions of greenhouse gases are scarcely influenced by the growth of population itself, but rather by population lifestyles (i.e. commuting and increasing energy demand for heating and cooling),the average dimension of families becoming lower and lower (passing from 3.4 to 2.6 in the period 1971-2001) and the increased residential energy demand following the increase of the number of families (around 26% in the period 1971-2001 against an increase in the population of 5% and in dwellings of around 36%).

Per capita Gross Domestic Product (GDP) is another indicator that explains the emissions trend of greenhouse gases. The Italian per capita GDP is one of the lowest in the European Union with an average annual growth of 1.4% in the period 1990-2005. The industrial sector was characterized by a year of heavy recession, 1993 (-3.2%), followed by two years of high growth, 4.2% and 3.8% in 1994 and 1995, and one of light recession, -0.7% in 1996. The period 1997-2001 was characterized by a light growth, 0.9%/y, while the last years showed a continuous decrease, except 2004. , the pulling sector of Italian economy is the services sector.

During the last years, in spite of moderate growth of Italian economy, energy supply and intensity have slowly increased. The primary energy consumption per fuel types shows a reduction of oil, which remain in any case, the most important energy source. The corresponding increase in the use of the natural gas confirms a substitution process between gas and oil started in mid nineties. Coal has decreased in 2005. Basically stable the quantity of imported electricity.

The energy bill in 2005 has been of 38.5 B€, with a raise of 9.1 B€ (+ 38%) compared with 2004, which represents the most important bill increase in the last two decades mostly due to the energy dependence of Italy from abroad and the increasing energy prices.

The energy dependence of Italy from abroad, mostly due to oil (92.86%), is growing continuously since the end of nineties (in 2005about 85.07%, compared with a European average of 54%).

Energy end-uses total consumption in 2005 has been of 146.6 Mtep, of which 32% related to the tertiary sector (residential, public and tertiary sectors) and 30% to the transports sector. Industrial sector covers 28% of total end-uses energy consumption.

In the period 2002-2005, primary and final energy intensities in Italy have increased in line with growing energy consumption (+5.2%). Energy consumption has increased more than economic growth (+1.0%) in particular because of a rise in consumption in the civil sector due to climatic reasons (more gas

[1] General coordinators.

consumption for heating in wintertime, more electricity consumptions for cooling in summertime). Instead, industry and transport energy intensities have decreased in the same reference period.
Concerning the electric sector, more than 80% of the production in Italy is provided by thermal power plants. The rest is ensured by renewable resources (hydropower, wind, photovoltaic and biomass). The share of renewable resources has grown in the latest years.
In 2005, transport sector represents 22.56% of total greenhouse gas emissions and 14.3% of total households' consumption.
Although the population is stable, since 1990 passengers mobility rose significantly, increasing energy use and greenhouse gas emissions. That growth is mostly attributable to private car use, as public transport and railroad transport are stable.
The transport sector is responsible for an important share of energy consumption; moreover transport demand appears in strong expansion. For these reasons, the transport sector represents a critical point for environmental policies and, in particular, for compliance with the Kyoto Protocol. In the period 1990-2004, a 30% increase of greenhouse gas emissions (CO_2, CH_4, N_2O) took place; despite an increase in the fuel efficiency of vehicles, the demand of mobility as well as the car displacement rose.
In 2004 the agriculture sector contributed 6.6% of Italy's national GHG emissions and without CO_2 emissions and removals from LULUCF, in CO_2 equivalent, is the third source of emissions after the energy and industrial processes sectors.
The decrease observed in the total emissions from the agricultural sector (-7%) is mostly due to the decrease in CH_4 emissions from enteric fermentation (-11%) which account for 28% of the total emissions of this sector.
Total removals, expresses as CO_2 equivalent, show an increase of 31%, from the base year to 2004. CO_2 accounts for more than 99% of total emissions and removals of the sector: in the period 1990–2004 CO_2 removals increased by 32%, mostly because of the increase of forest areas.

Greenhouse gas inventory

In 2005, total greenhouse gas emissions, in CO_2 equivalent, were 12.1% above the base year levels.. Italy has decided to set 1990 as the base year for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (HFCs, PFCs and SF_6).
National emissions of CO_2, which account in 2005 for 85.1% of total greenhouse gas emissions in CO_2 equivalent, showed an increase of 13.5% between 1990 and 2005. Specifically in the energy sector, emissions in 2005 were 14.5 % greater than in 1990.
CH_4 and N_2O emissions were equal to 6.9% and 7.0%, respectively, of the total CO_2-equivalent greenhouse gas emissions. CH_4 emissions showed a decrease by 4.4% from 1990 to 2005, while N_2O increased by 6.2%.
Fluorinated gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), ranged from 0.1% to 1% of total emissions. Despite their increase from 1990 to 2005 (+144%) their contribution to overall GHG emissions is still negligible.

Italy has established a national system, which includes all institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases, and for reporting and archiving inventory information.

Quality Assurance (QA) Quality Control (QC) activities and different verification measures are applied thoroughly the current inventory compilation as part of the estimation process. Particularly, APAT has elaborated an inventory QA/QC procedures manual which helps in the improvement of the inventory whereas specific activities implemented during the current inventory compilation are figured out in the annual QA/QC plans.

Policies and measures

In its efforts to meet the commitments under the UNFCCC and the Kyoto Protocol, Italy has implemented a number of sectoral and cross-sectoral policies and measures that have had or are expected to have a direct or indirect effect on the reduction of greenhouse gas emissions.

The most relevant cross-sectoral initiative is represented by the White Certificates system, aimed at promoting energy efficiency and delivering emission reductions in all the energy end-use sectors. The system is designed to achieve a primary energy saving target of 2.9 Mtoe per year by 2009. As regards additional measures still under discussion, there is a realistic chance that the White Certificate system will soon be extended firstly to 2012 and lately to 2020.

The European Union Emissions Trading Scheme (EUETS) and the flexible mechanisms of the Kyoto Protocol are also assessed and are expected to deliver reductions for respectively 13.25 and 20.75 $MtCO_2$ per year by 2010.

In the energy supply sector, strong reductions are expected from implemented and planned policies and measures in the renewable energy sources field, where reductions for 6.87, 19.01 and 26.60 $MtCO_2$ per year will be delivered respectively by 2010, 2015 and 2020. The major policy mechanism through which the Government supports the development of new renewables capacity is the Green Certificates system that introduced the obligation on electricity producers to feed the grid with a minimum share of electricity produced from renewable energy sources. This system is likely to be changed in the near future as a draft amending bill is currently under discussion in Parliament. A different dedicated scheme applies to the promotion of photovoltaic electricity, based on feed-in tariffs guaranteed for 20 years that vary in relation to the nominal power and the type of the installation.

Cogeneration is currently supported by means of different incentive schemes, rewarding both the production of heat and the production of electricity. All cogeneration plants benefit from the White Certificate system while RES cogeneration plants are additionally entitled to receive Green Certificates to reward the green electricity produced. These supporting measures were already included in the trend scenario; an assessment of the planned measures to further support the diffusion of cogeneration plants and district heating systems indicates reductions for 1.65, 5.44 and 9.33 $MtCO_2$ per year respectively by 2010, 2015 and 2020.

As regards energy efficiency of power plants all the emission reduction measures were already included in the trend scenario and no new measures are yet planned or envisaged.

Policies affecting CO_2 emissions in the industry sector are generally designed to improve industrial energy intensity. The main instrument is represented by the White Certificates system but since the potential for energy saving in the industry sector is still consistent, several new additional measures are currently under discussion to try to exploit it. The planned measures are expected to deliver respectively 1.93, 7.42 and 11.50 $MtCO_2$ per year respectively by 2010, 2015 and 2020.

In the civil sector the package of policies deployed aims at tackling energy efficiency through specific actions targeted both at existing and new buildings and at appliances. The most important regulatory measures affecting this sector are the White Certificate system and the legislation introduced to improve the energy performance of buildings, strengthening their thermal demand requirements. The combined effect of implemented and planned measures results in a reduction of 4.45, 24.25 and 30.54 $MtCO_2$ per year respectively by 2010, 2015 and 2020.
The transport sector is characterized by an important reduction potential and the task of tackling its emissions growth is challenging. The measures assessed in this report include reducing the average emissions of the circulating fleet, building new infrastructures in public transport and increasing the use of biofuels. The estimated effect of implemented and planned measures is assessed at 5.35, 16.87 and 24.47 $MtCO_2$ per year respectively by 2010, 2015 and 2020.
As regards the non-energy sources of greenhouse gas emissions, the combined effect of the measures deployed in the industrial processes, agriculture and waste sectors can be assessed at 3.70, 9.31 and 9.65 $MtCO_2$ per year respectively by 2010, 2015 and 2020. The forestry sector is assessed only for the year 2010 and it is expected to deliver reductions for 25.3 $MtCO_2$.

As far as the local measures are concerned, it has to be mentioned
The Regional Energy Plan (PER). The PER is the main tool through which Regions can plan and address their intervention, also the structural ones, in energy sectors in their own territories and to regulate the functions of the Local Agencies, harmonizing the important decisions at the regional and local level. The energy-environmental Plans are structured to guarantee coherent targets with the national energy policy and to insure to the regional territory the development of a policy that respects the requirements of the society, of the environment protection and health of the citizens. They constitute the reference picture for the private and publics subjects, who assume initiatives in energy sector in their own territory. The PER contains the addresses, targets, the concrete indications, the available tools, the legislative and normative references, the financial institutions opportunities. The regional energy programming put into effect also for "regulating" and to address the realization of the participations to the free energy market.
All Italian Regions activated initiatives in the renewable energy sources field, through two main participation lines. The first one refers to the programs "photovoltaic Roofs" and "Solar thermal" putting into effect the decree of the Ministry for the Environment, Land and Sea emanated in 2000. The second one works through the specific measures of the Operative Regional Programs (POR) by the Structural funds of the Community Support Framework 2000-2006 of the European Union.
The Structural Funds contribute to realize the objective of economic and social cohesion of the European Union. These funds are used to reduce the differences between the Regions of the Union and to promote equal professional opportunities of the various social groups. The action of the Structural Funds focuses mainly on a series of priority objectives. The general document that defines the strategic lines for the programming of the Structural Funds is the Community Support Framework 2007 – 2013 (QCS, in Italian), that contains an analysis of the initial situation, the strategy of interventions for the joint action of the European Union and of the State, the priority actions of intervention, their specific objective, the attended impact evaluation, the financial equipment, the identification of the Operative Programs and their conditions of realization.

Projections and effects of policies and measures

According to most recent data, emissions from Annex I countries will increase of 1-2% between 1990 and 2010 (against a reduction of "at least 5%" to be met according to art. 3.1 of the Kyoto Protocol). The Kyoto objective for EU (EU-15) is to attain an 8% emissions reduction. Most of the EU 15 Member states are out of path in getting to their target in the EU "burden sharing" agreement. The target will be met taking into account the measures for the forestry sector and the use of flexible mechanisms.

The Italian target is to reduce total GHG emissions by 6.5% over the 2008-2012 periods with respect to 1990. The emissions for the latest available inventory year (2005) reports a 12.1% increase with reference to 1990. A review of all the implemented sectoral measures up to the latest available decrees connected with the financial law 2007 was performed. Moreover the effects at 2010 and 2020 of all planned measures were evaluated.

When the effect of the implemented measures is subtracted by the trend emission scenario and also the contribution of LULUCF sector is accounted for, a gap of about 54 Mt CO_2 relatively to the Kyoto objective is still present. The potential reductions by 2010 of the planned measures and of the flexible mechanism limited to the 20% of the total gap between trend scenario and Kyoto objective cannot fill entirely this gap. The additional measures needed to close this residual gap of about 20 $MtCO_2$ are still under investigation by the competent institutions and they will be set in the national strategy to mitigate climate change at the moment under revision. Such revision will also take into account EU objectives set by EU Heads of Governments at the Spring Council of 9 March 2007 (an independent reduction of at least 20% of greenhouse gas emissions, a mandatory target of 20% for the contribution of renewables to the overall energy consumption and a 20% reduction of energy consumption through energy efficiency improvements).

The effect of all evaluated implemented and planned measures at 2020 is much higher than the one at 1010 (about 112 $MtCO_2$) and this will bring total GHG emissions in 2020 about 1.1% lower than 1990, without considering any flexible mechanism and the contribution of forestry.

Finally in the chapter an historical review of projections from different National Communications is reported. As can be seen there is a remarkable stability of projections of the emissions from the energy sector for the year 2010, with a range of +/-2%, confirmed by historical data up to 2005. For the emissions of other gasses and other sectors methodology (IPCC guidelines) for the estimate has been changed therefore projections have been developed with different methodology and assumptions and cannot be compared.

Impacts, Vulnerability and Adaptation

Observed trends

> Current trends in temperature in the Italian territory show an overall mean warming of 1.0 ± 0.1 °C per century, with no significant differences between seasons and regions. Minimum temperatures have increased more than maximum temperature (particularly in the north), more in winter (particularly in the South) than in summer. The year 2006 has been the 15th consecutive year with positive anomaly, and its value is the 6th from 1961 to date.

> Differently from temperature, the cumulated precipitations do not show either pronounced or univocal trend on the Italian territory.

Sea level changes in the Mediterranean Sea. Only a few long sea level records spanning to the beginning of the 1900s exist in the Mediterranean Sea and these are located at the Northern coasts of the Western Mediterranean and at the northern coasts of the Adriatic Sea.

The sea level trends for the three sites with longest time series, are presently in the range 1.1÷1.3 mm/yr, thus lower than the estimated global value for sea level rise. During the same period of time a reduction in the sea level gradient across the Strait of Gibraltar has been observed and the change was suggested as caused by varied hydraulic conditions in the Strait or by changes in the density difference between the Mediterranean and the Atlantic. The extent to which the Mediterranean Sea can have long-term sea level variability different from the global ocean remains an open question.

Climate Change Scenarios

Temperatures. In the A1B scenario, GCM models evaluate that the annual average temperature in South Europe in the period from 1980-1999 respect to 2080-2099 will increase in a range between 2.0 and 5.1 °C with a median value of 3.5 °C.

In the regions bordering the Mediterranean, Italy included, the expected warming is greater in the summer and all the models considered agree about the occurrence, in South Europe, of summers warmer then the warmest summer of the period 1980-1999.

Precipitations.

Unlike the changes in temperature, which are therefore rather uniform, the forecasts of precipitation may vary significantly on reduced scale, in particular on areas with a complex orography as our peninsula.

An increase of the average temperature of 4 °C in the Alps, would reduce the duration of the snow of 50% to the altitude of 2000 m and 95% under 1000 m a.s.l.

The combined effects of warmer temperatures and reduced mean summer precipitation would enhance the occurrence of heat waves and droughts.

Impacts of Expected Climate Change and Vulnerability Assessment

Energy sector. As far as energy supply is concerned, a reduction of electricity generation from hydropower is expected. In terms of energy demand, it is expected a decrease of the

Energy consumption for heating is expected together with an increase for domestic cooling.

Agriculture. In the Mediterranean region, increases in the frequency of extreme climate events during specific crop development stages, together with higher rainfall intensity and longer dry spells, are likely to reduce summer crops yields.

Lengthening of the growing period of about 10-15 days per each °C of rise in yearly average temperature and consequent shortening of cold winter periods are expected.

In terms of crop production, outcomes of the PESETA project show that the change foreseen for 2020 and

2080 would result in a yield decrease from 1.9% to about 22.4% in the Southern Europe regions, caused primarily by likely reduction of the growing season, by extreme events more frequent during the production cycle phases, as for example strong precipitations during sowing dates, heat waves during the flowering period and longer dry spells.

Coastal zones. Sea level rise will imply higher risks for the Italian coastal areas. About 4500 square kilometres of coastal areas and plains would be at risk of sea flooding; floods might be frequent and distributed over all the Italian coasts-.

Soil degradation and water resources.

Climate change might cause general soil quality 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 erosion because of dryness, salinization, and nutrients loss as a consequence of precipitations decrease and increase of droughts.

Desertification. The highest sensitivity to desertification risk occurs in southern and insular regions, where environmental conditions are more unfavourable and where agriculture and sheep-farming affect the territory conditions.

Biodiversity and ecosystems. Under the mainstream scenarios, the reduction in the number of stable plant species in 2100, compared to 1990, might range between 20÷40% in Northern Italy and Apennines, 60÷80% in the Mediterranean area, 40÷60% in Southern Italy. The increased aridity observed in Central-Southern Italy makes the Italian forests more vulnerable to biotic and abiotic disturbances reducing their resistance and resilience.

Tourism. Since about 40% of tourists come to Italy during summer, the hot weather conditions can play a very important role in determining the quality of a vacation. Furthermore, the extreme hot conditions may represent a risk factor for tourists, especially among the elderly and those who are affected by chronic diseases. However, conditions in spring and autumn will improve.

The availability of water supply could become a major constraint and the quantity and quality of water available may not be sufficient to satisfy future tourist demand.

Human health. Italy is at risk of changes in spatial and temporal distribution of vector borne diseases.

The importance of the mosquitoes as disease vectors it is tied up above all to the transmission of malaria. Today, the cases of malaria annually notified in Italy are imported for the almost totality; only very few cases are locally contracted, usually following accidental events.

In next decades, the constant increase of the mean temperature could widen the area of distribution of the vectors. Although, the possibility that a tropical vector can settle in our country it appears highly unlikely because of the complexity of ecological factors linked to the different anopheline species. There is also a high potential risk of West Nile fever cases, and an increase risk of Leishmania and of bottonneuse fever moving northward.

Water borne disease outbreaks could increase, because of extreme rainfall and changes in water runoff that can influence the microbiological contamination of coastal, recreational, or surface waters.

ADAPTATION

The Ministry for the Environment, Land and Sea has organised the National Conference on Climate Change (MATTM 2007a), including a series of preparatory workshops focusing on the most critical national situations, such as desertification, erosion and coastal areas flooding, glaciers and snow covers loss, hydro-geological risk, and hydrographic area of the river Po.
The Conference has analysed the problems concerning the changes in the level of vulnerability brought about by climate change and the available adaptation options and has proposed a climate manifesto for sustainable adaptation and environmental safety, calling for the preparation of national, regional and local adaptation strategies, together with 13 actions for sustainable adaptation to be implemented on a priority basis.

Financial resources and technology transfer

In view to meet its commitments under Articles 4.3, 4.4 and 4.5 of the Framework Convention on Climate Change, Italy supplied remarkable financial resources for the implementation of programmes and projects on climate change and related topics in developing countries, in collaboration with governmental, regional a local authorities, private companies, universities and scientific institutions.
The objectives of these initiatives are various and ambitious: efficient use of energy and water resources, carbon sequestration, and promotion of renewable energy sources, professional training and exchange of know-how, promotion of eco-efficient technologies.

Among its major bilateral cooperation initiatives on climate change Italy has developed programmes and projects in China, India, the Mediterranean region, Central and Eastern European countries, Latin America, the Caribbean and Pacific islands.

At multilateral level, the Italian commitment in environmental protection activities has been consistent and has ensured continuity with the previous years (1997-2000) through the definition and implementation of more efficient co-operation strategies with major international environmental bodies and institutions.
Such cooperation has involved a wide range of activities, from the supply of financial resources, to the design and implementation of programmes and projects, the promotion of transfer of environmentally-sound technologies aiming at reducing the impacts of human activities on climate change, and support to adaptation measures.

In particular, these initiatives was performed with UNESCO, the Regional Environmental Centre for Central and Eastern Europe (REC), the Global Environment Facility (GEF), the World Bank (WB), the Food and Agriculture Organisation (FAO) and the United Nations Development Programme (UNEP)

The financial resources provided for the implementation of the above mentioned activities have been taken from two different channels: the Official Development Assistance (ODA) and the law June 1, 2002, n° 120 that transposes the Kyoto Protocol obligations into the national legislation.

Law June 1, 2002, n° 120 represents a major accomplishment in raising financial resources for the Convention objectives Such Law mobilizes "new and additional" resources - amounting to 68 million euro/year- to finance activities in developing countries aiming at substantively contributing to the implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

According to Official Development Assistance flows data, Italy ranks seventh among OECD countries, thus representing one of the largest contributors, with 2005 official development assistance (ODA) volume of USD 5 091 million, representing 0.29% of Italian Gross National Income (GNI) and an increase of more than 106% in comparison with 2001-2004 levels.

Research and Systematic Observations

Italian scientific institutions (universities, governmental research agencies, etc.) continue to play an active role in the fields of climate and climate change research and climate systematic observations. A number of Italian scientists played leading roles in the preparation of the Fourth Assessment Report (AR4) of IPCC (Intergovernmental Panel on Climate Change). Climate research in Italy is conducted by several organisations and institutions including government research agencies, universities, consortiums and foundations.

The major Italian research institutions and organisations working on climate change are described in the chapter.

A support to scientific research and technological development has been provided by the Special Integrative Fund for Research (FISR - Fondo Integrativo Speciale per la Ricerca), aimed at funding specific activities with particular strategic relevance, pursuant to the National Research Programme (PNR) and its updated versions. The FISR is financed by different Italian Ministries. The FISR, in the context of various PNR, co-funds the Strategic Programme for Sustainable Development and Climate Change, whose activities extend in the period 2005-2007. This programme focuses on the following fields:

- study of the evolution of climate variability and its impacts on urban, agricultural and forestry sectors;
- characterization of local soil structures, regional climate simulation and optimization of land management, with a special emphasis on water resources, agriculture and forestry resources, and fishery resources;
- regional studies on vulnerability of coastal zones and impacts assessments;
- projections for land and water ecosystems, with a special emphasis on biodiversity;
- atmospheric processes dynamics (aerosols, clouds, past climate reconstruction);
- applications of remote sensing to understand the climate processes;
- monitoring, assessments, simulations and predictions of the evolution of the agricultural systems in relation to climate change;
- sustainable methods and techniques for carbon sinks;
- studies of the oceanic carbon cycle;
- sustainability of the renewable resources to reduce Greenhouse Gases (GHGs) emissions.

Hence through this programme nine large national projects have been financially supported along with the establishment of a new research network called Euro-Mediterranean Center for Climate Change (CMCC – Centro Euro-Mediterraneo), whose research activities focus primarily on climate change and the impacts of climate change over the Mediterranean area.
The major Italian funding bodies for climate change research are:

- Environmental Protection and Technical services Agency (APAT - Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici),
- Ministry of Agriculture Food and Forestry Policies (MIPAAF - Ministero delle Politiche Agricole Alimentari e Forestali),
- Ministry of Economy and Finance, (MEF - Ministero dell'Economia e delle Finanze),
- Ministry for the Environment, Land and Sea (MATTM - Ministero dell'Ambiente e della Tutela del Territorio e del Mare),
- Ministry of Foreign Affaires (MAE - Ministero degli Affari Esteri),
- Ministry of University and Research, (MUR - Ministero dell'Università e della Ricerca)

In addition, the Italian scientific institutions conduct national projects with other national funding and also are involved in several European projects funded by the EC.
Furthermore, many agencies in Italy are involved in climate systematic observation. Italy has a very comprehensive observational coverage of its home territories, although not always such coverage can be used concurrently to estimate climate related parameters. In addition, Italy contributes significantly to shared international and national programmes involving ocean and space-based measurements; it has one of the longest instrumental temperature record in the world. APAT is managing, in collaboration with MeteoAM, CMA CRA, former UCEA, and regional services, a system (denominated SCIA) for the coordinated collection, calculation, representation and periodic update of ten-days, monthly and yearly climatic data. Finally Italy is supporting a research base in the Antarctica, which includes a meteorological observation site.

Education, Training and Public Awareness

The purpose of this chapter is to analyse the state of the art of education, training and public awareness in Italy. To assess the progresses made since the Third National Communication, the report makes an evaluation of the activities deployed by public administrations, both at central and local level, national scientific agencies (ENEA, CNR and APAT) and climate change NGOs.
The main findings of this evaluation can be summarised as follows:
- the information on climate change is developed not only by institutional entities but also by private companies and NGOs;
- there are different obstacles to the diffusion of activities on training, education and public awareness, as well as the "distance" between Institutions and citizens.
- priority must be given to the development of a detailed, non-technical review of the possible impacts of climate change on the Italian territory, especially in terms of the potential economic and social

consequences. Such a task can be accomplished through an improvement of the collaboration between the ministries and national research agencies and the educational system.

CHAPTER 2

NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

Government profile

Italy is a bicameral parliamentary Republic organised into 20 Regions which are part of the constitutional structure of the State.

The Government has overall responsibility for the implementation of the Kyoto Protocol and the delivery of the agreed emissions reduction, although a range of policies are the responsibility of regions, provinces and municipalities.

At central level, the Ministry for the Environment, Land and Sea is responsible for overall climate policy coordination, while the Ministry of Economic Development is responsible for national energy policy.

The legislative powers are divided between the national and regional level. The constitutional reform approved by Parliament in 2001 (constitutional law nr. 3 of 2001) and subsequently ratified in a referendum that same year, has deeply modified the attributions of powers between the central government and the regions, overturning the criteria that applied previously. The Regions have now legislative powers for any other matter not expressly reserved for the exclusive competence of the national Parliament. The protection of the environment and cultural resources is listed among the exclusive competences of the State.

In some other sectors specifically listed by the Constitution, as it is the case for 'energy production, transport and distribution', the State and the Regions have concurrent legislative powers. This means that the Regions have the power to adopt legislation, provided that it does not contrast with the framework principles adopted at State level.

The Constitutional reform also reorganises the distribution of administrative functions. Competences are now allocated according to the principles of unity, subsidiary, differentiation and adequacy. The effect is that municipalities have an enhanced administrative role and Regions have the responsibility to administer matters on which they legislate.

The complexity of this allocation system and the potential conflicts between different levels of government for attribution of competences has raised a strong debate for a further reform of the Constitution.

Climate and geographic profile

The Italian peninsula (contained between 47° and 36° north parallel) is nearly in the middle of the temperate area of the boreal hemisphere.

From the climatic point of view, being Italy surrounded by sea, its climate is temperate Mediterranean.

From Alps to Sicily there are 11 latitude degrees. The peninsula is divided in two versants from Apennines and the continental part of the country is surrounded by Alps.

Italy is formally divided in four climates:

- Alpine climate, dominant on Alps and northern and central Apennines, characterized by night and winter low temperatures and moist summer;
- Mediterranean climate, in the island and in the southern Italy, characterized by mild temperatures and moist winter;
- Peninsular climate, peculiar of the central part of the peninsula, characterized by mild temperatures along the coast and in the prompt hinterland (in the middle where the altitude is high there is an alpine climate), moist in spring and autumn;
- Po valley climate, with low temperatures in the winter, high in the summer, moist in spring and autumn.

In order to promote the collection and elaboration of climate data, APAT[2] has realized the National System of climate data (SCIA), in collaboration with the Meteorological Service of the Air Force, the central office of agriculture ecology and many Regional Agencies for the Environmental Protection (ARPA).

Through the elaboration of time series data, observed in different monitoring networks, SCIA provides monthly, annual and decadal data and normalized values of numerous meteo climatic variables[3].

Here are some considerations about data temperatures verified in 2005. Analysing the monthly and seasonal trend of thermic deviation compared with the climatic period 1961-1990 (see following figure), 2005 has been slightly warmer of the average (annual average anomaly +0.3 °C). May and the beginning of the summer have been much more warm than normal values (May: +2.2 °C; June: +2.1 °C; July: +1.5 °C); February has been the colder month compared with the normal values (-2.3 °C), followed by December (-1 °C). Concerning the different geographic areas no substantial anomaly values have been observed.

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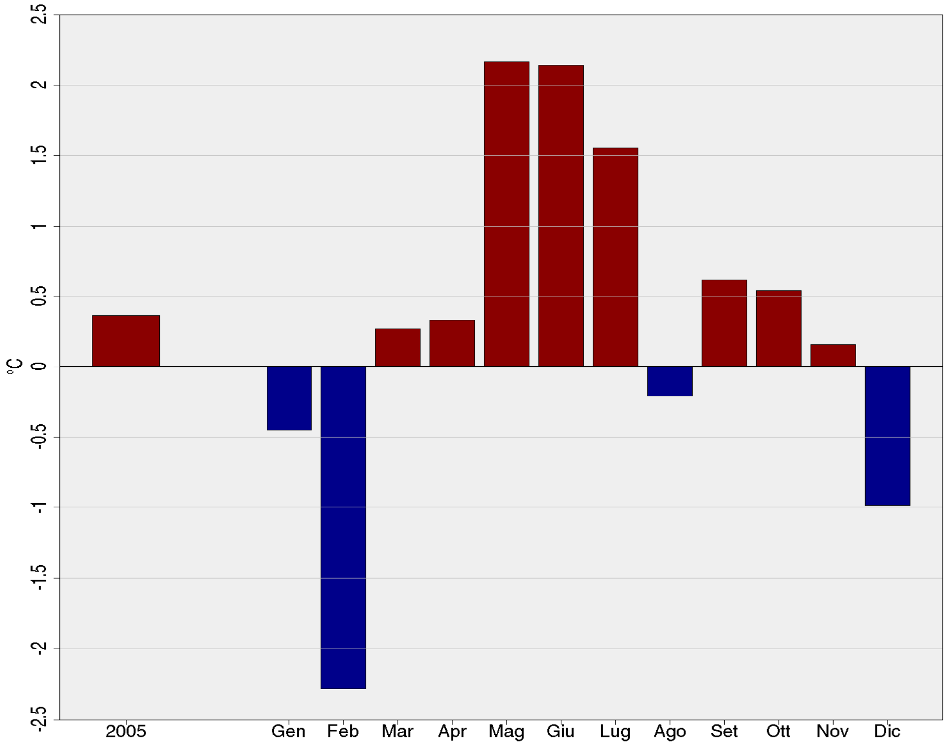
2 National Agency for Environment

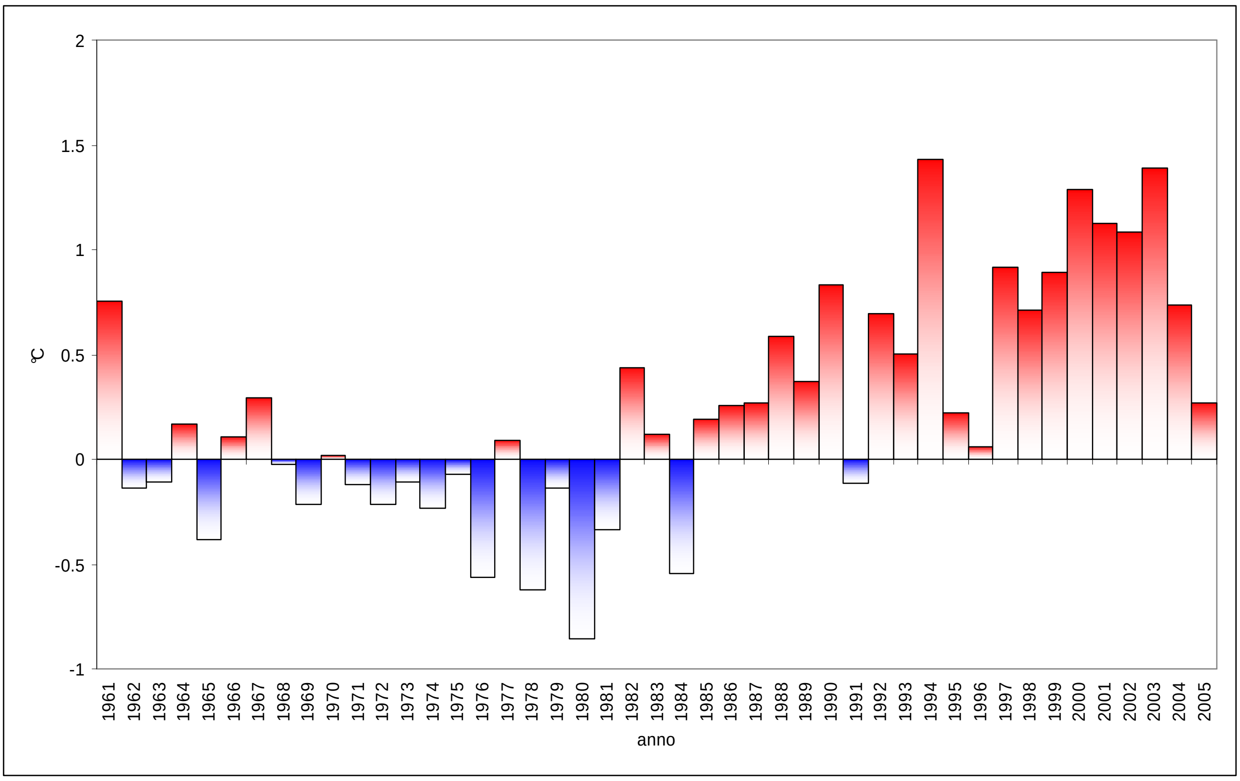
3 Criteria adopted for the calculation and representation of indicators are those suggested from World Meteorologic Organization

Figure 2.1: 2005 average anomaly (annual and monthly) of average temperature compared with normal values (1961-1990)



Source: Air Force network (60 stations)

Figure 2.2: Annual average anomalies from 1961 to 2005, of the average temperature compared to normal values (1961-1990).

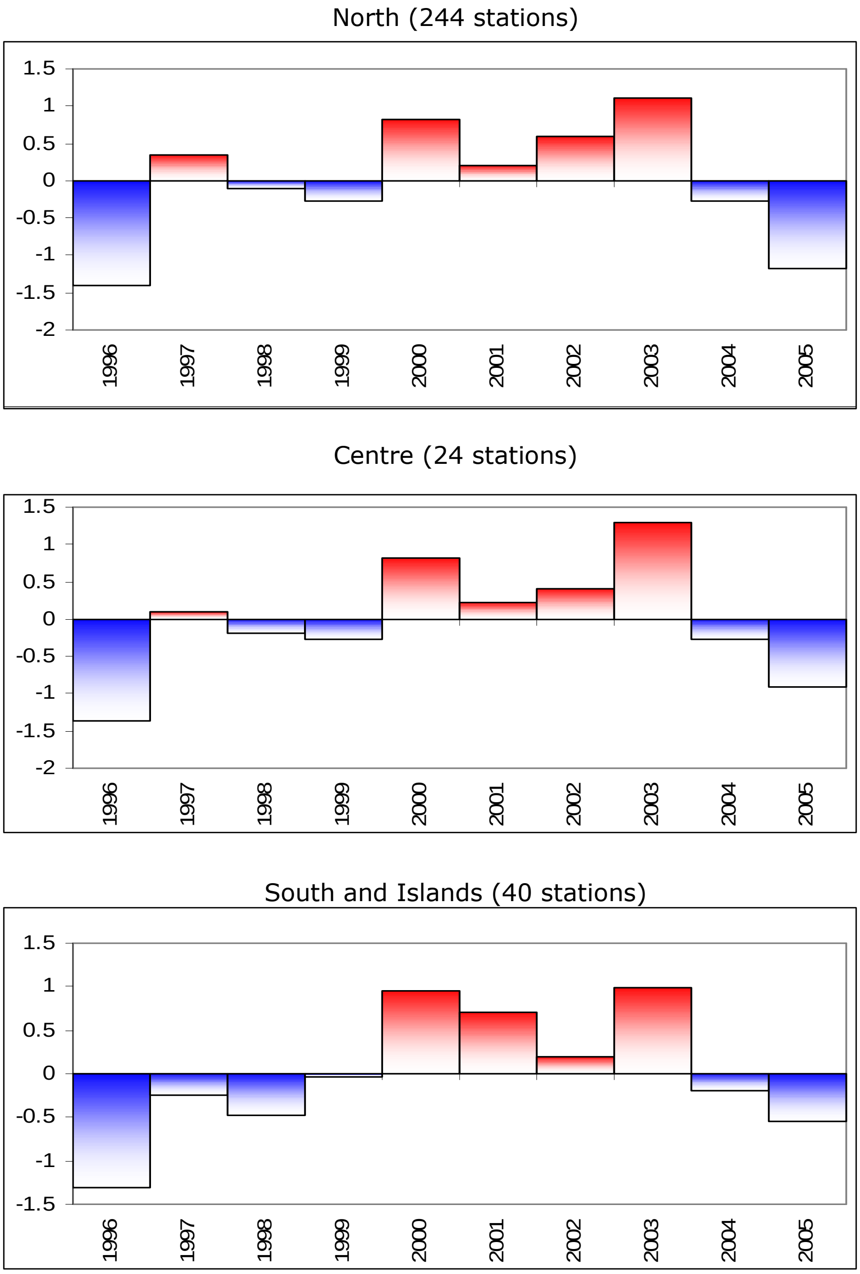


Source: Homogeneous time series of 49 stations of air force monitoring network

The year 2005 has been the 14° consecutive year with positive temperature anomaly, even if more moderate, compared with those registered in the last 8 years.

The average temperatures of the last 10 years are shown in the next figure. Positioning last decade values from the warmer to the colder, 2005 is positioned as second last. The average thermic trend in the last years does not show significant differences among northern, central and southern Italy, confirming that it depends basically from climate tendencies and factors on large scale.

Figure 2.3: Deviation of the last 10 years average, from the average temperature values

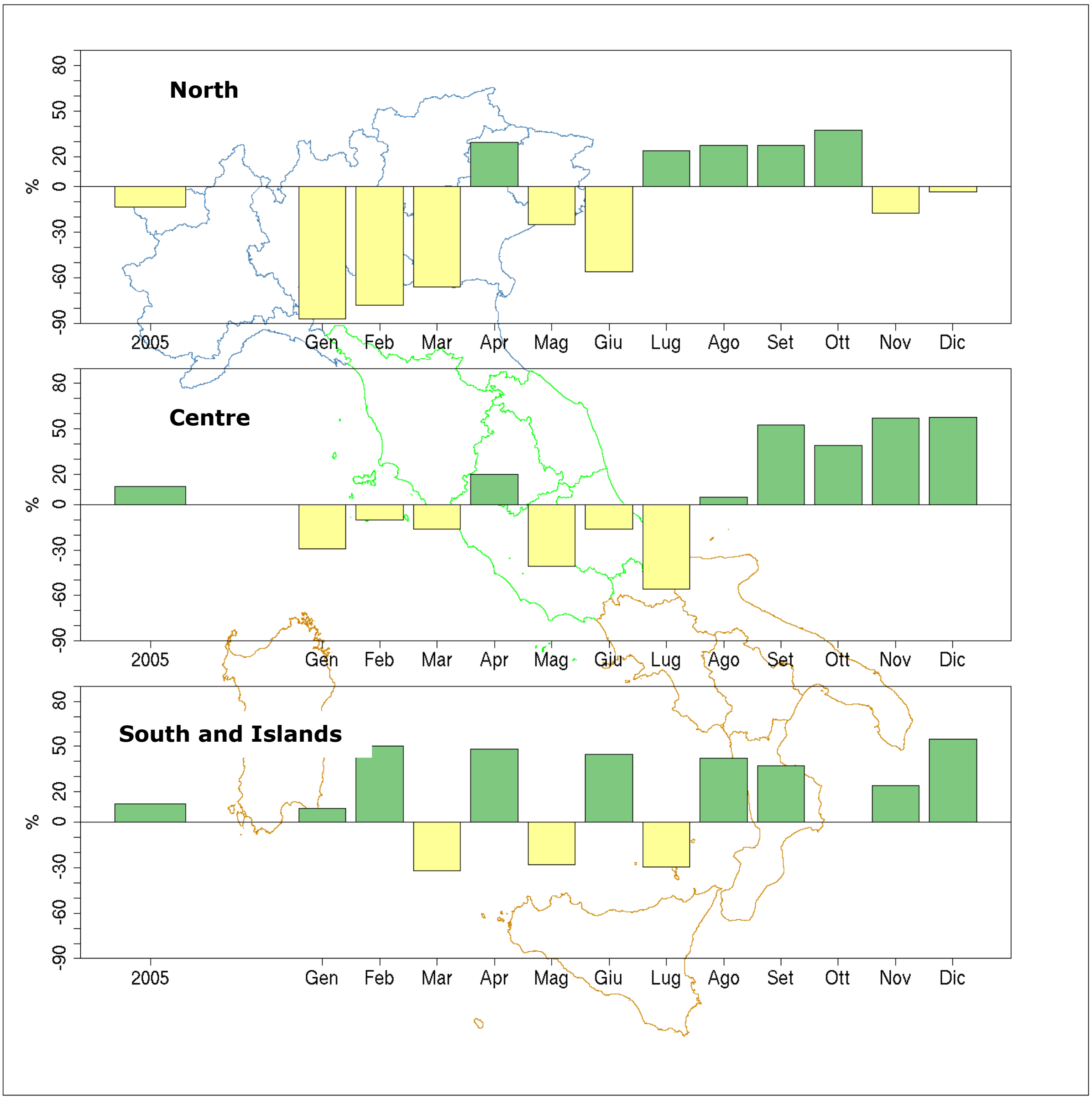


Source: Data from 223 stations of regional monitoring networks, 64 stations of air force and 21 stations of RAN (UCEA) network.

In order to illustrate extreme temperature values trend, have been calculated three indicators proposed by "CCL/CLIVAR Working Group on Climate Change Detection".
The indicators are: the average number of frost days (with a minimum temperature inferior to 0° C), the number of tropical nights (minimum temperature superior to 20° C) and the number of summer days (maximum temperature superior to 25° C).
It has been registered in average 9 frost days more than the normal value registered in the period 1961-1990, confirming the negative anomaly in the winter months. On a parallel plane, tropical nights and summer days have been superior to the normal values, which confirm the positive temperature anomaly in the summer months.
Finally, nevertheless the annual average temperature value is quite close to the long period one, 2005 has been characterized by several cold and warm extreme events, in particular frost wave events.

Concerning the rainfall trend, in 2005 it has been very different per geographic area.
In the North of Italy, total moist values have been lower than the average (about -15%); January and February has registered a deficit, of about 70-90%. Rainfall slightly higher than the average occurred in April, July, August, September and October has not been sufficient to fill the deficit observed in the other months of the year.
A different situation has happened in Central, Southern and Insular part of Italy where rainfall has been slightly higher to the average. In the Central part of Italy the total annual rainfall has been more than 10% compared with the normalized values of the period 1961-1990. in the Southern part and in the Islands rainfall have been of about 15% higher than the average.

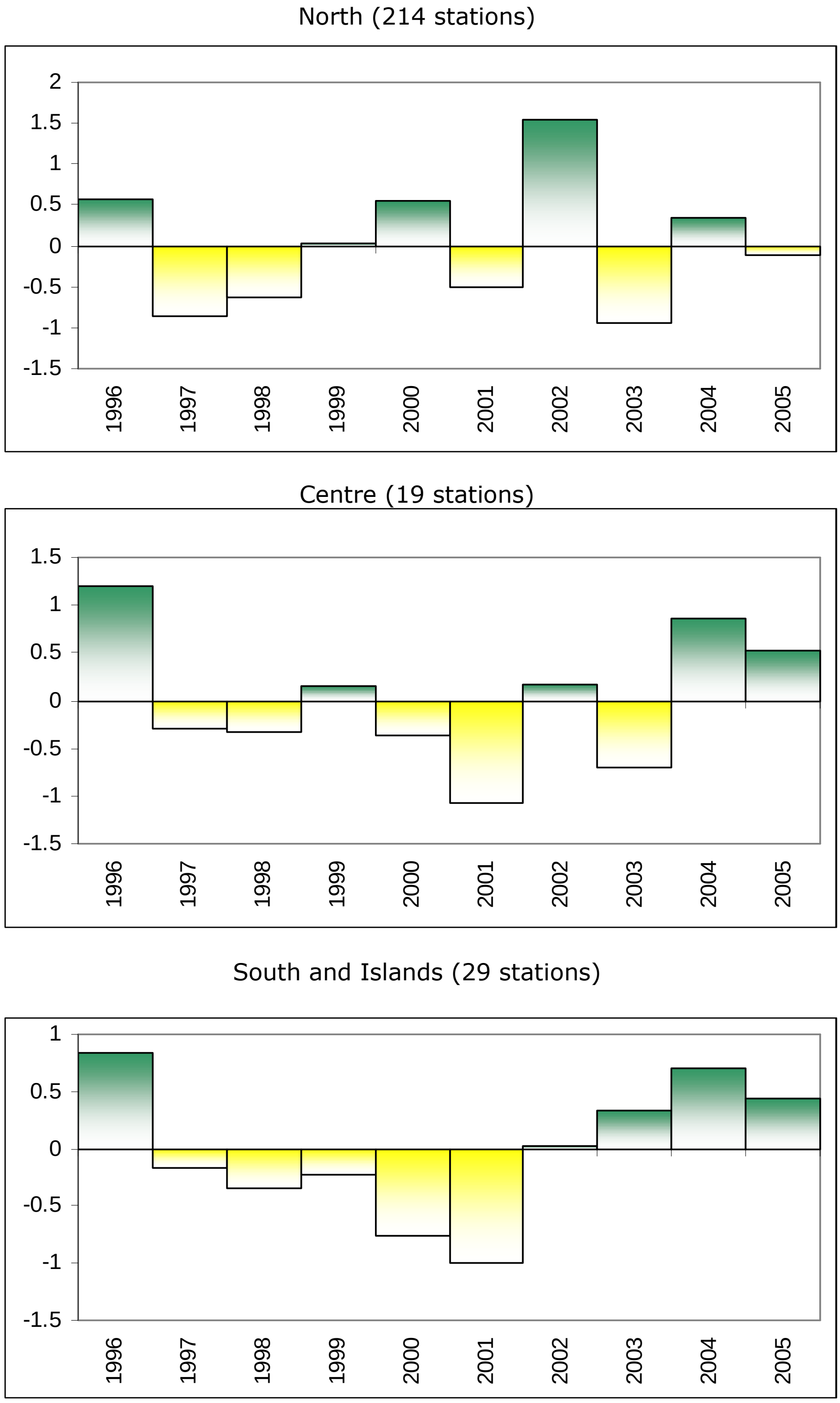
Figure 2.4: Average anomaly 2005 (annual and monthly, expressed in per cent values) of cumulated downfall compared to normal value 1961-1990



Source: Data from 272 stations in the North, 23 in the Centre and 45 in South and Islands

Comparing 2005 rainfall with the average of last 10 years, it can be observed that 2005 has been the third most rainfall year in the Central and Southern Italy; while, in the Northern part rainfall have been slightly lower than the average values of the decade. The figure of northern part is more precise compared with those of Central and Southern region, because the network of monitoring is denser in the North.

Figure 2.5: Standard deviation from the average of the last 10 years cumulated rainfall



Source: Data from 199 regional network stations, 51 stations from AM network, and 12 from RAN (UCEA) network

Population profile, building stock and urban structure

The national population is almost 59 millions at the end of 2005, with an increase of 0.5% compared with 2004. The growth is due to the migratory movements, +302,618 units that counterbalance the negative natural balance.

The aging trend of population was keeping on increasing. In the European Union Italy has the most elder population: at the 1st January 2005 the Italian aging index was 137.8%. In EU there were some countries with an index over 100%, such as Germany, Spain and Greek, bur far away from 130%. The estimate of Italian aging index at 1st January 2006 is 140.4%.

This situation is due to a low birth rate, about 1.3 children per woman, and a continuous growth of the elders of the population. The over 80 became a considerable share of the population: 3,055,089 (5.2%) at 1st January 2006 against 1,757,525 (3.1%) at 1st January 1990.

The migratory movements from abroad had influence on the structure of population: 86.0% of the new units of 2005 are foreigners. At 1st January 2006 the resident foreign population is 2.670.514, 4.5% of the population. In the period 2002-2005 the increase in the foreign population was 72%. The average age of the foreigners is 30.8 years against 42.6 years of resident population and 43.2 years of only Italians.

The national emissions of greenhouse gases are scarcely influenced by the growth of population. A bigger influence is given by the quality of the population. For example, the rate of urbanisation (Table 1) and the distribution of urban areas between warm and cold zones determine the demand for mobility for work and study, as well as the demand for the heating of indoor settings, both factors which modify the emissions per capita of greenhouse gases.

Table 2.1: Municipalities and population by categories of demographic magnitude as of 31 December 2005

Number of inhabitants	North-Centre		South		Italy		Cumulative Italy		
	Municipalities	Inhabitants	Municipalities	Inhabitants	Municipalities	Inhabitants	Municipalities	Inhabitants	
Up to 5,000	4,026	7,090,472	1,730	3,343,730	5,756	10,434,202	5,756	10,434,202	(17.8%)
5,001-20,000	1,233	11,538,021	615	5,830,299	1,848	17,368,320	7,604	27,802,522	(47.3%)
20,001-50,000	207	6,254,132	147	4,422,708	354	10,676,840	7,958	38,479,362	(65.5%)
50,001-100,000	49	3,414,061	51	3,317,964	100	6,732,025	8,058	45,211,387	(77.0%)
100,001-250,000	21	3,047,834	10	1,559,229	31	4,607,063	8,089	49,818,450	(84.8%)
250,000-500,000	4	1,269,804	2	631,059	6	1,900,863	8,095	51,719,313	(88.0%)
More than 500,000	4	5,377,336	2	1,655,062	6	7,032,398	8,101	58,751,711	(100.0%)
TOTAL	5,544	37,991,660	2,557	20,760,051	8,101	58,751,711	---	---	---

Source: ISTAT

The gradual aging of the population causes a decrease in the demand for mobility, but also it requires a greater need for climate-control, in both winter and summer. An advancing age population leads to a rise in the cares with a probable increase of emissions tied to the energy consumption. The extra-European Union immigrants also affect the emissions of greenhouse gases. At the beginning the immigrants cut the emissions per capita because they have less intensive models of consumption with reference to the emission of carbon. Later on the immigrants adopt the national models of consumption that usually have higher emissions than those prevalent in their countries of origin.

Another characteristic which affects efficiency consumption patterns and emissions is the average dimension of families. In Italy, according with our last census, there are around 22 millions of families with an average dimension of 2.6 persons per family. This dimension is becoming lower and lower, passing from 3.4 to 2.6 in the period 1971-2001.
Concerning the building stock, in Italy there are around 27 millions of dwellings. In the period 1971-2001, dwellings have increased of around 36%, the population of 5% and the number of families of around 26%. So, even if new buildings are more energy efficient, the increase of number of families has increased residential energy demand.

Economic profile and industry

The Gross Domestic Product (GDP) per capita is the second general factor that explains the emissions trend of greenhouse gases and the differences in the emissions levels between one country and another. The Italian GDP per capita is one of the lowest in the European Union and it's also lower than USA and Japan (Japan and Germany passed Italy in the last years) (table 2.2).

Table 2.2: Gross Domestic Product per capita at market prices. Values at current prices with purchasing power parity ($US)

Countries	1990	1995	2000	2001	2002	2003	2004	2005
Austria	19.159	23.248	28.723	29.239	29.963	31.740	33.235	34.393
Belgium	18.514	22.235	26.660	28.078	29.339	30.590	31.988	32.996
Denmark	18.230	22.696	28.823	29.914	30.307	30.684	32.161	34.091
France	17.851	20.962	25.938	27.278	27.961	27.697	29.006	30.266
Germany	18.033	22.050	25.568	26.352	27.108	28.933	29.916	30.777
Hungary	-	9.417	12.343	13.644	14.762	15.630	16.519	17.484
Ireland	13.104	18.057	28.852	30.778	33.032	34.580	36.536	38.850
Italy	17.910	21.482	25.886	26.818	27.471	27.267	27.777	28.172
Spain	13.301	16.023	21.086	22.333	23.762	24.880	26.018	27.400
Sweden	18.997	21.499	27.185	27.595	28.375	29.690	31.072	32.111
Switzerland	24.202	26.320	30.374	30.626	32.492	33.350	34.740	35.650
United Kingdom	16.456	19.887	25.588	27.092	28.978	29.873	31.780	32.860
Japan	18.713	22.403	25.597	26.199	26.834	27.723	29.305	30.773
United States	22.987	27.527	34.574	35.308	36.140	37.470	39.660	41.789

Source: OECD

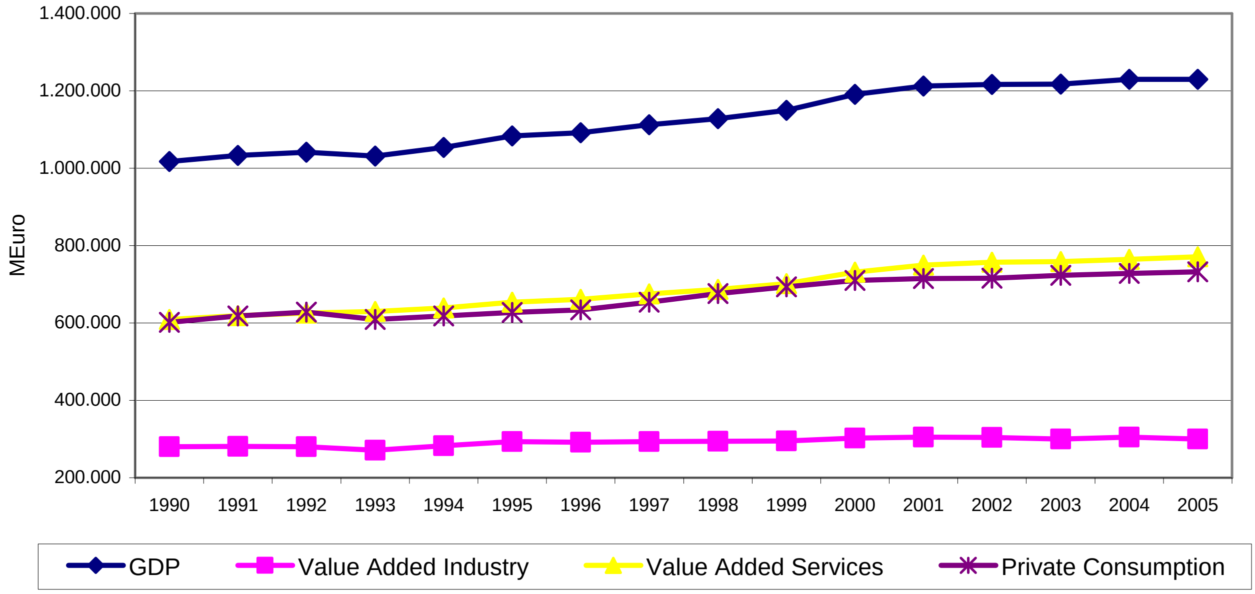
Table 2.3: Gross Domestic Product. Percentage change compared to previous year

Countries	2001	2002	2003	2004	2005
Austria	2.2%	3.0%	6.4%	5.4%	4.2%
Belgium	5.7%	5.0%	4.7%	5.0%	3.7%
Denmark	4.2%	1.7%	1.5%	5.1%	6.3%
France	5.9%	3.2%	-0.3%	5.4%	5.0%
Germany	3.3%	3.0%	6.8%	3.4%	2.8%
Hungary	10.3%	7.9%	5.6%	5.5%	5.6%
Ireland	8.3%	9.2%	6.4%	7.5%	8.7%
Italy	3.7%	2.8%	0.0%	2.9%	2.2%
Spain	7.1%	7.9%	6.5%	6.3%	7.1%
Sweden	1.8%	3.2%	5.0%	5.1%	3.8%
Switzerland	1.9%	6.9%	3.5%	4.9%	3.3%
United Kingdom	6.3%	7.3%	3.5%	6.9%	4.1%
Japan	2.6%	2.7%	3.5%	5.7%	5.0%
United States	3.2%	3.4%	4.7%	6.9%	6.4%

Source: OECD

The trend of main macroeconomics indicators, GDP, value added of industry and services and private consumptions, are showed in figure 2.6.

Figure 2.6: Macroeconomic indicators in Italy (values chain-linking – reference year 2000)



Source: ENEA's elaboration on ISTAT data

The average annual growth rate of GDP was 1.4% in the period 1990-2005. In the period there was a year of recession, 1993 (-0.9% compared with 1992), followed by eight years of high growth with an annual rate of 2.2% in 1994-2001. The last years showed a zero growth except 2004 (+1.1%).

The industrial sector showed a similar trend but more negative: a year of heavy recession, 1993 (-3.2%), followed by two years of high growth, 4.2% and 3.8% in 1994 and 1995, and one of light recession, -0.7% in 1996. The period 1997-2001 was characterized by a light growth, 0.9%/y, while the last years showed a continuous decrease, except 2004.

The pulling sector of Italian economy is the services sector. This sector showed an increasing trend over all period 1990-2005 with an annual growth rate of 1.8%. The period of bigger growth was 1994-2001, 2.4%/y, while the last showed a lighter growth.

The private consumption showed the same trend of GDP: a drop in 1993 (-3.1%), a period of high growth in 1994-2000 (2.4%/y), and a light growth in the last years. The annual growth rate was 1.4% in 1990-2005.

Table 2.4: National resources – 2005

	Values chain-linking	
	Millions euro	**%**
GDP at market prices	1,229,568	79,1
Imports of goods and services	323,776	20,9
TOTAL	1,552,877	100

Source: ISTAT

In 2005 the GDP was 1,229,568 millions euro against 1,230,006 millions euro in 2004.

In 2005 the agriculture accounted for 2.3% of Italian overall value added, while industry and services had a share of 26.9% and 70.9%, respectively (table 2.6).

Table 2.5: GDP in 1980-2005 (values chain-linking, reference year 2000)

Years	Millions euro	%
1980	802,050	-
1990	1,017,430	-
1995	1,083,771	-
2000	1,191,057	-
2001	1,212,442	1.8
2002	1,216,588	0.3
2003	1,217,040	0.0
2004	1,230,006	1.1
2005	1,229,568	0.0

Source: ISTAT

In 2005 the industrial sector showed a decrease compared with 2004 because of the bad performance of energy products and textile sectors. The primary metals and chemicals sectors showed the best performances in industry. In 2005 agriculture also showed a drop, only services sector presented an increase even if light.

Table 2.6: Value added at basis prices and GDP at market prices – 2005
(Values chain-linking, reference year 2000)

Branches	Absolute values	%
Agriculture. forestry and fishing	**29,692**	**2.3**
Industry	**299,962**	**26.9**
Energy products	*28,183*	*2.7*
Products of industrial transformation	*209,297*	*18.2*
Construction	*62,340*	*6.0*
Services	**770,810**	**70.9**
Trade and hotels	*172,874*	*15.4*
Transport and communications	*92,437*	*7.8*
Credit, insurance and rental of buildings	*280,131*	*26.9*
Public Administration and defence	*66,096*	*6.5*
Other services	*159,771*	*14.3*
Value added at basis prices	**1,100,744**	**100.0**
VAT and indirect taxes on imports	*128,550*	*11.4*
Gross Domestic Product at market prices	**1,229,568**	**111.4**

Source: ISTAT

Table 2.7: Uses - 2005 (Values chain-linking, reference year 2000)

	Millions euro	%
National consumption	**973,364**	**62.6%**
resident families	727,228	46.3%
of which: transport	103,013	6.4%
Public Administration	245,988	16.4%
in the economic territory	738,896	47.1%
Gross fixed investments	**257,551**	**16.3%**
of which: construction	115,260	7.7%
transport equipment	24,144	1.5%
net fixed investments	71,135	4.7%
Amortization	186,620	11.6%
Stock changes	,,	..
Valuable objects	1,576	0.1%
Exports of good and services fob	**313,178**	**20.8%**
TOTAL	**1,552,877**	**100.0%**

Source: ISTAT;[(a)] Final domestic consumptions.

In the 2005 the world trade increased by 12% because of both a rise in exchanged quantities and an increase of average unit values. In an international outlook characterised by significant instability and intense competitive pressure Italy's market share dropped from 3.9% in 2004 to 3.5% in 2005.

The Italian trade balance had a deficit of 9,947 millions euro against a surplus of 1,221 million euro in 2004. The exports showed an increase of 4% while the growth in the imports was equal to 7%. About the geographic areas the bigger deficits were from North Africa and East Asia, while the greater surpluses were from North America and Oceania.

The main markets for the national exports were European Union (58.6%, with Germany at 13.1% and France at 12.2%) and North America (8.9%). In 2005 the exports kept on having the same structure: equipment goods had the bigger share (40.1%), followed by chemicals (13.9%) and textile (13.0%) (table 2.8)

Table 2.8: Italian exports - %

Branches	2002	2003	2004	2005
Agriculture	1.5	1.5	1.3	1.3
Mining	0.3	0.3	0.3	0.3
Food	5.6	5.6	5.5	5.4
Textile and leather	15.3	14.7	13.7	13.0
Wood	0.5	0.5	0.5	0.4
Paper	2.3	2.3	2.2	2.1
Chemicals	13.7	13.6	13.4	13.9
Coke and refined petroleum products	1.7	2.0	2.2	3.3
Primary metals	8.0	8.3	9.6	10.1
Non metallic minerals	3.4	3.3	3.2	3.0
Equipment goods	40.4	40.2	40.6	40.1
Other manufactories	6.3	5.7	5.4	5.0
Energy	0.0	0.0	0.0	0.0
Other products not classifiable elsewhere	1.0	2.0	2.1	1.8
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**
TOTAL in millions euro	**269,064**	**264,616**	**284,413**	**295,739**

Source: ISTAT.

The imports of goods were the 20.9% of national resources in 2005. The imports showed an increasing trend with acceleration in the last two years.
European Union (57.2%) and East Asia (9.6%) were the main geographic areas of imports for Italy. The main imported goods were transport equipment (13.4%), chemical products (13.3%) and electronic and optical devices (12.4%).

Table 2.9: Italian imports - %

Branches	2002	2003	2004	2005
Agriculture	3.2	3.2	3.0	2.7
Mining	10.1	10.4	11.1	14.3
Food	7.1	7.1	6.9	6.5
Textile and leather	7.8	7.6	7.2	7.1
Wood	1.3	1.3	1.2	1.1
Paper	2.5	2.4	2.2	2.1
Chemicals	15.6	15.7	15.6	15.4
Coke and refined petroleum products	1.9	1.8	1.7	1.8
Primary metals	9.3	9.1	10.4	10.3
Non metallic minerals	1.1	1.1	1.1	1.0
Equipment goods	36.2	35.1	34.6	32.8
Other manufactories	1.6	1.6	1.6	1.7
Energy	0.7	0.7	0.6	0.7
Other products not classifiable elsewhere	1.4	2.4	2.5	2.1
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**
TOTAL in millions euro	**261,226**	**262,998**	**285,634**	**305,686**

Source: ISTAT

Table 2.10: Exchange trade by geographic areas and main countries – 2005 (Millions euro)

Countries and geographic areas	Exports	Imports
EUROPE	**210,961**	**212,926**
European Union	**173,370**	**174,994**
-France	36,188	30,309
-Germany	38,768	52,516
-Netherlands	7,099	17,265
-Spain	21,936	12,721
-United Kingdom	19,032	12,141
Other European countries	**37,591**	**37,932**
-Switzerland	11,626	9,270
AFRICA	**11,494**	**24,600**
North Africa	**7,544**	**19,527**
-Libya	1,361	9,732
Other African countries	**3,950**	**5,072**
-Republic of South Africa	1,302	2,390
AMERICA	**35,061**	**19,744**
North America	**26,372**	**12,107**
United States	23,940	10,716
Central-Southern America	8,689	7,637
-Brazil	2,033	2,874
ASIA	**33,942**	**46,633**
Middle East	**11,791**	**12,125**
-Iran	2,257	2,922
Central Asia	**2,932**	**5,193**
-India	1,679	2,200
East Asia	**19,219**	**29,315**
-China	4,605	14,131
-Japan	4,541	4,976
OCEANIA	**3,027**	**1,507**
OTHER TERRITORIES	**1,253**	**274**
WORLD	**295,739**	**305,686**

Source: ISTAT

Employment

In the last years there was an 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.). Also the unemployment rate showed a decreasing trend: it's dropped from 8.0% in 2004 to 7.7% in 2005.

In 2005 the labour force represented 42.1% of Italian population while the workers were 38.8%. This situation was the result of a cut in agriculture sector (-4.3%) and light increases both in industry and services sector, +1.0% and +0.9% respectively. In the industrial sector the industry in strict sense showed a drop (-0.2%) counterbalanced by an increase in construction (+4.4%). In the services sector the growth of 0.9% was caused by a drop in credit and insurance, public administration and communications (-1.2%, -1.0% and -1.0% respectively) and an increase in services to firms and hotels and restaurants (+2.7% and 2.4% respectively).

Table 2.11: Labour force in Italy

(thousands of units, average value of the year)

	2004		2005	
	Thousands	%	**Thousands**	%
Labour force	**24,365**	**42.3**	**24,451**	**42.1**
Employed	22,404	38.9	22,563	38.8
Agriculture	**990**	**1.7**	**947**	**1.6**
Industry	**6,868**	**11.9**	**6,940**	**11.9**
in strict sense	*5,036*	8.7	*5,028*	8.6
Construction	*1,833*	3.2	*1,913*	3.3
Services	**14,546**	**25.3**	**14,675**	**25.2**
Commercial activities	3,434	6.0	3,416	5.9
Other	11,112	19.3	11,259	19.4
Individuals seeking work	1,960	3.4	1,889	3.2
Not labour force	**33,189**	**57.7**	**33,683**	**57.9**
Total resident population	**57,553**	**100.0**	**58,135**	**100.0**

Source: ISTAT

Table 2.12: Population and labour force in Italy

(thousands of units, average value of the year)

	Population	Labour force	Activity rate (%)	Unemployment rate (%)
2000	57,189	**23,598**	**61.0**	**10.1**
2001	57,348	**23,769**	**61.6**	**9.1**
2002	57,474	**23,975**	**62.1**	**8.6**
2003	57,478	**24,289**	**62.9**	**8.4**
2004	57,553	**24,365**	**62.5**	**8.0**
2005	58,135	**24,451**	**62.4**	**7.7**

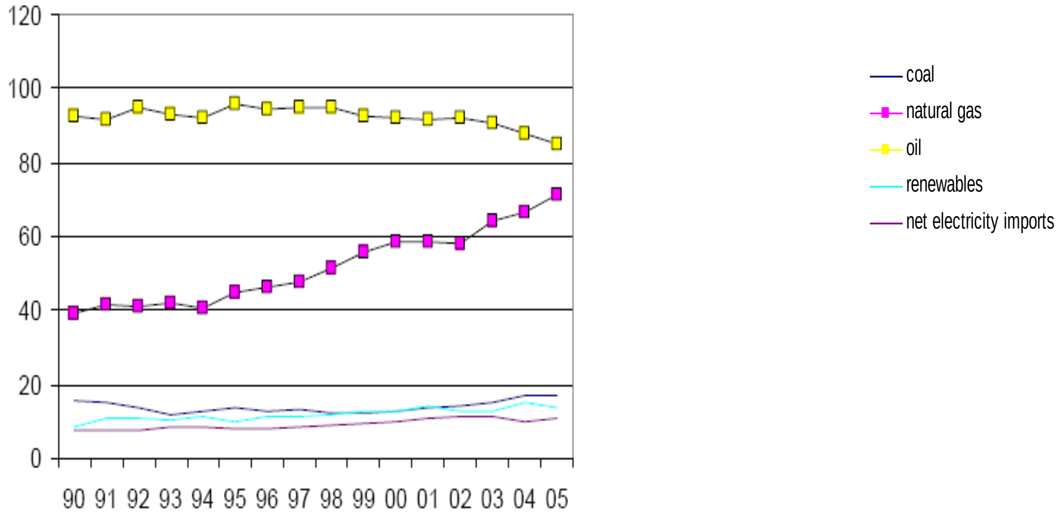
Source: ISTAT

Energy

During the last years, in spite of moderate growth of Italian economy, energy supply and intensity have slowly increased. The primary energy consumption per fuel types shows a reduction of oil, which remain in any case, the most important energy source. The corresponding increase in the use of the natural gas confirms a substitution process between gas and oil started in mid nineties. Coal has decreased in 2005. Basically stable the quantity of imported electricity.

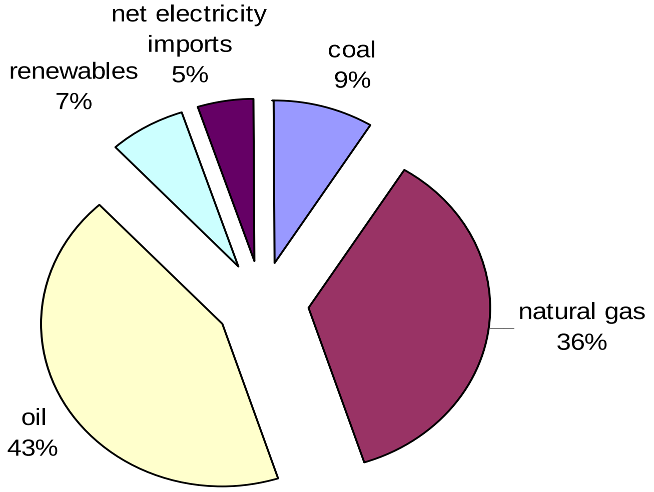
Compared with others European countries, Italy's energy primary consumption is characterized by a major use of oil and gas, a structural electricity imports, a weak coal contribution and absence of nuclear power. The share of renewable energy in the energy supply mix is slowly higher compared with the OECD's average, mostly due to hydropower.

Figure 2.7: Energy supply per fuel type, trend 1990-2005 Mtep



Source: Economic Development Ministry

Figure 2.8: Breakdown of Italy energy supply (2005)



Source: Economic Development Ministry

Table 2.13: Energy gross domestic consumption, energy intensity, electrical intensity

	1995	2000	2001	2002	2003	2004	2005
Energy Demand (Mtep)	172.6	185.9	188.8	188.1	194.4	196.5	197.8
Gross domestic consumpti on (TWh)	278.9	320.9	327.4	335.9	344.8	349.0	352.9
End-uses electric consumpti on (TWh)	243.4	279.3	285.5	291.0	299.8	304.5	309.8
Gross Domestic Product (M€)	1.083.771	1.191.057	1.212.442	1.216.588	1.217.040	1.230.006	1.229.568
Energy intensity (tep/M€)	159.2	156.1	155.7	154.6	159.7	159.8	160.8
Electric intensity (MWh/M€)	225	235	235	239	246	248	252

Source: Economic Development Ministry, ENEL (until 1998), GRTN (1999-2005), TERNA

In 2005 the total energy demand has increased of 1.7% compared with the previous year. The electric consumption has increased mainly in the tertiary sector. The growth of electrical consumptions, higher than GDP growth, has caused a raise of electrical intensity.

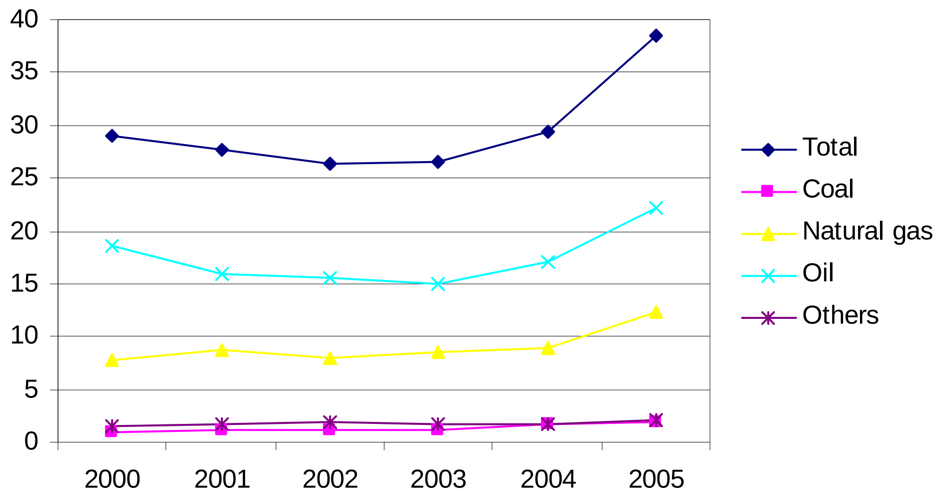
The energy bill in 2005 has been of 38.5 B€, with a raise of 9.1 B€ compared with 2004. That growth is about 31%, which represent the most important bill increase in the last two decades. This is due mostly to the increasing of energy prices.

Table 2.14: Trend of energy bill in Italy (M€)

	2000	2001	2002	2003	2004	2005
Coal	996	1223	1142	1130	1707	1881
Natural gas	7834	8782	7921	8547	8901	12299
Oil	18651	15985	15511	15032	17021	22213
Others	1524	1751	1867	1797	1762	2134
Total	29005	27741	26441	26546	29391	38527
Oil cost ($/Barrel)	26.9	23.0	23.0	27.7	35.1	50.4
Change $/€	0.9174	0.8954	0.9495	1.1273	1.2426	1.2359
Oil cost (€/ton)	223.5	196.0	188.9	187.1	216.5	307.4

Source: Unione Petrolifera

Figure 2.9: Trend of energy bill in the last 6 years (B€)



Source: Economic Development Ministry, Unione Petrolifera

The raise of energy bill is due to the energy dependence of Italy from abroad, which is growing continuously since the end of nineties. In 2005, the energy dependence of Italy was about 85.07%, compared with a European average of 54%. The dependence is mostly due to oil (92.86%)

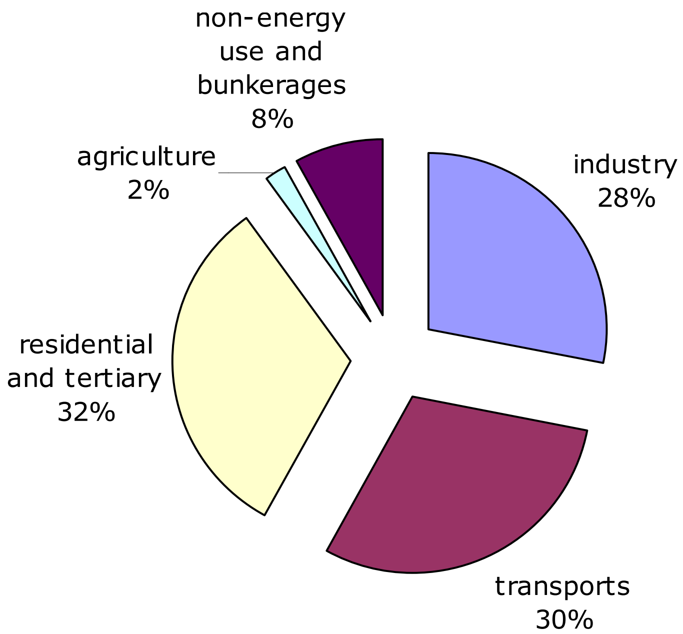
Table 2.15: Energy dependence EU-15

	1995	2000	2001	2002	2003	2004	2005
Austria	67,8	66,4	68,1	67,9	69,7	69,2	70,9
Belgium	77,4	77,1	77,7	76,5	77,2	75,9	75,9
Finland	56,3	54,4	55,5	55,1	57,6	55,8	55,2
France	47,4	49,6	50	49,4	49,7	50	50,3
Germany	57,6	60,6	61,9	61	61,3	60,6	60,3
Greece	60,4	63,8	64,7	64,7	66,8	65,7	66,2
Ireland	61,1	83,9	87,4	89,4	86,3	87,1	88,9
Italy	**81,6**	**84,2**	**84,9**	**84,6**	**85,2**	**85,4**	**85,7**
Luxemburg	98,6	98,5	98,4	98,6	98,6	98,5	98,3
Netherlands	8,5	25	22,4	23	27,7	17,5	24,1
Portugal	83,8	84,8	83,9	86,2	83,2	85,5	87,3
Spain	69,6	74,4	73,8	75,9	75,8	76,6	79
Denmark	23,8	-39,6	-33,3	-43,6	-37	-53,1	-58,7
United Kingdom	-15	-16,9	-11,8	-12,9	-6,2	3,5	12,9
Sweden	36,3	35,2	32,3	38,8	38,8	33,7	32,7

Source: ENERDATA

Energy end-uses total consumption in 2005 has been of 146.6 Mtep, of which 32% related to the tertiary sector (residential, public and tertiary sectors) and 30% to the transports sector. Industrial sector covers 28% of total end-uses energy consumption, as shown in the following figure:

Figure 2.10: Energy end-use consumption per sector, 2005 (Mtep)



Source: Economic Development Ministry

Energy intensity in Italy

In the period 2002-2005, primary and final energy intensities in Italy have increased according with major energy consumptions (+5.2%). Energy consumption has increased more than economic growth (+1.0%). This is due in particular to consumption raise in the civil sector, for climatic reasons, more gas consumptions for heating in the winter, more electricity consumptions for cooling in the summertime. Instead, industry and transports energy intensities have decreased in the same reference period.

Table 2.16: Fundamental variables and energy intensities in Italy (years 2003-2005)

	2003	Variance 2003/2002	2004	Variance 2004/2003	2005	Variance 2005/2004
GDP	1.217.040 M€	+0.04%	1.230.006 M€	+1.07%	1.229.568 M€	-0.04%
Population	57.888.245	+1.0%	58.462.375	+1.0%	58.751.711	+0.5%
Total energy consumption	194,4 Mtep	+3.4%	196,5 Mtep	+1.1%	197,8 Mtep	+0.64%
Primary energy intensity	159,7 tep/M€ ('99)	+3.3%	159,8 tep/M€ ('99)	+0.04%	160,8 tep/M€ ('99)	+0.67%
Final energy consumption:	142,3 Mtep	+4.4%	145,1 Mtep	+2.0%	146,6 Mtep	+1.0%
- industry	41,0 Mtep	+3,6%	41,4 Mtep	+1,0%	41,1 Mtep	-0,8%
- transport	43,7 Mtep	+2,1%	44,4 Mtep	+1,6%	44,0 Mtep	-1,0%
- residential and tertiary	43,8 Mtep	+8,8%	44,7 Mtep	+2,1%	47,1 Mtep	+5,3%
Final energy intensity	116,9 tep/M€ ('99)	+4.39%	118,0 tep/M€ ('99)	+0.9%	119,2 tep/M€ ('99)	+1.0%
Final electric intensity	20,6 tep/M€ ('99)	+3.0%	20,7 tep/M€ ('99)	+0.3%	21,0 tep/M€ ('99)	+1.8%
Final energy consumption per capita	2,458 tep/pop	+3.4%	2,482 tep/pop	+1.0%	2,495 tep/pop	+0.5%
Gas consumption	77.680 Mmc	+10.2%	80.609 Mmc	+3.8%	83.027 Mmc	+3.0%
Oil consumption	97.463 kt	+0.4%	99.035 kt	+1.6%	99.728 kt	+0.7%

Source: Elaboration data from Economic Development Ministry, ISTAT and GRTN

Compared with the European average, Italy has a lower primary and final energy intensities, even if, the gap with European average has reduced in the recent years. That's because although energy intensity has fallen due to a shift of the economy from industry to tertiary sector, consumption patterns of energy in the civil sector are more energy intensive.

Concerning the electric sector, more than 80% of the production in Italy is assured recurring to thermoelectric. The rest is cover with renewable resources (hydropower, wind, photovoltaic and landfill gas). The weight of renewable resources has grown in the latest years.

In reference to the industry sector, there has been a switch from energy intensive sub-sectors to less energy intensity sub-sectors (as within the chemical sector). In the latest years, overall industrial sectors have registered lower energy intensities, as in the chemical (-5.3%), food and agriculture (-1.5%) mechanics (-1.6%), buildings and paper sector (-0.9%) and others manufacturing sectors (-3.9%).

Due to the competition of emerging countries, strong changes in Italian industrial system are expected, influencing also energy intensities.

Table 2.17: Energy intensities per industrial sector. Years 2003-2005 (tep/M€99)

	2003	Variance 2003/2002	2004	Variance 2004/2003	2005	Variance 2005/2004
Building materials, glass and ceramics	727.9	+9.2%	744.0	+2.2%	721.1	-3.1%
Chemicals sector	335.2	+7.4%	319.4	-4.7%	317.4	-0.6%
Petrochemical	116.1	+17.3%	122.1	+5.2%	121.3	-0.6%
Metallurgy	225.9	+5.2%	235.5	+4.3%	232.8	-1.1%
Paper	214.3	+6.0%	215.2	+0.4%	212.3	-1.4%
Agroindustrial	181.1	+3.1%	184.8	+2.1%	178.3	-3.5%
Textiles	112.3	+5.7%	107.1	-4.6%	112.9	+5.4%
Mechanics	91.2	+3.3%	88.8	-2.6%	89.7	+1.0%
Others	107.2	-2.2%	102.3	-4.6%	103.0	+0.7%
Total manufacturing sector	**192.4**	**+6.0%**	**191.7**	**-0.3%**	**192.9**	**+0.6%**
Building industry	3.2	+13.2%	3.3	+3.2%	3.4	2.6%
Industry*	**136.4**	**+4.9%**	**135.7**	**-0.5%**	**136.9**	**+0.9%**

**"Industry" row includes industry sector strictly speaking + building sector*

Source: Elaboration data from Italian ministry for economic development, ISTAT

Transport

In 2005, transport sector represents, 22.56% of total greenhouse gases emissions and 14.3% of total households consumptions. In Italy there is the world highest concentration of private car per capita (1.69 inhabitants per car). There are 48 millions of cars circulating, with an average walk of 13,000 km/year and a movement of goods for 240 billions of tons/year.
Although the population is stable, since 1990 passengers mobility rose significantly, increasing energy use and greenhouse gases. That growth is mostly attributable to private car use, as public transport and railroad transport are stable.
In terms of passengers/km, the demand of mobility is the higher in Europe (+29% compared with European average). The transport of goods is for 65% on the road.
In the last decade the transport of goods rose of +36% compared with 1990. The transport sector absorbs an important share of energy consumption, moreover transport demand appears in strong expansion. For these reasons, the transport sector represents a critical point for environmental consequences and in order to respect the Kyoto protocol.
The major critical elements of the Italian systems of transport, could be summarized as follows:

- Strong use of private cars
- Congestion (mostly in urban areas)
- Energy consumption in consistent increase in the period 1990-2004 (10.6 Mtoe)
- Alarming increase of air pollutants (NOx, COVNM, PM_{10}, PB, C_6H_6)
- in the period 1990-2004, 30% increase of greenhouse gases emissions (CO_2, CH_4, N_2O), as although more fuel efficient cars, the demand of mobility as well as the car displacement rose.
- Weak public transports networks.

The need of energy in the transport sector in Italy rose of about 31%, in the period 1990-2005, as shown in the following table:

Table 2.18: Energy consumption in the transport sector per source (Mtep)

	1990	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Natural gas	0.210	0.329	0.370	0.365	0.367	0.364	0.384
Oil	32.820	40.446	41.126	41.523	42.270	42.955	42.568
Renewable			0.094	0.136	0.226	0.243	0.157
Electricity	0.580	0.732	0.737	0.771	0.814	0.826	0.853
TOTAL	**33.610**	**41.507**	**42.327**	**42.795**	**43.677**	**44.388**	**43.962**

Source: ENEA

Energy final end-uses raised about 10 Mtep. Transport sector depends almost completely by oil (97%).
Actually, in Italy the increase of vehicles fuel efficiency is not able to balance the increase of transport demand and car displacement. Efforts undertaken from car industry in collaboration with the European Commission in order to reduce car's CO_2 emissions, will contribute in a strong way to reduce these tendencies.
The energy demand increase combined with lack of infrastructures and a good public transport system, exasperate congestion problems in urban areas, with negative consequences for environment and citizens' life, without considering external costs of pollution estimated in about 2% of GDP.
Concerning policies for the transport sector, the more important are:

- Obligation for Municipalities of more than 30,000 inhabitants to establish a Urban Traffic Plan (PUT), in order to improve traffic, pollutant emissions and energy efficiency;

- The use of telematic technologies for traffic management;
- Establishment of cycle tracks and pedestrian areas;
- New regulation on biofuels

Within 2008, according with the ACEA agreements, on the Italian market will be cars using less than 5.8 L/100km and gasoline cars using less than 5.25 L/100km of fuel. Considering a presence of 16.6% on the total cars circulating in Italy, for these types of new cars, it is possible to estimate an average of unit consumption of about 5.6 L/100km at 2010 that will produce an energy saving of 2.9%. One point of saving obtained in the transport sector, means 0.43 Mtep, corresponding to about 1.2 Mt CO_2 avoided. Therefore, the environmental importance of one point energy saving in the transport sector, correspond to avoid 0.25% of the total CO_2 emissions of the national energy system.

Table 2.19: Energy intensity in the transport sector (final energy consumption/GDP) – (tep/M€)

	1990	1995	2000	2001	2002	2003	2004	2005
Gas	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Oil Products	**33.2**	**35.0**	**34.3**	**34.2**	**34.4**	**35.1**	**35.3**	**35.1**
Fuel	13.8	16.8	14.7	14.3	13.8	13.3	12.4	11.5
Diesel fuel	15.9	14.1	15.1	15.7	16.7	17.6	18.9	19.5
Carboturbo	2.0	2.6	3.1	2.9	2.7	3.1	3.0	3.2
Lpg	1.5	1.5	1.3	1.3	1.2	1.1	1.0	0.9
Electric Energy	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.7**	**0.7**	**0.7**
Total	**33.9**	**35.8**	**35.1**	**35.2**	**35.4**	**36.2**	**36.5**	**36.3**

Source: ENEA

Waste

Production and collection of municipal waste

The production of municipal waste (MW) in Italy is approximately 31.7 Mt/a (2005), corresponding to a daily per-capita production of 1.47 kg (539 kg per person per year). Of these, 7.7 Mt/a (24.3%) are subject to separate collection, showing an increasing trend during last years, even though figures are lower than minimum targets set by the legislation (Government Decree n. 22/97 and Government Decree n. 152/2006).

Available data for years 1996-2005 are shown in detail on table 2.20.

Table 2.20: Production and collection of MW

Year	Production	Separate collection		
	(Mt/a)	(Mt/a)	(%)	Legislation targets
1995	25.8	n.a.	n.a	
1996	26.0	1.87	7.2	
1997	26.6	2.51	9.4	
1998	26.9	3.01	11.2	
1999	28.4	3.71	13.1	15% (1)
2000	29.0	4.18	14.4	
2001	29.4	5.12	17.4	25% (1)
2002	29.9	5.74	19.2	
2003	30.0	6.34	21.1	35% (1)
2004	31.1	7.07	22.7	
2005	31.7	7.70	24.3	
2006	32.4 (3)			35%(2)

Source: ENEA analysis

Notes:
(1) Minimum targets of Government Decree n. 22/97
(2) Minimum target of Government Decree n. 152/2006
(3) Estimated value

Management of urban waste

There are different approaches for MW management, which can be summarised as follows:

- composting of the selected organic fraction;
- mechanical treatments for the recycling of the separately collected materials and/or other forms of recovery;
- mechanical-biological treatments of mixed MW (RDF, refuse derived fuel/bio-stabilised production);
- incineration, with or without energy recovery;
- disposal at controlled landfills.

Based on an ENEA analysis, the present situation and trend are summarised on table 2.21.

Energy recovery through incineration

At the end of 2005, there were in Italy 50 operating plants for incineration of MW, as shown on table 2.22, which also lists the treated quantities, the production of electricity and heat during the period 1997-2005.

In 2005, in particular, the total electricity produced from MW was 2,637 GWh (with an installed electric power of 536 MWe), while the thermal energy recovered (in the form of steam and/or hot water) was

706 GWh; the corresponding overall recovery efficiency (electricity and heat) was estimated at approximately 25% of the total energy content of the treated MW.

The recovery of energy from the combustion of biogas

The collection of the biogas that is released from controlled landfills of organic waste, required under the law for environmental reasons, has favoured the energy recovery in recent years, partly thanks to the economic incentives[4] provided for the production of electricity from renewable energy sources.

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

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 manage 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 MW landfills, while other applications (sludge from wastewater treatment, animal detritus, residues from the agro-food industry etc.) play a very marginal role.

In terms of the energy recovered from MW landfills, the main data available (number of plants, installed power and gross production of electricity) are summarised on table 2.23.

4 In the past, Deliberation no. 6/92 of the CIP (in force until December 1996); at present, the "green certificates "

Table 2.21: Management of Municipal Waste

Treatment	1997		1998		1999		2000		2001		2002		2003		2004		2005	
	Mt/a	%	Mt/a	%	Mt/a	%	Mt/a	%	Mt/a	%	Mt/a	%	Mt/a	%	Mt/a	%	Mt/a	%
Composting (organic + green waste)	0.60	2.27	0.89	3.32	0.84	2.97	1.24	4.27	1.73	5.88	1.70	5.68	1.80	5.98	1.96	6.29	2.09	6.59
Other form of recovery (1)	1.90	7.15	2.12	7.88	2.87	10.10	2.94	10.17	3.39	11.51	4.04	13.54	4.54	15.13	5.11	16.40	5.61	17.71
Mechanical-biological treatments	1.64	6.17	2.01	7.49	2.38	8.37	3.12	10.77	3.79	12.89	5.24	17.55	7.48	24.91	7.43	23.85	8.46	26.70
Incineration municipal solid waste	1.75	6.57	1.95	7.26	2.12	7.48	2.32	8.02	2.59	8.81	2.67	8.94	2.85	9.49	3.08	9.89	3.21	10.13
Incineration municipal solid waste and RDF	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2.73	9.14	3.15	10.49	3.55	11.40	3.82	12.06
Residues from treatments	0.55	2.07	1.25	4.66	1.59	5.59	2.58	8.91	1.79	6.09	2.63	8.82	4.63	15.42	4.17	13.38	4.91	15.51
Controlled landfill	21.26	79.91	21.13	78.71	21.74	76.67	21.92	75.69	19.71	67.00	18.85	63.11	18.00	59.92	17.74	56.96	17.23	54.38
TOTAL	**26.61**	**100**	**26.85**	**100**	**28.36**	**100**	**28.96**	**100**	**29.41**	**100**	**29.86**	**100**	**30.03**	**100**	**31.15**	**100**	**31.68**	**100**

Source: ENEA analysis
Note:(1) Estimated value

Table 2.22 : Energy recovery from MW incineration

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Operating plants	38	41	42	43	42	50	49	48	50
with energy recovery	23	26	27	33	36	39	45	45	47
Total waste treated, Mt/a	1.75	1.98	2.13	2.58	2.89	3.03	3.49	4.09	4.38
Waste treated in plant with energy recovery, Mt/a	1.18	1.41	1.77	2.37	2.74	2.89	3.43	4.06	4.33
Installed electric power, MW	95	168	175	n.a.	n.a.	n.a.	n.a.	n.a.	536
Electricity production, MWh	281,011	394,600	421,900	809,433	1,229,507	1,418,457	1,884,588	2,376,360	2,636,959
Heat production, MWh	152,832	166,000	200,000	470,135	505,166	413,937	491,735	575,213	705,919

Source: APAT for years 1997-1998, ENEA analysis for years 1999-2005

Table 2.23 : Energy recovery from biogas at landfills

	1998	1999	2000	2001	2002	2003	2004	2005
Operating plants	79	89	104	111	127	150	155	160
Installed electric power, MWe	115.9	127.7	162.9	179.1	187.7	218.3	229.6	236.8
Electricity production, MWh	478,800	566,400	551,300	664,600	822,000	910,500	1,038,400	1,052,000

Source: TERNA

Production of special waste

The data on the production of special waste (SW) are provided by APAT, essentially on the basis of the declarations (MUD) made under the provisions of Law 70/94, appropriately upgraded to guarantee their reliability, in this way reducing, to as great an extent as possible, the use of supplementary estimates.

Data for the years 1997-2005 are shown on table 2.24.

Table 2.24: Production of Special Waste (Mt/y)

	1997	1998	1999	2000	2001	2002	2003	2004
Non hazardous Special Waste (NHSW)	37.1	43.9	44.6	51.8	55.0	49.4	52.4	56.5
Hazardous Waste (HW)	3.4	4.1	3.8	3.9	4.3	5.0	5.4	5.3
Inert Waste (IW)	20.4	21.3	23.9	27.3	31.0	37.3	42.5	46.5
Unclassified Special Waste (USW)	n.a.	n.a.	0.2	0.1	0.1	0.4	0.2	0.2
TOTAL	**60.9**	**69.3**	**72.5**	**83.1**	**90.3**	**92.1**	**100.6**	**108.4**

Source: ENEA analysis

Management of special waste

Significant discrepancies can be observed between the data of production and those one related to management, according to the report, annually issued by APAT. This is due to various reasons, among these, mention should be made of the uncertainty regarding the quantities of waste subjected to recovery and/or disposal caused by a scarce standardisation of management operations other than incineration and disposal into landfills (i.e. temporary storage, preliminary storage etc.) and the introduction of simplified procedures for waste recovery (Ministerial Decree of 5 February 1998), that results for waste management in figures lower than those of production.

The different forms of management of special wastes are summarised in the following list, which includes related operations of recovery and disposal for reference, as those that are identified in appendices IIA and IIB of Directive 91/156 on waste[5]:

- composting of biodegradable organic fractions (R3)
- recovery of materials (from R2 to R11);
- recovery of energy (R1);
- incineration, with or without the recovery of energy[6](D10);
- other forms of recovery (biological treatments (D8), chemical-physical treatment (D9), etc.);
- disposal at controlled landfills (D1, D5, D12).
- temporary storage (R13)
- preliminary storage (D15)

According to the above mentioned classification the available data are summarised on table 2.25

5 Definitions employed, at national level, by the Government Decree 22/97 (appendices B and C).

6 Limited data are available on energy recovery

Table 2.25 : Management of Special Waste (Mt/y)

Treatment	1997		1998		1999		2000		2001		2002		2003		2004	
	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%
Temporary storage	n.a.	n.a.	n.a.	n.a.	9.57	13.20	9.75	11.73	11.84	13.11	12.13	13.17	11.45	11.38	12.13	11.18
Preliminary storage	n.a.	n.a.	n.a.	n.a.	2.32	3.20	1.41	1.70	2.31	2.56	2.08	2.26	1.63	1.62	1.97	1.81
Biological treatment	1.22	2.00	4.23	6.10	5.40	7.45	5.84	7.03	7.38	8.17	6.52	7.08	6.37	6.34	6.50	6.00
Physical-chemical treatment	n.a.	n.a.	n.a.	n.a.	3.53	4.87	5.34	6.43	6.68	7.39	4.41	4.79	4.95	4.93	5.42	5.00
Energy recovery	n.a.	n.a.	n.a.	n.a.	1.45	2.00	1.58	1.90	2.17	2.40	2.30	2.50	2.82	2.80	3.36	3.10
Incineration	0.76	1.24	0.82	1.19	0.60	0.83	0.74	0.89	0.89	0.98	0.86	0.94	0.86	0.85	1.14	1.05
Recovery of material	15.22	25.00	24.94	36.00	30.94	42.65	34.32	41.30	36.58	40.50	42.10	45.70	46.50	46.23	47.58	43.87
Controlled landfill	27.40	45.00	27.50	39.70	17.17	23.67	20.18	24.28	21.80	24.14	19.09	20.72	19.71	19.60	18.59	17.14
Other treatments	16.29	26.76	11.79	17.01	1.54	2.12	3.94	4.74	0.67	0.74	2.63	2.85	6.29	6.26	11.76	10.85
TOTAL	**60.89**	**100**	**69.26**	**100**	**72.54**	**100**	**83.10**	**100**	**90.31**	**100**	**92.11**	**100**	**100.58**	**100**	**108.44**	**100**

Source: ENEA analysis

Agriculture

Due to variegated climatic and geographic situations, the 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.

At the end of 2005, about 1.38 million agricultural holdings have an economic size of at least 1 European Size Unit (ESU), among these holdings[7]: 64% made use of less than one Annual Work Unit (AWU), while 12% made use of 2 or more AWUs; 67% used less than 5 ha agricultural area, while 1% used 100 ha or more; 19% were holdings of the type specialist olives, 15% specialist cereals, oil seed and protein crops, 12% specialist vineyards, 10% were engaged in mixed cropping and 10% were general field cropping; and 50% of their agricultural area was situated in less favoured or mountain areas.

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 livestock areas in Northern Italy, of grain and foodstuffs in the South, of fruit in the coastal areas and in the islands, and of areas devoted to extensive livestock in the Apennines and in the South.

In this situation have been adopted national and European policies and measures aiming at managing environmental aspects in the countryside (Regulation 2078) or promoting specific agricultural practices (Agenda 2000).

In 2005 the agriculture sector contributed 6.4% of Italy's national GHG emissions and without CO_2 emissions and removals from LULUCF, in CO_2 equivalent, is the third source of emissions after the energy and industrial processes sectors. The agriculture sector has been the dominant national source for methane and nitrous oxide emissions, accounting for 39.0% and 53.8% of total national emissions, respectively. Methane emissions from enteric fermentation and nitrous oxide emissions from direct agriculture soils are the most relevant source categories in this sector; their individual share, in national total greenhouse gas emissions without CO_2 from LULUCF, in CO_2 equivalent, is 1.9% and 1.6 %, respectively.

7 EUROSTAT, 2007[a]. Farm structure in Italy – 2005. Statistics in Focus Agriculture and Fisheries 22/2007 Product KS-SF-07-022 European Comunities.

Table 2.26: Total emissions in CO2 equivalent from the agricultural sector by source (1990-2005)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Gg CO_2 eq.															
CH_4	17,215	17,416	16,967	16,908	16,948	17,222	17,253	17,285	17,154	17,287	16,836	16,395	15,725	15,780	15,515	15,480
N_2O	23,362	23,956	23,896	24,255	23,694	23,127	22,844	23,865	23,264	23,508	23,103	23,033	22,524	22,319	22,378	21,734
Total	**40,577**	**41,372**	**40,863**	**41,163**	**40,641**	**40,349**	**40,097**	**41,150**	**40,418**	**40,795**	**39,939**	**39,428**	**38,250**	**38,099**	**37,892**	**37,214**

Source: APAT – National Inventory Report 2007

For the agriculture sector, the trend of GHGs from 1990 to 2005 shows a decrease of 8.3% due to reduction in activity data such as the number of animals and cultivated surface/crop production.

The amount of livestock shows a nearly stationary trend, with approximately 6,457 millions head of bovine, 9,201 millions head of swine and 7,954 millions head of sheep in 2005.

Concerning the use of mineral and organic-mineral fertilisers, in the period 2000-2006 have been observed the following trends: among the simply formulated products, the increases were in nitrates (+1.7%), decreases in phosphates (-30.9%), potassium based (-9.2%). In the category of composite mineral fertilisers, binary products (+3.2%), while ternary compounds (-14.4%).

Forestry

Italy has a rich biological heritage of forest and several types of landscape as, our 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

The Italian forested surface is about 10 millions hectares, equivalent to a third of our National territory and to a 5% of the European forested area. Italy is at sixth position in Europe for forested areas, after Sweden, Finland, Spain, France and Germany (excluding Russia).

The Italian forested area is spreading, at a rate of about 100,000 hectares per year. This is due to the dismiss of agriculture practices, mostly in mountain zones, and to the natural conversion of cultivated lands and grazing in forests.

Italian forests are for 65% private owned, public ones are owned mostly by Municipalities.

In the period 1990-2005, forest areas destined to preserve biodiversity has grown and attained about 3 millions of hectares, which means 30% of National forest surface. Primary forests amount 160,000 ha and consist in parks and environmental protected areas.

Natural protected areas are about 700, having been established on various administrative levels: national, regional and local. These areas occupy the 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.

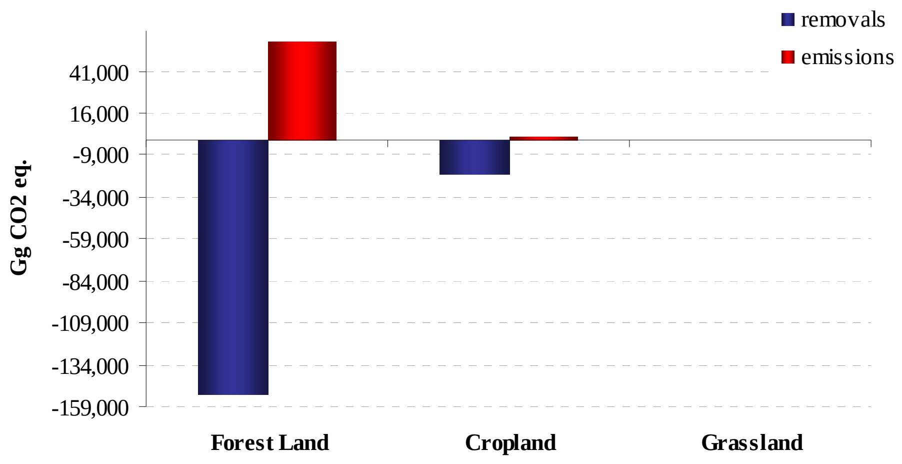
Wood per use amounts about 10 millions m^3, which about 6.8 millions hectares consist of forest managed for the supply of lumber, coming mostly from coppice forests not subject to legal, economic or environmental restrictions. Concerning fuel-wood use, statistics show an increase of it in the very last years.

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.

Wood sector is very important in our economy, because Italy is the largest exporter of furniture in the world.

LULUCF sector is responsible for 110 Mt of CO_2 removals from the atmosphere in 2005. CO_2 emissions from forest fires have been included in the calculation of the net carbon stocks. Greenhouse gas removals and emissions in the main categories of the LULUCF sector in 2005 are shown in following figure:

Figure 2.10: GHG removals and emissions in LULUCF sector in 2005 (Gg CO2 eq.)



Source: APAT – National Inventory Report 2007

Table 2.27: Total emissions in CO_2 equivalent from the LULUCF sector by source/sink (1990-2005)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
								Gg CO_2 eq								
Total emissions - removals	**-79818**	**-101233**	**-97344**	**-82402**	**-98026**	**-103222**	**-106174**	**-98970**	**-95666**	**-103185**	**-97121**	**-109806**	**-113977**	**-112177**	**-103940**	**-110010**
Forest Land	-59068	-80830	-77150	-62616	-79005	-84389	-87332	-79906	-77792	-85539	-79416	-88034	-94529	-84601	-92508	-92289
Cropland	-22030	-21919	-21677	-21067	-20301	-20113	-19821	-20344	-19154	-18926	-18985	-20611	-20469	-19681	-12712	-19001
Settlements	1280	2527	2531	1280	1280	1280	2572	1280	1280	1280	1280	2559	2560	2559	1280	1280
Grassland	0	-1011	-1048	0	0	0	-1593	0	0	0	0	-3721	-1538	-10454	0	0
Wetlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: APAT – National Inventory Report 2007

Total removals, in CO_2 equivalent, show an increase of 37.8%, from the base year to 2005. CO_2 accounts for more than 99% to total emissions and removals of the sector: in the period 1990–2005 CO_2 removals increased by 37.7%, mostly because of the increase of forest areas.

As far as the Forest Land category, emissions and removals have been estimated using, as input data for the forest area, the First Italian National Forest Inventory (IFN) data and the Second Italian National Forest Inventory data (INFC[8]), Concerning the INFC the first phase of sampling consisting in a photo-interpretation of over 301,000 points of digital photos, has been completed. Forest classification has been undertaken following the FAO FRA2000 forest definitions according with the classification system of Corine Land Cover.

All the data presented in the following table are INFC data, and have been officially recognized by ISTAT.

[8] CFS – National Forest Service of the Ministry of Agriculture and Forestry Policies INFC – National Inventory of Forests and Forest Carbon Sinks. URL: http://www.sian.it/inventarioforestale/jsp/home.jsp

Table 2.28: Italian forestry areas

Regions	Forest		Other wooded land		Total forest area		Total land area
	surface	ES	surface	ES	surface	ES	
	(ha)	*(%)*	*(ha)*	*(%)*	*(ha)*	*(%)*	*(ha)*
Piemonte	870,594	1.1	69,522	7.2	940,116	1.0	2,539,983
Valle d'Aosta	98,439	3.1	7,489	21.4	105,928	2.7	326,322
Lombardia	606,045	1.4	59,657	8.2	665,703	1.2	2,386,285
Alto Adige	336,689	1.6	35,485	9.9	372,174	1.3	739,997
Trentino	375,402	1.4	32,129	10.3	407,531	1.1	620,690
Veneto	397,889	1.7	48,967	8.3	446,856	1.4	1,839,122
Friuli V. Giulia	323,832	1.7	33,392	9.9	357,224	1.3	785,648
Liguria	339,107	1.5	36,027	9.5	375,134	1.1	542,024
Emilia Romagna	563,263	1.4	45,555	8.5	608,818	1.2	2,212,309
Toscana	1,015,728	1.0	135,811	4.9	1,151,539	0.7	2,299,018
Umbria	371,574	1.4	18,681	13.4	390,255	1.2	845,604
Marche	291,394	1.8	16,682	12.8	308,076	1.6	969,406
Lazio	543,884	1.4	61,974	7.3	605,859	1.2	1,720,768
Abruzzo	391,492	1.5	47,099	7.6	438,590	1.3	1,079,512
Molise	132,562	2.9	16,079	14.2	148,641	2.3	443,765
Campania	384,395	1.9	60,879	7.3	445,274	1.5	1,359,025
Puglia	145,889	3.4	33,151	10.0	179,040	2.6	1,936,580
Basilicata	263,098	2.4	93,329	5.6	356,426	1.5	999,461
Calabria	468,151	1.8	144,781	4.6	612,931	1.1	1,508,055
Sicilia	256,303	2.7	81,868	6.2	338,171	1.9	2,570,282
Sardegna	583,472	2.0	629,778	1.8	1,213,250	0.8	2,408,989
Italia	**8,759,200**	**0.4**	**1,708,333**	**1.3**	**10,467,533**	**0.3**	**30,132,845**

Source: INFC - CFS – National Forest Service of the Ministry of Agriculture and Forestry Policies

Regional Energy Situation

General Valuation

After the law 10/91, the Italian Regions have important functions in energy policies. This law assigned to the Regions the task to predispose the Regional Energy Plans, in order to address the system of incentives of own competence to the specific initiatives for the reduction of the energy consumption and to the promotion of renewable sources.

A good knowledge of the regional energy system in terms of supply (production, import, stock, transformation, nets of transmission and grid) and demand (levels of final consumptions by sources and by sector of employment) and, moreover, the knowledge of the efficiency and the modalities of production and consumption, is fundamental for the formulation of the energy policy by the Regions.

On the base of the Regional Energy Balances (BER), carried out by ENEA, is possible to proceed to a comparative energy analysis between the Italian Regions. In this paragraph are presented last available data, relative to 2004.

The main energy items are the production of primary energy, the gross consumption, the final total consumption, the production of oil-products and especially electric power, the energy self-sufficiency, electrical power in particular; moreover there are consumptions disaggregate by sectors and by sources. Finally the energy efficiency indicators are calculated as regards the main physics, demographic and economic variables.

The greater part of the Regions consumes more energy than they have available locally, in terms of primary energy sources. The Region Emilia Romagna had the greater production of primary energy (gas and oil). In other Regions appreciable amounts of energy, per different sources, have been produced. The gross domestic consumption includes the internal amounts produced in every region, the relative imports, destined, in part, to the transformations for internal uses and in part "exported" towards other Regions. The final consumptions are therefore clearly lower than gross consumptions; just in few Regions the final consumptions are lower or equal to the primary production.

The energy final consumptions have been obviously much various quantitatively from Region to Region: Lombardia consumed 19.2% of the national total; Emilia Romagna 10.6%, Piemonte and Veneto around to 9% each one; follow are other Regions like Lazio, Toscana and Puglia. These seven Regions consumed together more than 70% of the national consumption. Also the final consumptions of Campania and Sicilia had a remarkable weight, respective 4.9% and 5.9% of the national total.

At national level, in 2004, final energy demand is lightly increased (to 0.5%) with respect to the previous year, while in 2003 it was a strong increasing of energy sources consumptions, + 5.6% with respect to the 2002. As regards the final consumptions of the various sources of energy, there are meaningful differences at regional level. In Italy, with respect 2003, in 2004 it consumed 5% more of solid fuels, following the increment trend of 2003 that interrupted the series lessening in the previous years.

The solid fuel consumption constituted 3.2% of the final total consumption of Italy; in particular, at level of the single Region are relevant, the situations of Puglia, Liguria and Toscana. However, the variation of the solid fuel demand has been a lot diversified; as an example, in Molise, Campania, Abruzzo and Sardegna the consumption, in 2004, nearly totally disappeared; strong reductions were also in Friuli V. G. and Sicilia; in other Regions, on the contrary, the use of solid fuels strongly increased, such as in the case of Emilia Romagna, Calabria, Marche, Toscana, Veneto, Trentino Alto Adige and Valle d’ Aosta.

For the oil products, almost the South Regions, plus Lazio, Valle d'Aosta and Trentino Alto Adige, consumed quotas higher than national averages (45.5%). In 2004, the national consumptions diminished of 0.1% as regarding 2003; Sardegna and Sicilia had a strong decrease, while in other Regions relevant increases recorded, such as in Basilicata, Puglia, Molise, Emilia Romagna, Trentino Alto Adige and Valle d'Aosta. The gaseous fuel employment in 2004 was 31.3% at national level. This value has been generally exceeded in the central Regions and in the North ones, to exclusion of Lazio, Valle d'Aosta and Trentino Alto Adige. The domestic demand increased of 0.3% in a year, with consisting increments. Reductions of consumptions had, instead, in Campania and Molise.

The quotas of electric power consumption, in the Regions turned out more on line with national quota (18.9% mainly), but someone as Sardinia, where the quota was quite higher for the absence of the natural gas, and in Liguria, Emilia-Romagna and Valle d'Aosta, with lower quota for a greater one uses, respectively, of coal, gas fuel and oil products. The electric power demand increased altogether of 1.5% and regarded all the Regions except Basilicata and Sicily, where in 2004, the demand was inferior of 0.3%. The greater increment had in Molise (3.8%).

The energy demand obtained by the direct employment of renewable sources in 2004, in Italy, increased of 9% as regarding 2003 and constituted 1% of the final consumption of 2003. In the several Regions, the employment of this source still remains quite limited and subject to the instability due to the peculiarity of its nature; the greater quota final consumptions had in Valle d'Aosta (4.5%) due to the hydropower, following by Piemonte and Molise, respectively with 3.3% and 2.7%.

The analysis of the final energy consumptions, disaggregated by economic sectors, in 2004, shows that the **Industry** sector, at national level, employed 31.8% of the final total consumption and with respect to 2003, the demand diminished of 1.4%.

The Italian Regions where the energy industry demand represented the greater part of the respective final consumption were, Puglia, Sicily, Sardinia, Umbria, Tuscany, Friuli Venezia Giulia, Veneto and Piemonte. This very high quota underlines the importance of the great industrial takeovers in the economy of these Regions, in particular petrochemical and the iron workers in Puglia and the aluminium and petrochemical ones, in Sardinia.

In Lazio, whereas, the sector of the industry absorbs only 8.9% of the relative final consumption, because there was a consistent tertiary, mostly constituted by small-medium enterprises, with not energy-intensive sectors. Moreover, as regarding 2003, the energy consumption, in examined sector, had a rather diversified course in the several Regions: the most consisting increases recorded in Sicilia, Calabria, Puglia, Toscana and Veneto, while substantial reductions characterized the energy demand, in Sardegna and Molise.

In Italy 2.4% of the final energy consumption is due to the sector of **Agriculture**, forestry and fishing. The north Regions employed an inferior quota than national average, with the exclusion of Emilia Romagna and Marche; in the centre only Lazio and Toscana assign a lower quota than national average, and then in the South all the regions destined quotas higher than 2.4%, except Sicilia.

The **Civil** sector includes the energy consumption of residential and the services subsectors (tertiary and Public Administration). In the residential sector, generally, the Regions of the North had the highest incidence of consumption, higher than medium national value. In this sector, it affected the structural diversity and the climate influence. Also the Services sector evidenced differences due to the aggregation of the consumptions of Public Administration, that substantially reflected also the various development of the tertiary, in particular of that "advanced one", at regional level. In 2004, in Italy, 33.1% of the final energy consumption has been absorbed in this macrosector, 1.6% more than 2003. The northern Regions assigned the greater part of their energy consumption to this sector. Increments also consisting, with respect to the previous year, were everywhere, but in Campania (-4.7%).

The **Transport** sector, compared with the previous year, consumed 1.8% more at national level, by absorbing 32.8% of the total. It is in the Centre-South Regions where the energy demand destined for transports constituted the greater part of the final consumption: Calabria turned out the Region with the highest incidence percentage (52%); in Lazio the transport sector absorbed 50%; in Campania 41%; while Friuli Venezia Giulia turned out the Region with smaller incidence (23.3%). The increases of energy consumption regarded the greatest part of the Regions; in particular, in Valle d'Aosta the demand increased of 11.2%, in Basilicata of 7.6% and in Trentino Alto Adige of 9.3%; while the consumption decreased in four Regions, as Friuli V. G. (-3%).

Table 2.29: Final consumption of energy by economic sectors and by Regions (2004)

Regions	Agriculture, Forestry and Fishing	Industry	Civil	Transports	Total
	Quota %				Ktoe
Piemonte	1.5	36.9	37.5	24.1	**12,327**
Valle D'Aosta	0.8	14.5	52.6	32.2	**569**
Lombardia	1.8	32.0	38.6	27.6	**25,400**
Trentino A. A.	2.1	22.3	38.1	37.5	**2,515**
Veneto	2.1	34.6	34.1	29.2	**12,199**
Friuli V. Giulia	1.6	45.2	29.8	23.3	**3,456**
Liguria	1.1	25.2	42.7	31.0	**3,230**
Emilia Romagna	3.6	32.5	33.9	30.0	**14,056**
Toscana	1.7	33.5	33.2	31.7	**8,862**
Umbria	2.4	43.3	23.3	31.1	**2,360**
Marche	3.8	26.2	30.1	39.9	**3,199**
Lazio	2.1	8.9	39.3	49.7	**10,561**
Abruzzo	3.0	33.2	27.9	35.9	**2,862**
Molise	5.4	24.6	29.2	40.8	**516**
Campania	2.9	20.8	28.9	47.4	**6,423**
Puglia	3.9	50.4	19.7	26.0	**9,177**
Basilicata	5.1	33.4	28.6	32.9	**1,003**
Calabria	3.7	12.6	31.9	51.9	**2,124**
Sicilia	1.7	39.8	20.7	37.8	**7,820**
Sardegna	2.9	36.4	21.5	39.2	**3,344**
Italia*	**2.4**	**31.8**	**33.1**	**32.8**	**132,003**

* Preliminary estimate

Source: ENEA

Regional energy indicators

Table 2.30 reported, for each region, energy intensities (total and electrical) per GDP and per capita. The energy intensities differ also in meaningful among the several regions regarding to the national average. In 2004, in Italy, the final energy intensity of the GDP remained almost constant with respect to the previous year, while the electrical intensity, in 2004, increased of 0.3%. Valle d'Aosta, Emilia Romagna, Umbria, Abruzzo, Puglia, Sardegna, Piemonte and Friuli Venezia Giulia recorded an energy intensity value widely higher than national one, that relatively to the 2004, it amounted to 125.9 toe/M€95. In particular, the energy indicator value recorded increases in all Regions; the highest values of intensity there are in Sardegna, Valle d'Aosta, Puglia and Friuli V. G; in Campania the energy intensity diminished in 2004 of 1.5%. The most elevated electrical intensity of the GDP, relatively to 2004, has been recorded in Sardegna, because the presence of great industries. The industries consume much of electric power (aluminium in particular) and, moreover in Sardegna, the absence of the natural gas, foster the use of electric power also for final uses, not-obliged as typically, the sanitary warm water production. The electrical intensity in Sardegna reached 511.2 MWh/M€95 compared to national of 309.2 MWh/M€95.

The second value is the electrical intensity of Friuli Venezia Giulia, that amounted to 392.8 MWh/M€95, while Lazio and Liguria had the lower values, respective 200.4 MWh/M€95 and 207.7 MWh/M€95. These general indicators show an energy consumptions somewhere in connection with the regional added values, and show the energy and environmental pressure, existing on the territory; however, one more punctual estimate could be obtained reporting these evaluations to activity sector much more disaggregated. Relatively to the final energy consumptions per capita, in 2004, Italy had 2.3 toe/inh. This value has been widely exceeded in the northern Regions, in particular in Valle d'Aosta, where the consumption per capita was of 4.6 toe/inh., the higher value in Italy. The Regions with medium consumption per capita lowest were Calabria and Campania, both with 1.1 toe/inh.

The consumption per capita of electricity, in 2004, in Italy was 5.6 MWh/inh, 5.6% more than 2003; also in this case, the northern Regions had greater unitary consumptions than the national average: from 8.1MWh/inh. of Friuli Venezia Giulia to 7.8 of Valle d'Aosta; in Liguria instead the consumption per capita MWh/inh was very low (4.1); the biggest annual increment had in Valle d'Aosta, where every inhabitant consumed an average value of 1.3% more than the previous year. In the centre of Italy, the Region with the highest electricity consumptions per capita were Umbria (6.4 MWh/inh), but regarding the previous year, recorded a reduction of 1.8%. The elevated value of the electricity consumptions per capita testifies the constant increase of the electricity consumption recorded in the last years in particular in the iron industry. Lazio was the Region with the lowest unitary consumptions (4.2 tep/inh.), with the same amount in 2003. The electricity consumptions per capita in southern Italy, oscillated among 7.3 MWh /inh. of Sardegna, with an annual increment of 4.2%, and 2.7 MWh/inh. of Calabria.

Table 2.30: Main regional energy efficiency indicators (2004)

Regions	Final energy Intensity of GDP (tep/Meuro$_{95}$)	Electrical Intensity of GDP (MWh/Meuro$_{95}$)	Energy Consumption per capita toe/inh	Electrical energy Consumption per capita (MWh/inh)
Piemonte	140.5	302.1	2.8	6.1
Valle D'Aosta	199.0	325.1	4.6	7.8
Lombardia	120.6	299.5	2.7	6.8
Trentino A. A.	113.6	266.7	2.6	6.3
Veneto	129.7	309.5	2.6	6.4
Friuli V. Giulia	141.1	392.8	2.9	8.1
Liguria	103.3	207.7	2.0	4.1
Emilia Romagna	153.9	288.5	3.4	6.4
Toscana	126.6	291.7	2.5	5.8
Umbria	162.3	376.7	2.7	6.4
Marche	119.7	271.3	2.1	4.9
Lazio	101.5	200.4	2.0	4.2
Abruzzo	143.6	343.3	2.2	5.2
Molise	109.9	315.5	1.6	4.6
Campania	94.4	235.9	1.1	2.9
Puglia	187.1	344.3	2.3	4.3
Basilicata	128.5	348.1	1.7	4.7
Calabria	91.7	215.3	1.1	2.7
Sicilia	123.3	293.3	1.6	3.6
Sardegna	136.5	511.2	2.0	7.3
Italia	125.9	309.2	2.3	5.6

Source: ENEA

Regional emissions from the energy systems - The situation in 2004 of the regional emissions of CO_2

CIPE 137/98 and 123/02 Deliberations constitute an important passage in the engagement of the Regions for the development of their tasks in energy and environmental sector by the assumption of a full responsibility, not only of each Region for own activities and own objective, but also for other Regions, with an integrated formulation, in the framework of national and European addresses. Especially in the last Regional Energy Plans produced, is very clear on how the Regions measure their programs and interventions, with the objective of the gases greenhouse reduction, contributing therefore to the engagement assumed from Italy forward the obligation of the UE, established from the international agreements and programmed in deliberation CIPE 137/98 and successive update deliberation CIPE 123/02.

On the base of the outline used in deliberation CIPE 123/02 for the quantification of respective reduction targets, for the CO_2 emissions from combustion processes, can be elaborated some regional energy and environmental indicator performances.

In this way it is possible to estimate the entity of the engagements to assume at regional level, in several sectors of intervention.

The application of the Kyoto protocol and the targets of CIPE 123, implies a greater involvement of the Regions aiming at simplifying the procedures, profiting by definition at local level, of policies addressed to potentiate the renewable energy source. The exploitation of the renewable energy source, in comparison with the other sources, affects mainly the territory management, making unavoidable the directed involvement of the local administrations.

On the base of the amounts of transformed and consumed products, obtained by Regional Energy Balances in 2004, have been estimated the emissions of CO_2 per sector. At national level, from a value of approximately 401 million tons of CO_2 emitted in 1990, reached 450 million in 2004 (table 2.32), with an increment of 11.2%. In 1990 the CO_2 emissions came for 64% from oil products. During the last years, the quota of gas methane emissions increased, while the quota of oil consumptions and above all solid fuels reduced in meaningful way, with the relative emissions. The CO_2 emissions at regional level, depend by the use of energy sources (production, transformation, final uses). The choices of participation to reduce them, therefore will be adapted to the emissions amounts and to specific regional characteristics. With respect to the previous year an emissions decrement had in the industrial and agricultural sector, a substantial stability in the energy sector, while there were moderated rises in thermoelectrial, civil and transports sector.

In Thermoelectrial sector Liguria picks, with elevated emissions quotas, more than 50%, and Sardegna with quotas 43%. The Veneto, Friuli Venezia Giulia, Lazio, Calabria and Sicilia regions have emissions quotas higher than 30%, but however lower than the previous year values. Particular situations had in Trentino Alto Adige and Valle d’Aosta, where the Thermoelectrial sector, recorded respectively only 3.3% and 0.1%, because the electric power produced nearly exclusively from water source, with regional budgets surplus. Strong movements in this sector from the 2003 had in Umbria (+38.8%), in Lombardia (47.7%) in Calabria (-32.5) and in Lazio (-27%). In Transports sector derived emissions for approximately 40% in 7 Regions: Valle d’Aosta, Trentino Alto Adige, Marche, Lazio, Abruzzo, Campania and Calabria. The CO_2 emissions produced from the industry sector, in 2004, had an incidence of 18.8% in Italy. The greater quota has been reached in Umbria (26.9%), while the smaller quota has been registered in Lazio (4.7%). As regarding the 2003, civil sector maintained substantially stable emissions in about all the Regions. The value of CO_2 emission was rather consisting for the Lombardia Region. However the greater percentage has been recorded in Valle d'Aosta, for obvious climatic reasons and also cause insufficient presence of high energy consumption industries. There were also consisting quotas in other northern Regions such as Piemonte, Trentino Alto Adige and Emilia Romagna. Considerable was the CO_2 amount of the civil sector in Veneto, even if the quota coincided with the national average.

The civil sector includes the tertiary (approximately 29%) and the residential. There were many diversities from Region to Region, from Lombardia, where the residential absorbed the 4/5 of Civil consumption, to Lazio, where the residential consumed 60% of civil total. From the sector of agriculture, forestry and fishing, in 2004, derived 1.8% of total CO_2 emissions, at national level, the emissions that have been produced in activities related to this sector, were rather low. Highest values were about 4.7% for Molise and 4.9% for Basilicata. Relatively to the preceding year have not been had strong variations.

In the following table 2.31 are reported some information about carbon intensities indicators. They are related to: "GDP" per Region; gross energy consumptions and the CO_2 quantity per capita.

Regarding the GDP values there are many differences among the Regions, from 234 tCO_2/M€ of Campania to 1024 tCO_2/M€ of Puglia. These two Regions had extreme values, also in the previous years. In 2004, the CO_2 amount for unit of GDP produced in Italy reached 428 tCO_2/M€, lightly lower than the preceding year.

The CO_2 emissions per capita, in Italy, were 7.8 tCO_2/inh., in Liguria (12.1 tCO_2/inh.) and Puglia (12.4 tCO_2/inh.), they recorded the most elevates values; in Campania the emissions per capita were, instead, the lowest of Italy (2.8 tCO_2/inh.). Regarding the gross domestic energy consumptions, the CO_2 emissions exceeded the national average value (that's 2.6 tCO_2 /toe) in seven Regions.

Anyway, it is crucial to take into account that in these last Regions was very significant the strong component of thermoelectrical production, great part of which it destined to the export. In the hypothesis of a territorial re-balance in the medium term of the thermoelectrical production, also the emissions could be programmed and controlled.

Total CO_2 emissions data reported in the table 2.32 slightly differs from the total national data in the chapter III, because is calculated by a different methodology starting from regional energy balances.

Table 2.31: Regional Indicators of energy consumptions and carbon intensities (2003-2004)

	kt CO_2		GDP M€		Inhabitants		Gross domestic Consumption* (ktep)		tCO_2/M€		tCO_2/inhabitant		tCO_2/tepCIL	
REGIONS	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**
Piemonte	32,395	33,418	87,227	88,207	4,231,334	4,270,215	16,321	17,047	371.4	378.9	7.6	7.8	2	2.0
Val d'Aosta	1,241	1,420	2,902	2,941	120,909	122,040	680	749,3	427.7	482.7	10.2	11.6	1.8	1.9
Lombardia	69,155	75,901	209,296	212,070	9,108,645	9,246,796	35,274	37,241	330.4	357.9	7.5	8.2	2	2.0
Trentino	5,504	5,843	22,321	22,723	950,495	962,464	3,306	3,685	246.6	257.2	5.7	6.1	1.7	1.6
Veneto	42,736	41,834	94,429	95,787	4,577,408	4,642,899	16,488	18,155	452.6	436.7	9.2	9.0	2.6	2.3
Friuli V.G.	13,589	12,287	24,784	24,822	1,191,588	1,198,187	5,045	5,535	548.3	495.0	11.3	10.3	2.7	2.2
Liguria	19,233	19,075	31,656	31,575	1,572,197	1,577,474	4,663	5,723	607.6	604.1	12.2	12.1	4.1	3.3
E. Romagna	39,262	41,172	91,340	91,562	4,030,220	4,080,479	16,657	18,079	429.8	449.7	9.6	10.1	2.4	2.3
Tuscany	30,197	30,075	69,997	70,560	3,516,296	3,566,071	12,040	13,095	431.4	426.2	8.5	8.4	2.5	2.3
Umbria	7,268	8,087	14,568	14,972	834,210	848,022	3,109	3,012	498.9	540.1	8.6	9.5	2.3	2.7
Marche	8,479	8,751	26,928	27,392	1,484,601	1,504,827	4,379	4,574	314.9	319.5	5.6	5.8	1.9	1.9
Lazio	41,936	37,484	104,970	108,938	5,145,805	5,205,139	13,985	14,411	399.5	344.1	8.1	7.2	3	2.6
Abruzzo	7,613	7,519	19,913	19,745	1,273,284	1,285,896	3,754	3,791	382.3	380.8	5.9	5.8	2	2.0
Molise	1,703	1,551	4,659	4,733	321,047	321,697	826	743	365.5	327.7	5.3	4.8	2.1	2.1
Campania	16,313	16,132	68,524	68,855	5,725,098	5,760,353	9,146	9,583	238.1	234.3	2.8	2.8	1.8	1.7
Puglia	47,591	49,965	48,629	48,784	4,023,957	4,040,990	12,559	14,116	978.6	1024.2	11.8	12.4	3.8	3.5
Basilicata	2,604	2,679	7,683	7,740	596,621	597,000	1,386	1,439	339	346.0	4.4	4.5	1.9	1.9
Calabria	8,547	7,473	23,478	24,123	2,007,392	2,011,338	2,964	3,594	364	309.8	4.2	3.7	2.9	2.1
Sicily	36,043	36,895	62,771	62,972	4,972,124	5,003,262	13,478	20,796	574.2	585.9	7.2	7.4	2.7	1.8
Sardinia	14,837	14,288	22,779	23,052	1,637,639	1,643,096	5,990	7,097	651.3	619.8	9	8.7	2.5	2.0
Italy	**446,246**	**450,057**	**1,038,863**	**1,051,560**	**57,320,870**	**57,888,245**	**182,049**	**202,465**	**429.6**	**428.0**	**7.7**	**7.8**	**2.5**	**2.2**

* CIL, net of bunkers and non energy uses

Source: ENEA’s elaboration on data from different sources

Table 2.32: Regional emissions from the energy systems per sector (2004)

Regions	Thermoelectric		Transport		Residential		Industry		Energy sector		Agriculture		Total	
	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	% Italy
Piemonte	4,398.4	13.2	8,679.7	26	9,827.4	29.4	9,310.8	27.9	593	1.8	608.5	1.8	33,417.8	7.4
Valle d'Aosta	1	0.1	543.2	38.3	757.5	53.4	114.8	8.1	0	0	3.2	0.2	1,419.8	0.3
Lombardia	20,529.5	27	20,479.7	27	19,195.1	25.3	13,786	18.2	813.8	1.1	1,096.9	1.4	75,901	16.9
Trentino A. A.	191.7	3.3	2,750.7	47.1	1,875.1	32.1	901.3	15.4	1.2	0	123.4	2.1	5,843.4	1.3
Veneto	14,680.4	35.1	10,184.2	24.3	7,746.4	18.5	8,091.9	19.3	481.9	1.2	649.2	1.6	41,833.9	9.3
Friuli V. Giulia	4,438.9	36.1	2,282	18.6	1,904.1	15.5	3,313.8	27	207	1.7	141.7	1.2	12,287.4	2.7
Liguria	10,184	53.4	2,895.7	15.2	2,555.6	13.4	2,455	12.9	714.9	3.7	269.4	1.4	19,074.7	4.2
Emilia Romagna	9,682.2	23.5	12,371.2	30	9,435	22.9	8,401.6	20.4	114.9	0.3	1,166.6	2.8	41,171.5	9.1
Toscana	8,738	29.1	8,261.2	27.5	5,262.4	17.5	6,189.4	20.6	1,253.9	4.2	370.4	1.2	30,075.2	6.7
Umbria	2,642	32.7	2,153.8	26.6	952.1	11.8	2,173	26.9	5.1	0.1	160.8	2	8,086.7	1.8
Marche	913.1	10.4	3,766.9	43	1,681.4	19.2	1,581.8	18.1	530.2	6.1	277.4	3.2	8,750.7	1.9
Lazio	12,026.9	32.1	15,646.6	41.7	7,189.5	19.2	1,779.3	4.7	356.8	1	485	1.3	37,484.2	8.3
Abruzzo	1,196	15.9	3,057.8	40.7	1,426	19	1,592.1	21.2	18.9	0.3	227.7	3	7,518.5	1.7
Molise	416.5	26.9	577.9	37.3	226.7	14.6	257.3	16.6	0	0	72.7	4.7	1,551	0.3
Campania	1,431.5	8.9	8,957.6	55.5	2,516.1	15.6	2,679.9	16.6	60.9	0.4	486.4	3	16,132.3	3.6
Puglia	23,495.6	47	7,198.7	14.4	2,912	5.8	14,430.2	28.9	769.5	1.5	1,159.2	2.3	49,965.2	11.1
Basilicata	506.1	18.9	978.7	36.5	490.1	18.3	559.2	20.9	13.3	0.5	131.2	4.9	2,678.5	0.6
Calabria	2,520.2	33.7	3,139.4	42	832.2	11.1	740.3	9.9	53.8	0.7	187.3	2.5	7,473.1	1.7
Sicilia	12,328.9	33.4	8,850.9	24	1,856.7	5	5,004.5	13.6	8,233.1	22.3	620.8	1.7	36,895	8.2
Sardegna	6,099.2	42.7	3,956.1	27.7	958.9	6.7	2,553.1	17.9	436.9	3.1	283.9	2	14,288.2	3.2
Italy	**136,420.0**	**30.3**	**126,756**	**28.2**	**79,633.4**	**17.7**	**84,797.1**	**18.8**	**14,335.5**	**3.2**	**8,115.2**	**1.8**	**450,057.4**	**100**

Source: ENEA

CHAPTER 3
GREENHOUSE GAS INVENTORY

Summary

In 2005, total greenhouse gas emissions, in CO_2-equivalent, were 12.1% above the base year levels, while the national target, in the frame of the European Union commitment and the relevant burden sharing, is a reduction of 6.5% by the period 2008-2012. Italy has decided to set 1990 as the base year for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (HFCs, PFCs and SF_6).

National emissions of CO_2, which account in 2005 for 85.1% of total greenhouse gas emissions in CO_2-equivalent, showed an increase of 13.5% between 1990 and 2005. Specifically in the energy sector, emissions in 2005 were 14.5 % greater than in 1990.

CH_4 and N_2O emissions were equal to 6.9% and 7.0%, respectively, of the total CO_2-equivalent greenhouse gas emissions. CH_4 emissions showed a decrease by 4.4% from 1990 to 2005, while N_2O increased by 6.2%.

Fluorinated gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), ranged from 0.1% to 1% of total emissions. Despite their increase from 1990 to 2005 (+144%) their contribution to overall GHG emissions is still negligible.

National System for preparing the Italian Greenhouse Gas Inventory

Italy has established a national system, which includes all institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases, and for reporting and archiving inventory information.

The Agency for the Protection of the Environment and for Technical Services (APAT) is responsible for the compilation of the National Air Emission Inventory as single national entity for Italy. APAT is also responsible for the institutional, legal and procedural arrangements for the national system and for the strategic development of the national inventory.

APAT is responsible for all aspects of national inventory preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC 1996 Revised Guidelines, the IPCC Good Practice Guidance and Uncertainty management and the IPCC Good Practice Guidance for land use, land-use change and forestry, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common reporting format, the response to the review process, the updating and data storage.

In addition, there are different institutions responsible for statistical basic data and publication, which are primary to APAT for carrying out emission estimates.

These institutions are part of a National Statistical System (Sistan), which provides national official statistics. The main basic data needed to draw up the inventory are the energy statistics published in the National Energy Balance by the Ministry of Economic Development, industrial and agricultural production data published by the National Institute of Statistics (ISTAT), statistics on transportation provided by the Ministry of Transportation, and data supplied directly by the relevant industrial associations. The national

forest inventory supplied by the Ministry of Agriculture is the basis for the calculation of emission and removals resulting from the 3.3 and 3.4 activities.
Further description of the national system can be found in the document 'National Greenhouse gas Inventory System in Italy' prepared by APAT and available on the web site http://nfp-it.eionet.eu.int:8980/Public/irc/circa-it/reportnet/library .

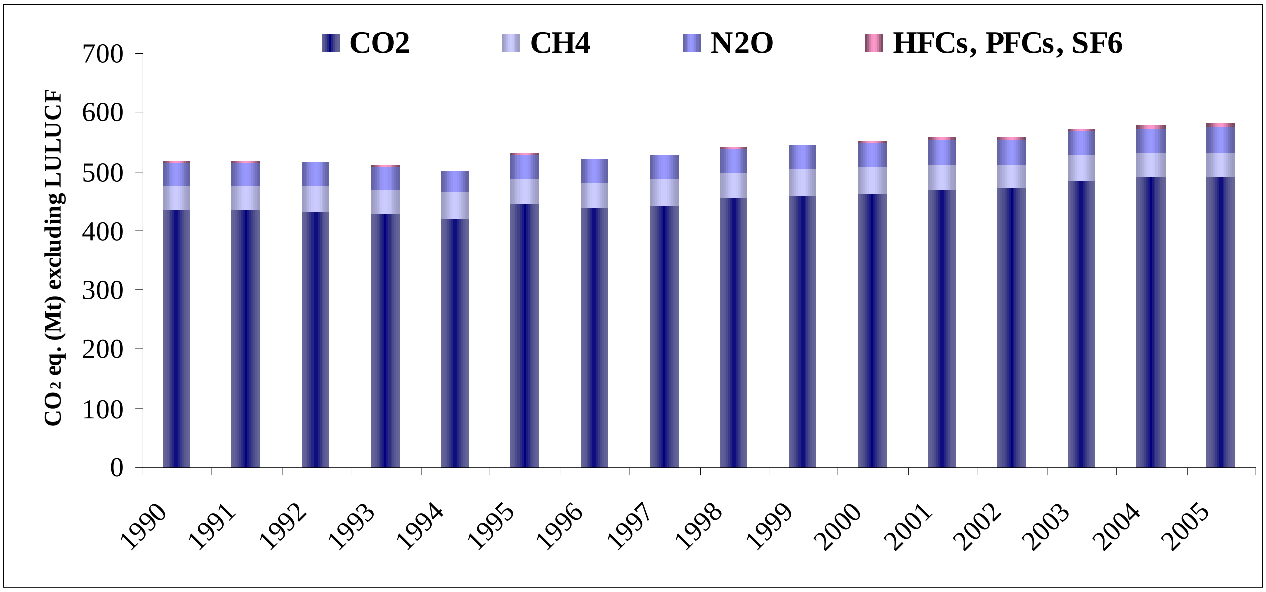
Greenhouse gas emission trends

The emission figures, which are presented in this document are those sent to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism. Emission trends are reported in the Appendix. The national GHG emission inventory is communicated through compilation of the Common Reporting Format (CRF) and the National Inventory Report (NIR), according to the guidelines provided by the United Nations Framework Convention on Climate Change. These documents provide more details on emission estimates, including all basic data as well as methodological information to carry out the final emission values. The CRF files, national inventory reports and other related documents can be found on website at http://nfp-it.eionet.eu.int:8980/Public/irc/circa-it/reportnet/library .
Furthermore, in order to reflect revisions and improvements in methodology and availability of new information the inventory is updated annually. Recalculations are applied retrospectively to earlier years, which explain any difference with previously published data. In the 2007 submission, the emission time series was updated from 1990 onwards. Such a revision is necessary on annual basis in order to meet the requirements of transparency, consistency, comparability, completeness and accuracy explicitly set by the UNFCCC Convention. It should be noted that emissions of the base year have changed from those reported in the Third Italian National Communication.
Quality Assurance (QA) Quality Control (QC) activities and different verification measures are applied thoroughly the current inventory compilation as part of the estimation process. Particularly, APAT has elaborated an inventory QA/QC procedures manual which helps in the improvement of the inventory whereas specific activities implemented during the current inventory compilation are figured out in the annual QA/QC plans. These documents are publicly available on website at http://nfp-it.eionet.eu.int:8980/Public/irc/circa-it/reportnet/library .

Total greenhouse gas emissions, expressed in CO_2 -equivalent, excluding GHG emissions and removals from land use, land use change and forestry (LULUCF), have increased by 12.1% between 1990 and 2005, varying from 517 to 580 million tons (Mt) of CO_2-equivalent, while the national commitment by the period 2008-2012 is a reduction of 6.5% compared to the base year level.
The most important greenhouse gas is CO_2, accounting approximately for 85% of total national emissions over the whole period 1990-2005. Moreover, the relative weight of CH_4 and N_2O, approximately 14% altogether, shows a slight decrease in the last years, while fluorinated gases have increased from 0.1% to 1% of the total.

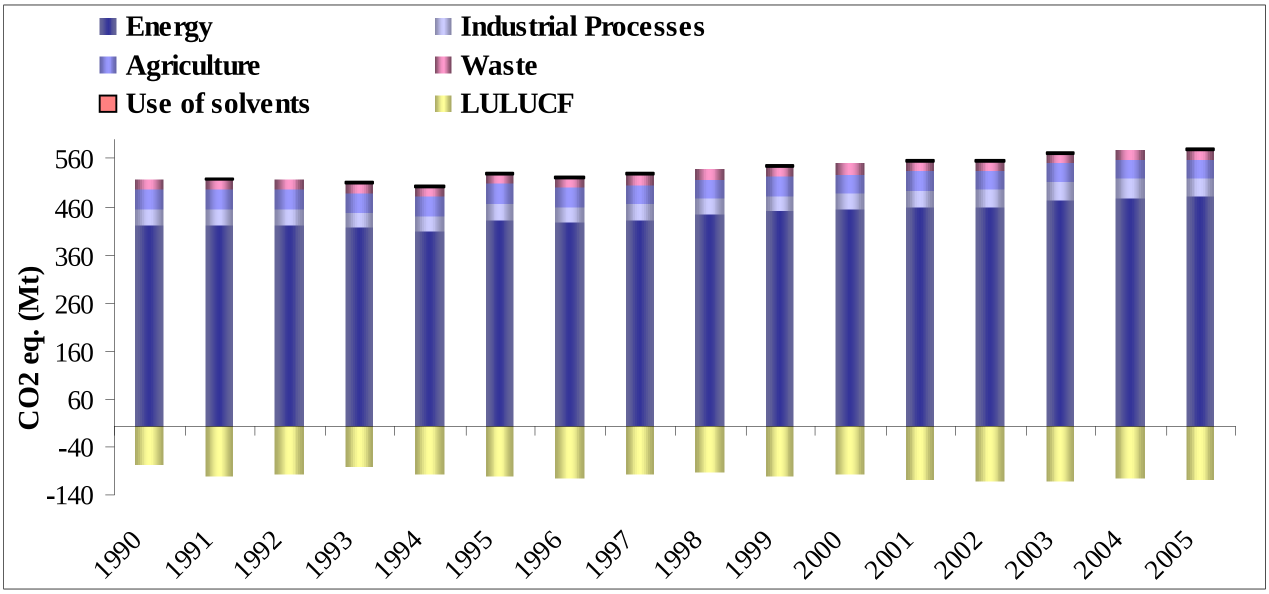
In Figure 3.1, the national trend of greenhouse gases from 1990 to 2005, expressed in Mt CO_2-equivalent, by substance, excluding emissions and removals from land use, land use change and forestry are shown.

Figure 3.1: National greenhouse gas emissions from 1990 to 2005 (excluding LULUCF)



The time series of greenhouse gas emissions and removals by sector, including the LULUCF sector, from 1990 to 2005, is reported in Figure 3.2.

Figure 3.2: National greenhouse gas emissions and removals from 1990 to 2005 by sector



The share of the different sectors in terms of total emissions remains nearly unvaried over the period 1990-2005. Specifically for the year 2005, the greatest part of total greenhouse gas emissions is to be attributed to the energy sector, accounting for 82.8%, followed by industrial processes (7%), agriculture (6.4%), waste (3.3%) and use of solvents (0.4%).

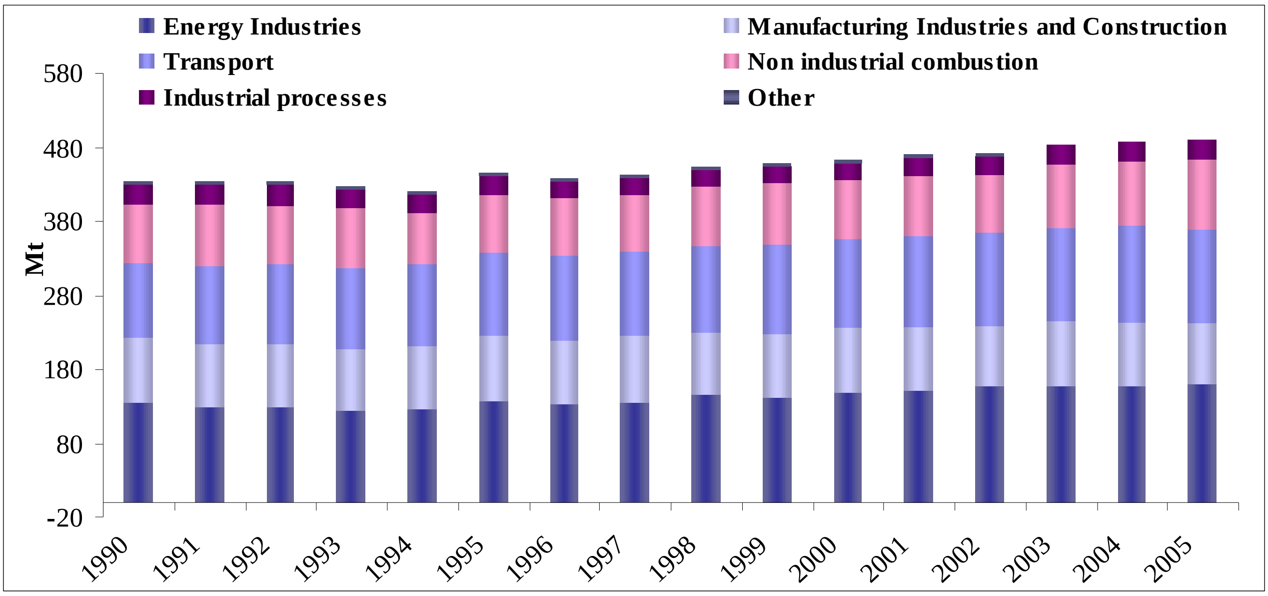
Considering total greenhouse gas emissions with emissions and removals from LULUCF, the energy sector accounts, in 2005, for 70% of total emissions and removals, as absolute weight, followed by the LULUCF sector which contributes with 16%.

Carbon dioxide emissions

CO_2 emissions, excluding CO_2 emissions and removals from LULUCF, have increased by approximately 13.5% from 1990 to 2005, ranging from 435 to 493 million tons.

Emissions derive mainly from the energy industries (32%) and transportation (26%). Non-industrial combustion accounts for 19% and manufacturing and construction industries for 17%, while the remaining emissions derive from industrial processes (5%) and other sectors (1%). The performance of CO_2 emissions by sector is shown in Figure 3.3.

Figure 3.3: CO_2 emissions by sector from 1990 to 2005

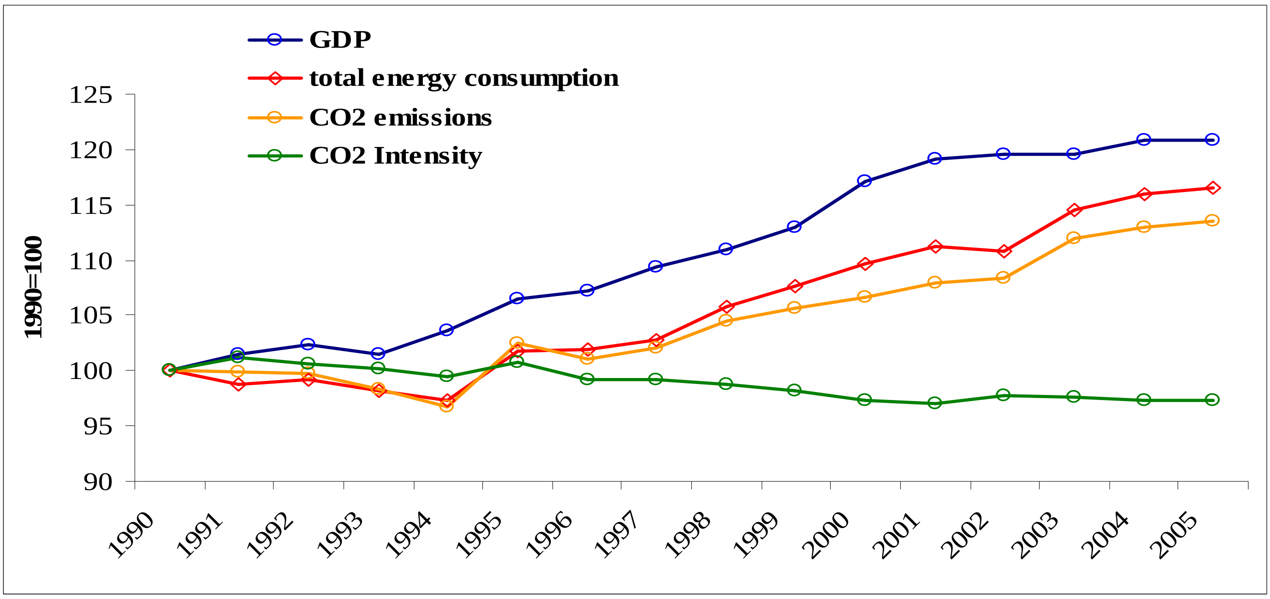


In Figure 3.4 the trend of the following economic and energy indicators is illustrated:

- Gross Domestic Product (GDP) at market prices as of 2000 (base year 1990=100);
- Total Energy Consumption;
- CO_2 emissions, excluding emissions and removals from land use, land-use change and forestry;
- CO_2 *intensity*, which represents CO_2 emissions per unit of total energy consumption.

The figures of CO_2 emissions per total energy unit show that CO_2 emissions in the 1990 mirrored energy consumption. A decoupling between the curves is observed in recent years mainly as a result of the substitution of fuels with high carbon contents by methane gas in the production of electric energy and in industry. Nevertheless, this trend slowed down in 2002, due to the increase of coal consumption in power plants.

Figure 3.4: Energy and economic indicators and CO_2 emissions



Methane emissions

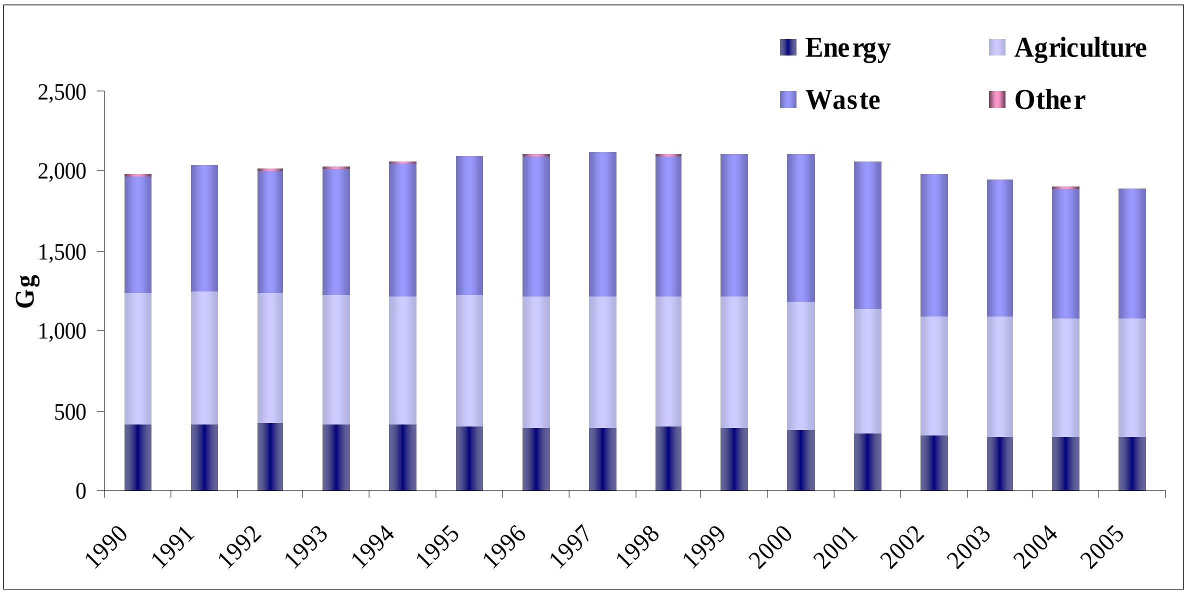
Methane emissions represent 6.9% of total greenhouse gases in 2005, equal to 39.7 Mt in CO_2 equivalent, and show a decrease of approximately 1.8 Mt as compared to 1990 levels. These emissions are mainly originated from the waste sector which accounts for 42.9% of total methane emissions in 2005, as well as agriculture (39%) and energy (17.9%).

Activities contributing to emissions in the waste sector are the operation of dumping sites and the treatment of industrial waste-water. The waste sector shows an increase in emission levels, 10.6% compared to 1990, mainly due to the solid waste disposal on land subcategory.

Emissions in the agriculture sector regard mainly the enteric fermentation and manure management categories. The agriculture sector shows a decrease of CH_4 emissions equal to 10.1% as compared to 1990.

In terms of CH_4 emissions, in the energy sector, the reduction (-19.3%) is the result of two contrasting factors. On the one hand, there has been a considerable reduction in emissions caused by leakage from the extraction and distribution of fossil fuels, due to the gradual replacement of natural-gas distribution networks. On the other hand, combustion emissions in the road transport sector have increased on account of the overall rise in consumption and, in the civil sector, of the increased use of methane in heating systems. In Figure 3.5, emission figures by sector, expressed in thousands of tonnes (Gg), are shown.

Figure 3.5: CH_4 emissions by sector from 1990 to 2005



Nitrous oxide emissions

Nitrous oxide emissions represent 7% of total greenhouse gases in 2005, with an increase of 6.2% between 1990 and 2005, from 38.01 to 40.37 Mt CO_2 equivalents.

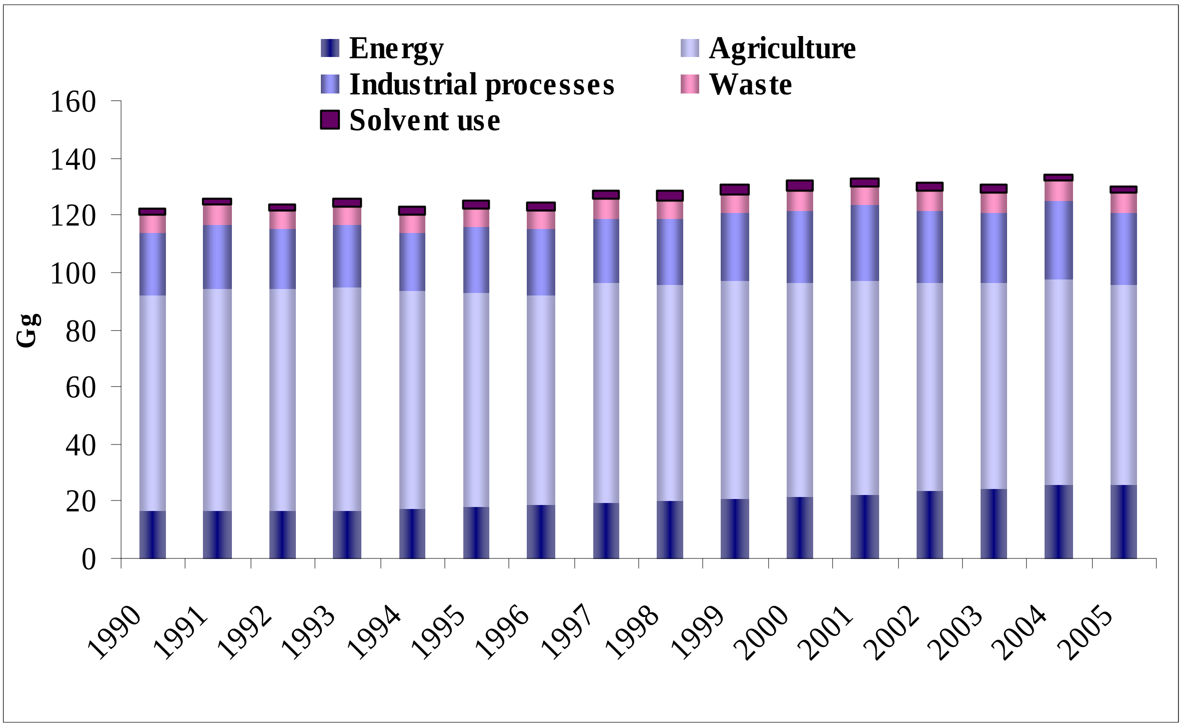
The major source of N_2O emissions is the agriculture sector (53.8%), in particular the use of both chemical and organic fertilisers in agriculture, as well as the management of waste from animal breeding. Nitrous oxide emissions show a decrease of 7% during the period 1990-2005.

Emissions in the energy-use sector (20% of the total) show an increase by approximately 53% from 1990 to 2005. This growth can be traced primarily to the road transport sector for the introduction of catalytic converters even though a high degree of uncertainty still exists on the N_2O emission factors of catalysed automobiles.

N_2O emissions for the production of nitric acid, which has decreased in recent years, and of adipic acid, whose levels have grown, account jointly for 19.2% of total N_2O emissions.

Other N_2O emissions regard the waste sector, primarily the processing of industrial and domestic waste-water. In figure 3.6 national N_2O emission figures by sector, expressed in thousands of tonnes (Gg), are shown.

Figure 3.6: N_2O emissions by sector from 1990 to 2005



Fluorinated gases emissions

Italy has set 1990 as the base year for reduction in the emissions of the fluorinated gases covered by the Kyoto Protocol, HFCs, PFCs and SF_6. Taken altogether, the emissions of fluorinated gases represent 1.05% of total greenhouse gases expressed in CO_2 equivalent in 2005, and they show an increase of 144.4% between 1990 and 2005. This increase is the result of different features for different gases.

HFCs, for instance, have increased considerably from 1990 to 2005, from 0.4 to 5.3 CO_2 equivalents Mt. The main sources of emissions are the consumption of HFC-134a, HFC-125, HFC-32 and HFC-143a in refrigeration and air-conditioning devices, together with the use of HFC-134a in pharmaceutical aerosols. Increases during this period are due both to the use of these substances as replacements for gases that destroy the ozone layer and to the greater use of air conditioners in automobiles.

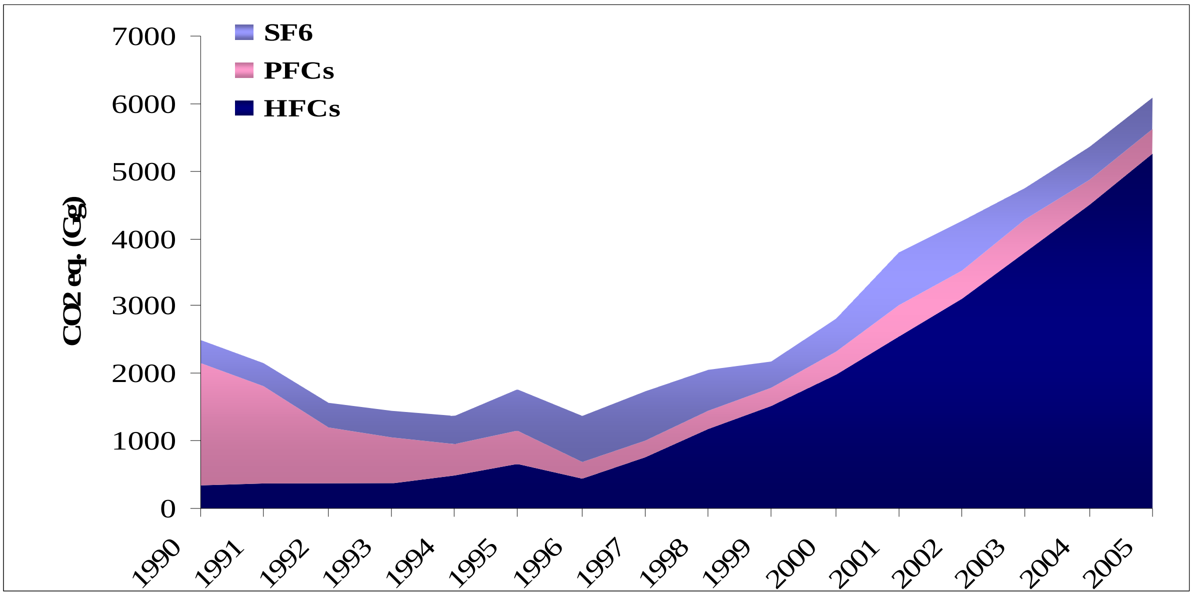
On the contrary, emissions of PFCs show a decrease of 80% from 1990 to 2005. The level of these emissions in 2005 is 0.4 Mt in CO_2 equivalent, and it can be traced in equal proportion to the use of the gases in the production of aluminium and in the production of semiconductors. Although the production of PFCs is equal to zero in Italy from the year 1999 onwards, the increase of emission is due to their consumption and use in metal production.

Emissions of SF_6 are equal to 0.5 Mt, expressed in CO_2 equivalent in 2005, with an increase of 38.2% as compared to 1990 levels. Out of the SF_6 emissions, 69% can be traced to the gas contained in electrical equipments, 18% to the use of gas in magnesium foundries. The remaining emissions results from the gas used in the production of semiconductors. The gas used in magnesium foundries has been on the rise in recent years, unlike the figures for the gas contained in electrical equipments, which have fallen.

The national inventory of fluorinated gases has largely improved in terms of the sources and the gases identified, and a strict cooperation with the relevant industry has been established. Higher methods are applied to estimate these emissions; nevertheless, uncertainty still regards some activity data which are considered of strategic economic importance and therefore kept confidential.

In Figure 3.7, emission trends by gas, expressed in CO_2equivalent thousands of tonnes (Gg), are shown.

Figure 3.7: Emissions of fluorinated gases by sector from 1990 to 2005



Appendix: CRF trend tables for greenhouse gases

This appendix shows a copy of Tables 10s1-10s5 from the Common Reporting Format 2005, submitted to the UNFCCC in 2007, in which time series of emission estimates are reported by:

CO_2
CH_4
N_2O
HFCs, PFCs, SF_6
All gases and sources categories

Table A.1 CO_2 emissions trends (1990-1999), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**405.378,85**	**405.252,71**	**404.383,42**	**401.166,08**	**395.108,88**	**418.330,84**	**414.252,35**	**418.382,42**	**429.339,91**	**434.326,25**
A. Fuel Combustion (Sectoral Approach)	402.037,89	401.987,94	401.171,80	397.786,19	391.882,81	415.156,77	411.217,12	415.139,01	426.221,39	431.921,80
1. Energy Industries	134.091,89	128.409,75	128.308,61	122.891,69	125.531,32	137.973,15	133.477,31	135.233,44	145.628,98	141.708,59
2. Manufacturing Industries and Construction	88.936,88	85.985,17	84.303,00	84.765,91	85.540,83	87.823,05	85.608,36	88.673,34	82.777,77	86.492,66
3. Transport	101.460,54	104.331,10	108.652,13	110.377,89	110.204,84	112.005,28	113.187,59	114.911,72	118.723,47	119.993,98
4. Other Sectors	76.507,63	82.070,11	78.631,88	78.307,53	69.150,58	75.919,68	77.766,18	75.098,63	78.055,13	82.619,59
5. Other	1.040,95	1.191,81	1.276,17	1.443,18	1.455,26	1.435,61	1.177,69	1.221,89	1.036,05	1.106,97
B. Fugitive Emissions from Fuels	3.340,96	3.264,77	3.211,62	3.379,89	3.226,07	3.174,07	3.035,22	3.243,41	3.118,52	2.404,46
1. Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	3.340,96	3.264,77	3.211,62	3.379,89	3.226,07	3.174,07	3.035,22	3.243,41	3.118,52	2.404,46
2. Industrial Processes	**27.268,15**	**26.826,54**	**27.360,17**	**24.488,16**	**23.607,28**	**25.474,31**	**23.091,61**	**23.165,00**	**23.218,83**	**23.335,81**
A. Mineral Products	21.099,66	21.051,69	21.863,21	19.407,30	18.913,76	20.768,08	19.075,78	19.320,39	19.575,62	20.383,81
B. Chemical Industry	2.185,80	2.089,16	2.051,07	1.461,33	1.196,91	1.222,91	962,27	1.034,92	1.040,80	958,46
C. Metal Production	3.982,69	3.685,69	3.445,89	3.619,53	3.496,61	3.483,32	3.053,57	2.809,68	2.602,41	1.993,54
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	1.598,05	1.584,54	1.586,70	1.535,12	1.469,09	1.423,99	1.378,75	1.378,90	1.328,15	1.330,94
4. Agriculture										
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, Land-Use Change and Forestry[(2)]	**-79.992,12**	**-101.273,02**	**-97.410,47**	**-82.607,79**	**-98.193,03**	**-103.332,09**	**-106.198,34**	**-99.071,70**	**-95.921,18**	**-103.459,31**
A. Forest Land	-59.225,71	-80.870,58	-77.216,14	-62.781,75	-79.072,49	-84.418,95	-87.356,35	-79.987,53	-77.887,22	-85.586,06
B. Cropland	-22.046,71	-21.919,15	-21.676,60	-21.106,33	-20.400,84	-20.193,42	-19.820,90	-20.364,46	-19.314,26	-19.153,55
C. Grassland	NO	-1.010,75	-1.048,27	NO	NO	NO	-1.593,17	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	1.280,29	2.527,47	2.530,54	1.280,29	1.280,29	1.280,29	2.572,08	1.280,29	1.280,29	1.280,29
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**536,90**	**562,22**	**562,44**	**521,18**	**524,10**	**483,02**	**472,13**	**507,76**	**504,42**	**393,47**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling										
C. Waste Incineration	536,90	562,22	562,44	521,18	524,10	483,02	472,13	507,76	504,42	393,47
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**354.789,83**	**332.953,00**	**336.482,25**	**345.102,76**	**322.516,32**	**342.380,07**	**332.996,49**	**344.362,37**	**358.470,13**	**355.927,16**
Total CO_2 emissions excluding net CO_2 from LULUCF	**434.781,95**	**434.226,01**	**433.892,72**	**427.710,54**	**420.709,36**	**445.712,15**	**439.194,84**	**443.434,08**	**454.391,31**	**459.386,47**
Memo Items:										
International Bunkers	**8.505,47**	**8.528,14**	**8.350,39**	**8.707,84**	**8.961,84**	**9.647,67**	**8.871,86**	**9.193,85**	**9.742,74**	**10.388,81**
Aviation	4.116,27	4.939,82	4.887,96	5.028,48	5.296,22	5.612,84	6.016,25	6.134,14	6.665,86	7.313,89
Marine	4.389,20	3.588,32	3.462,43	3.679,36	3.665,62	4.034,83	2.855,61	3.059,71	3.076,88	3.074,92
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass	5.243,86	5.962,78	6.286,98	6.210,29	7.215,92	7.076,58	7.063,49	7.702,89	7.572,41	8.897,95

Table A.1 CO_2 emissions trends (2000-2005), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**437.978,89**	**442.875,30**	**444.811,31**	**459.311,99**	**462.647,91**	**465.006,42**
A. Fuel Combustion (Sectoral Approach)	435.393,91	440.435,22	442.550,78	456.477,90	460.495,76	462.894,31
1. Energy Industries	147.769,95	150.930,41	157.781,46	158.591,88	157.732,36	159.876,51
2. Manufacturing Industries and Construction	87.888,78	85.138,29	81.108,59	86.005,03	86.115,95	81.960,31
3. Transport	120.458,18	122.760,82	124.883,18	126.202,46	128.352,54	126.890,70
4. Other Sectors	78.470,89	81.251,75	78.463,99	85.018,38	87.203,93	92.969,10
5. Other	806,10	353,94	313,56	660,15	1.090,98	1.197,69
B. Fugitive Emissions from Fuels	2.584,98	2.440,08	2.260,52	2.834,10	2.152,15	2.112,11
1. Solid Fuels	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	2.584,98	2.440,08	2.260,52	2.834,10	2.152,15	2.112,11
2. Industrial Processes	**24.153,07**	**24.905,81**	**24.781,91**	**25.780,48**	**26.770,31**	**26.879,20**
A. Mineral Products	21.265,81	22.095,84	22.088,70	22.985,79	23.831,78	23.908,28
B. Chemical Industry	1.061,65	1.033,79	1.081,56	1.243,32	1.327,72	1.316,92
C. Metal Production	1.825,61	1.776,18	1.611,66	1.551,37	1.610,81	1.654,00
D. Other Production	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	1.273,82	1.295,07	1.306,03	1.309,87	1.315,15	1.320,46
4. Agriculture						
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, Land-Use Change and Forestry(2)	**-97.437,48**	**-109.867,05**	**-114.010,75**	**-112.248,16**	**-104.844,42**	**-110.176,24**
A. Forest Land	-79.511,89	-88.094,49	-94.562,70	-84.672,24	-92.546,35	-92.329,64
B. Cropland	-19.205,88	-20.610,90	-20.469,49	-19.681,31	-13.578,36	-19.126,89
C. Grassland	NO	-3.720,99	-1.538,07	-10.453,51	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO
E. Settlements	1.280,29	2.559,32	2.559,50	2.558,90	1.280,29	1.280,29
F. Other Land	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA
6. Waste	**201,57**	**222,26**	**244,97**	**215,76**	**199,23**	**165,46**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling						
C. Waste Incineration	201,57	222,26	244,97	215,76	199,23	165,46
D. Other	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**366.169,88**	**359.431,38**	**357.133,47**	**374.369,95**	**386.088,18**	**383.195,29**
Total CO_2 emissions excluding net CO_2 from LULUCF	**463.607,36**	**469.298,43**	**471.144,22**	**486.618,11**	**490.932,60**	**493.371,53**
Memo Items:						
International Bunkers	**11.673,42**	**11.413,27**	**11.950,47**	**13.656,58**	**14.068,13**	**14.752,74**
Aviation	7.835,84	7.054,73	6.957,04	8.053,75	8.068,20	8.543,18
Marine	3.837,59	4.358,54	4.993,42	5.602,84	5.999,93	6.209,56
Multilateral Operations	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass	9.362,29	10.318,00	9.940,73	11.990,42	14.397,94	14.048,30

Table A.2 CH_4 emission trends (1990-1999), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	419,92	420,94	425,87	420,55	414,66	404,95	399,37	398,62	400,91	393,02
A. Fuel Combustion (Sectoral Approach)	67,79	71,18	74,20	74,13	77,00	79,08	78,97	80,02	78,40	80,21
1. Energy Industries	9,27	8,93	8,59	8,14	8,39	8,63	8,41	8,60	8,52	8,26
2. Manufacturing Industries and Construction	6,74	6,62	6,35	6,67	6,62	7,03	6,56	6,74	6,40	6,02
3. Transport	36,88	39,11	42,11	43,12	44,24	45,19	45,98	44,95	43,60	43,72
4. Other Sectors	14,73	16,33	16,95	15,99	17,54	18,01	17,82	19,56	19,72	22,04
5. Other	0,17	0,19	0,20	0,22	0,21	0,22	0,19	0,17	0,16	0,18
B. Fugitive Emissions from Fuels	352,13	349,75	351,67	346,42	337,66	325,86	320,40	318,60	322,51	312,80
1. Solid Fuels	5,79	5,33	5,31	3,90	3,39	3,07	2,88	2,85	2,63	2,52
2. Oil and Natural Gas	346,34	344,43	346,36	342,52	334,27	322,79	317,52	315,75	319,88	310,28
2. Industrial Processes	**5,16**	**4,95**	**4,83**	**4,87**	**5,07**	**5,36**	**2,99**	**3,23**	**3,11**	**3,05**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	2,45	2,43	2,40	2,28	2,49	2,65	0,60	0,62	0,59	0,59
C. Metal Production	2,71	2,51	2,43	2,59	2,58	2,71	2,39	2,61	2,52	2,46
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**819,75**	**829,35**	**807,95**	**805,14**	**807,03**	**820,11**	**821,59**	**823,10**	**816,87**	**823,18**
A. Enteric Fermentation	579,89	592,76	574,76	568,70	573,83	584,11	586,77	589,35	585,29	591,80
B. Manure Management	164,86	164,82	158,67	158,32	153,34	156,48	156,90	156,26	157,94	159,48
C. Rice Cultivation	74,39	71,09	73,86	77,48	79,22	78,90	77,27	76,91	72,99	71,27
D. Agricultural Soils	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,62	0,68	0,66	0,64	0,64	0,62	0,64	0,57	0,64	0,62
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**6,80**	**1,74**	**2,88**	**7,18**	**2,90**	**1,30**	**1,06**	**3,53**	**4,11**	**2,02**
A. Forest Land	6,80	1,74	2,88	7,18	2,90	1,30	1,06	3,53	4,11	2,02
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**734,63**	**786,32**	**772,92**	**795,26**	**830,94**	**867,60**	**876,83**	**891,82**	**881,50**	**886,92**
A. Solid Waste Disposal on Land	633,22	673,99	660,75	678,80	714,56	750,21	760,43	771,55	762,21	764,72
B. Waste-water Handling	93,74	97,53	100,55	103,83	104,54	104,46	105,49	106,98	107,47	107,74
C. Waste Incineration	7,65	14,78	11,61	12,61	11,81	12,91	10,89	13,24	11,76	14,38
D. Other	0,01	0,01	0,01	0,02	0,02	0,02	0,02	0,05	0,06	0,08
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**1.986,27**	**2.043,29**	**2.014,45**	**2.033,00**	**2.060,59**	**2.099,32**	**2.101,84**	**2.120,29**	**2.106,50**	**2.108,19**
Total CH_4 emissions excluding CH_4 from LULUCF	**1.979,46**	**2.041,55**	**2.011,58**	**2.025,82**	**2.057,70**	**2.098,01**	**2.100,78**	**2.116,76**	**2.102,39**	**2.106,17**
Memo Items:										
International Bunkers	0,54	0,47	0,47	0,50	0,50	0,55	0,45	0,49	0,51	0,53
Aviation	0,12	0,12	0,14	0,14	0,15	0,16	0,18	0,20	0,21	0,24
Marine	0,42	0,34	0,33	0,35	0,35	0,39	0,27	0,29	0,29	0,29
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass										

Table A.2 CH_4 emission trends (2000-2005), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	381,99	360,91	346,72	343,33	340,80	338,94
A. Fuel Combustion (Sectoral Approach)	75,59	69,72	63,96	64,50	69,65	66,89
1. Energy Industries	6,86	5,94	5,92	6,14	6,01	6,10
2. Manufacturing Industries and Construction	5,73	5,79	5,74	5,88	5,68	6,24
3. Transport	40,07	34,08	31,02	29,52	31,29	28,85
4. Other Sectors	22,81	23,82	21,21	22,85	26,53	25,54
5. Other	0,13	0,09	0,07	0,10	0,14	0,16
B. Fugitive Emissions from Fuels	306,40	291,19	282,76	278,83	271,15	272,05
1. Solid Fuels	3,48	3,85	3,72	4,50	3,05	3,27
2. Oil and Natural Gas	302,92	287,33	279,05	274,33	268,11	268,78
2. Industrial Processes	**3,01**	**2,83**	**2,71**	**2,76**	**2,90**	**3,05**
A. Mineral Products	NA	NA	NA	NA	NA	NA
B. Chemical Industry	0,40	0,33	0,33	0,31	0,33	0,33
C. Metal Production	2,61	2,50	2,38	2,45	2,57	2,72
D. Other Production						
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use						
4. Agriculture	**801,73**	**780,72**	**748,82**	**751,42**	**738,80**	**737,13**
A. Enteric Fermentation	579,26	555,54	525,21	526,44	515,98	516,77
B. Manure Management	156,10	158,85	155,39	154,84	150,26	150,00
C. Rice Cultivation	65,80	65,80	67,63	69,60	71,88	69,74
D. Agricultural Soils	NA	NA	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,58	0,53	0,60	0,55	0,67	0,62
G. Other	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**4,14**	**2,63**	**1,47**	**3,09**	**1,65**	**1,63**
A. Forest Land	4,14	2,63	1,47	3,09	1,65	1,63
B. Cropland	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA
6. Waste	**921,85**	**916,29**	**888,09**	**856,02**	**816,38**	**812,38**
A. Solid Waste Disposal on Land	801,15	793,42	765,11	733,44	690,02	687,46
B. Waste-water Handling	108,66	109,77	110,23	109,56	109,98	110,58
C. Waste Incineration	11,94	12,98	12,59	12,85	16,20	14,14
D. Other	0,10	0,12	0,16	0,18	0,18	0,20
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**2.112,73**	**2.063,38**	**1.987,82**	**1.956,62**	**1.900,52**	**1.893,12**
Total CH_4 emissions excluding CH_4 from LULUCF	**2.108,59**	**2.060,75**	**1.986,34**	**1.953,53**	**1.898,87**	**1.891,50**
Memo Items:						
International Bunkers	0,63	0,69	0,75	0,82	0,87	0,91
Aviation	0,27	0,28	0,27	0,28	0,30	0,32
Marine	0,37	0,42	0,48	0,54	0,57	0,59
Multilateral Operations	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass						

Table A.3 N_2O emission trends (1990-1999), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**16,85**	**16,72**	**16,98**	**17,04**	**17,29**	**18,27**	**18,72**	**19,27**	**20,43**	**21,27**
A. Fuel Combustion (Sectoral Approach)	16,84	16,72	16,97	17,04	17,29	18,27	18,71	19,27	20,42	21,26
1. Energy Industries	1,63	1,55	1,51	1,44	1,46	1,64	1,59	1,59	1,61	1,52
2. Manufacturing Industries and Construction	4,93	4,89	4,90	4,51	4,47	4,52	4,42	4,47	4,49	4,51
3. Transport	5,54	5,61	5,79	6,03	6,44	7,01	7,59	8,11	9,16	9,96
4. Other Sectors	4,52	4,44	4,53	4,78	4,66	4,88	4,94	4,89	4,99	5,13
5. Other	0,23	0,24	0,24	0,28	0,25	0,21	0,18	0,21	0,17	0,14
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
1. Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Industrial Processes	**21,54**	**22,81**	**21,11**	**21,65**	**20,36**	**23,35**	**22,66**	**22,78**	**23,06**	**23,56**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	21,54	22,81	21,11	21,65	20,36	23,35	22,66	22,78	23,06	23,56
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	2,57	2,42	2,41	2,45	2,41	2,44	2,91	2,91	3,35	3,28
4. Agriculture	**75,36**	**77,28**	**77,08**	**78,24**	**76,43**	**74,60**	**73,69**	**76,98**	**75,04**	**75,83**
A. Enteric Fermentation										
B. Manure Management	12,65	12,63	12,09	11,98	11,93	12,20	12,34	12,44	12,70	12,89
C. Rice Cultivation										
D. Agricultural Soils	62,70	64,64	64,98	66,25	64,48	62,39	61,34	64,53	62,33	62,93
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,10**	**0,01**	**0,02**	**0,18**	**0,34**	**0,27**	**0,01**	**0,09**	**0,55**	**0,75**
A. Forest Land	0,05	0,01	0,02	0,05	0,02	0,01	0,01	0,02	0,03	0,01
B. Cropland	0,05	NO	NO	0,13	0,32	0,26	NO	0,07	0,52	0,73
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	**6,30**	**6,57**	**6,41**	**6,28**	**6,28**	**6,27**	**6,36**	**6,43**	**6,51**	**6,73**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	6,01	6,08	6,01	5,86	5,89	5,85	6,01	5,99	6,12	6,28
C. Waste Incineration	0,28	0,49	0,40	0,42	0,40	0,42	0,36	0,43	0,39	0,45
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**122,71**	**125,81**	**124,01**	**125,84**	**123,12**	**125,20**	**124,34**	**128,46**	**128,93**	**131,42**
Total N_2O emissions excluding N_2O from LULUCF	**122,61**	**125,80**	**123,99**	**125,66**	**122,78**	**124,94**	**124,34**	**128,37**	**128,39**	**130,67**
Memo Items:										
International Bunkers	**0,17**	**0,15**	**0,15**	**0,16**	**0,16**	**0,18**	**0,16**	**0,17**	**0,18**	**0,19**
Aviation	0,06	0,06	0,06	0,07	0,07	0,07	0,08	0,09	0,10	0,11
Marine	0,11	0,09	0,09	0,09	0,09	0,10	0,07	0,08	0,08	0,08
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass										

Table A.3 N_2O emission trends (2000-2005), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**21,84**	**22,54**	**23,55**	**24,52**	**25,69**	**25,77**
A. Fuel Combustion (Sectoral Approach)	21,84	22,54	23,55	24,51	25,69	25,77
1. Energy Industries	1,61	1,70	1,78	1,81	1,89	1,90
2. Manufacturing Industries and Construction	4,66	4,74	4,77	4,93	5,03	5,01
3. Transport	10,32	10,76	11,83	12,24	12,90	12,92
4. Other Sectors	5,11	5,30	5,15	5,41	5,59	5,65
5. Other	0,14	0,03	0,02	0,13	0,28	0,29
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	0,00	0,00	0,00	0,00	0,00	0,00
2. Industrial Processes	**25,54**	**26,55**	**25,49**	**24,38**	**27,24**	**25,03**
A. Mineral Products	NA	NA	NA	NA	NA	NA
B. Chemical Industry	25,54	26,55	25,49	24,38	27,24	25,03
C. Metal Production	NA	NA	NA	NA	NA	NA
D. Other Production						
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	3,26	2,95	2,95	2,76	2,58	2,51
4. Agriculture	**74,53**	**74,30**	**72,66**	**72,00**	**72,19**	**70,11**
A. Enteric Fermentation						
B. Manure Management	12,46	13,11	12,41	12,31	12,03	11,90
C. Rice Cultivation						
D. Agricultural Soils	62,06	61,18	60,24	59,68	60,14	58,20
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,01	0,01	0,01	0,01	0,01	0,01
G. Other	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,74**	**0,02**	**0,01**	**0,02**	**2,81**	**0,43**
A. Forest Land	0,03	0,02	0,01	0,02	0,01	0,02
B. Cropland	0,71	NO	NO	NO	2,80	0,41
C. Grassland	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA
6. Waste	**6,70**	**6,64**	**6,64**	**6,67**	**6,81**	**6,79**
A. Solid Waste Disposal on Land						
B. Waste-water Handling	6,34	6,25	6,26	6,29	6,34	6,38
C. Waste Incineration	0,36	0,39	0,38	0,38	0,47	0,41
D. Other	NA	NA	NA	NA	NA	NA
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**132,62**	**133,01**	**131,29**	**130,35**	**137,30**	**130,64**
Total N_2O emissions excluding N_2O from LULUCF	**131,87**	**132,99**	**131,28**	**130,33**	**134,50**	**130,21**
Memo Items:						
International Bunkers	**0,22**	**0,24**	**0,25**	**0,27**	**0,29**	**0,30**
Aviation	0,12	0,13	0,12	0,13	0,14	0,15
Marine	0,10	0,11	0,13	0,14	0,15	0,16
Multilateral Operations	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass						

Table A.4 HFC, PFC and SF_6 emission trends (1990-1999), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**351,00**	**355,43**	**358,78**	**355,42**	**481,90**	**671,29**	**450,33**	**755,74**	**1.181,72**	**1.523,65**
HFC-23	0,03	0,03	0,03	0,03	0,03	0,03	0,00	0,00	0,00	0,00
HFC-32	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,02	0,05
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NO	0,00	0,00	0,00	0,00	0,01	0,01	0,04	0,05	0,08
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	NA,NO	0,00	0,00	0,00	0,10	0,20	0,29	0,43	0,68	0,85
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,01	0,01	0,02	0,03	0,03
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,01
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**1.807,65**	**1.451,54**	**849,56**	**707,47**	**476,84**	**490,80**	**243,39**	**252,08**	**270,43**	**258,00**
CF_4	0,21	0,17	0,10	0,08	0,06	0,06	0,03	0,03	0,03	0,03
C_2F_6	0,05	0,04	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6[3] - (Gg CO_2 equivalent)	**332,92**	**356,39**	**358,26**	**370,40**	**415,66**	**601,45**	**682,56**	**728,64**	**604,81**	**404,51**
SF_6	0,01	0,01	0,01	0,02	0,02	0,03	0,03	0,03	0,03	0,02

Table A.4 HFC, PFC and SF_6 emission trends (2000-2005), CRF year 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**1.985,67**	**2.549,75**	**3.099,90**	**3.795,82**	**4.515,13**	**5.267,21**
HFC-23	0,00	0,00	0,00	0,00	0,00	0,00
HFC-32	0,08	0,12	0,17	0,23	0,29	0,36
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	0,13	0,20	0,28	0,38	0,48	0,59
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	1,01	1,19	1,31	1,50	1,67	1,83
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	0,06	0,08	0,11	0,15	0,19	0,24
HFC-227ea	0,01	0,01	0,01	0,02	0,02	0,03
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**345,85**	**451,24**	**423,74**	**497,63**	**350,00**	**361,23**
CF_4	0,04	0,05	0,04	0,05	0,04	0,04
C_2F_6	0,01	0,01	0,02	0,02	0,01	0,01
C_3F_8	NA,NO	0,00	0,00	0,00	0,00	0,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c\text{-}C_4F_8$	0,00	0,00	0,00	0,00	0,00	0,00
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6(3) - (Gg CO_2 equivalent)	**493,43**	**794,96**	**737,65**	**464,69**	**491,57**	**460,17**
SF_6	0,02	0,03	0,03	0,02	0,02	0,02

Table A.5 Total emission trends (1990-1999), CRF year 2005

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	354.789,83	332.953,00	336.482,25	345.102,76	322.516,32	342.380,07	332.996,49	344.362,37	358.470,13	355.927,16
CO_2 emissions excluding net CO_2 from LULUCF	434.781,95	434.226,01	433.892,72	427.710,54	420.709,36	445.712,15	439.194,84	443.434,08	454.391,31	459.386,47
CH_4 emissions including CH_4 from LULUCF	41.711,64	42.908,99	42.303,53	42.693,06	43.272,45	44.085,64	44.138,57	44.526,07	44.236,46	44.272,01
CH_4 emissions excluding CH_4 from LULUCF	41.568,75	42.872,46	42.243,14	42.542,23	43.211,61	44.058,27	44.116,39	44.451,99	44.150,23	44.229,55
N_2O emissions including N_2O from LULUCF	38.039,53	39.001,66	38.442,82	39.009,05	38.167,78	38.813,20	38.546,70	39.823,67	39.969,38	40.740,10
N_2O emissions excluding N_2O from LULUCF	38.008,60	38.997,95	38.436,69	38.954,09	38.061,37	38.730,01	38.544,45	39.795,91	39.800,37	40.508,37
HFCs	351,00	355,43	358,78	355,42	481,90	671,29	450,33	755,74	1.181,72	1.523,65
PFCs	1.807,65	1.451,54	849,56	707,47	476,84	490,80	243,39	252,08	270,43	258,00
SF_6	332,92	356,39	358,26	370,40	415,66	601,45	682,56	728,64	604,81	404,51
Total (including LULUCF)	**437.032,58**	**417.027,01**	**418.795,20**	**428.238,15**	**405.330,95**	**427.042,46**	**417.058,03**	**430.448,57**	**444.732,93**	**443.125,42**
Total (excluding LULUCF)	**516.850,89**	**518.259,78**	**516.139,14**	**510.640,15**	**503.356,73**	**530.263,99**	**523.231,95**	**529.418,43**	**540.398,87**	**546.310,56**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	419.419,26	419.276,19	418.589,52	415.280,07	409.178,01	432.499,67	428.441,97	432.728,20	444.090,83	449.172,27
2. Industrial Processes	36.544,50	36.164,73	35.572,01	32.735,90	31.399,43	34.589,69	31.555,69	32.031,99	32.489,50	32.888,85
3. Solvent and Other Product Use	2.394,46	2.334,44	2.334,44	2.293,12	2.216,35	2.179,77	2.279,45	2.279,79	2.367,00	2.348,44
4. Agriculture	40.577,10	41.372,10	40.863,01	41.163,32	40.641,17	40.349,16	40.096,97	41.150,09	40.418,20	40.794,77
5. Land Use, Land-Use Change and Forestry[(5)]	-79.818,31	-101.232,78	-97.343,94	-82.402,00	-98.025,78	-103.221,53	-106.173,92	-98.969,87	-95.665,94	-103.185,13
6. Waste	17.915,56	19.112,33	18.780,16	19.167,74	19.921,76	20.645,71	20.857,87	21.228,37	21.033,33	21.106,22
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**437.032,58**	**417.027,01**	**418.795,20**	**428.238,15**	**405.330,95**	**427.042,46**	**417.058,03**	**430.448,57**	**444.732,93**	**443.125,42**

Table A.5 Total emission trends (2000-2005), CRF year 2005

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	366.169,88	359.431,38	357.133,47	374.369,95	386.088,18	383.195,29
CO_2 emissions excluding net CO_2 from LULUCF	463.607,36	469.298,43	471.144,22	486.618,11	490.932,60	493.371,53
CH_4 emissions including CH_4 from LULUCF	44.367,40	43.331,00	41.744,14	41.089,10	39.910,98	39.755,62
CH_4 emissions excluding CH_4 from LULUCF	44.280,40	43.275,81	41.713,21	41.024,13	39.876,37	39.721,46
N_2O emissions including N_2O from LULUCF	41.111,00	41.233,89	40.700,76	40.407,91	42.563,97	40.498,32
N_2O emissions excluding N_2O from LULUCF	40.881,17	41.228,29	40.697,62	40.401,32	41.693,71	40.366,05
HFCs	1.985,67	2.549,75	3.099,90	3.795,82	4.515,13	5.267,21
PFCs	345,85	451,24	423,74	497,63	350,00	361,23
SF_6	493,43	794,96	737,65	464,69	491,57	460,17
Total (including LULUCF)	**454.473,22**	**447.792,21**	**443.839,66**	**460.625,11**	**473.919,84**	**469.537,86**
Total (excluding LULUCF)	**551.593,87**	**557.598,47**	**557.816,34**	**572.801,70**	**577.859,38**	**579.547,66**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	452.771,94	457.442,05	459.394,07	474.122,05	477.768,73	480.113,79
2. Industrial Processes	34.959,49	36.993,23	37.001,79	38.153,57	40.630,85	40.792,17
3. Solvent and Other Product Use	2.284,53	2.210,51	2.219,20	2.166,67	2.114,18	2.097,80
4. Agriculture	39.939,48	39.428,43	38.249,50	38.098,97	37.892,35	37.214,06
5. Land Use, Land-Use Change and Forestry(5)	-97.120,65	-109.806,26	-113.976,68	-112.176,59	-103.939,54	-110.009,81
6. Waste	21.638,43	21.524,26	20.951,77	20.260,43	19.453,27	19.329,84
7. Other	NA	NA	NA	NA	NA	NA
Total (including LULUCF)(5)	**454.473,22**	**447.792,21**	**443.839,66**	**460.625,11**	**473.919,84**	**469.537,86**

CHAPTER 4
POLICIES AND MEASURES

Introduction

This chapter summarises the policies and measures introduced by the Italian Government to reach its reduction target under the Kyoto Protocol, organised by relevant sectors. The first section describes the overall policy context, the second section contains a brief description of the main national policies and measures and the third sertion gives an overview of the regional energy plans.

Policy making process

Italy's emissions reduction target under the Kyoto Protocol

Italy is a member State of the European Union. In the framework of the EU Burden Sharing Agreement, Italy has committed itself to reduce its greenhouse gas emissions by 6.5% below base-year levels over the first commitment period, 2008-2012.

Italy ratified the Kyoto Protocol through law n. 120 of 1 June 2002[9]. The new law prescribed the review of the 1998 "Guidelines for national policies and measures for the reduction of greenhouse gas emissions" and required the identification of new policies and measures aimed at:

- increasing the energy efficiency of the national economic system and fostering the use of renewable energy sources;
- increasing carbon dioxide removals deriving from land use, land-use changes and forestry, as established under article 3 paragraphs 3 and 4 of the Kyoto Protocol;
- implementing the Clean Development and the Joint Implementation mechanisms established under the Kyoto Protocol;
- fostering Research and Development activities in order to: promote hydrogen as a main fuel in energy systems and in the transport sector; promote the construction of: biomass plants; solar thermal power plants; wind and photovoltaic power plants; waste and biogas fuelled power plants.

[9] Law n. 120 of 1 June 2002, "Ratifica ed esecuzione del Protocollo di Kyoto alla Convenzione Quadro delle Nazioni Unite sui Cambiamenti Climatici, fatto a Kyoto l'11 dicembre 1997" , in GU n. 142 of 9 giugno 2002.

National Climate Change Strategy

The Revised Guidelines for national policies and measures for the reduction of greenhouse gas emissions were approved on December 19, 2002 by the Interministerial Committee for Economic Planning (CIPE)[10] together with the related National Action Plan (2003-2010). These documents identify the policies and measures already decided, even if not fully implemented, and some other additional measures envisaged to enable Italy to meet its commitment under the Kyoto Protocol. Alongside with domestic measures the National Plan provides for the use of the Clean Development and Joint Implementation mechanisms to reach the Kyoto target.

The competent ministries are currently working on the review of the Guidelines to update the national greenhouse gas emissions projections and identify additional domestic policies and measures to reach the national target. Since the review has not yet been completed, this report is based on the background information used for such revision.

Monitoring and evaluation of progress with climate policies and measures

The National Action Plan 2003–2010 set up an Interministerial Technical Committee for greenhouse gas emissions (CTE), chaired by the Ministry for the Environment, Land and Sea .The Committee has the responsibility to regularly monitor progress in the implementation of policies and measures, on the basis of indicators and sectoral-level emissions. It also has the task to carry out cost-effectiveness analysis to identify additional measures needed to meet the Kyoto target. The Technical Committee includes representatives of the Regions and of the Ministries for Economic Development, Agricultural and Forestry Policies, Infrastructures, Transport, University and Research, Foreign Affairs.

Main policies and measures and their effects

This section gives a short description of the main policies and measures that have had or are expected to have a direct or indirect effect on the reduction of greenhouse gas emissions in Italy. When appropriate a brief description of the policies and measures already reported in the Third National Communication is given. Additional measures still at the planning stage are reported at the end of the pertinent paragraphs. The policies and measures described are as known on 1 May 2007.

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10 CIPE Deliberation 123 of 19th December 2002.

Cross cutting policies

The White Certificates system

The White Certificates system represents a cross cutting policy aimed at promoting energy efficiency and delivering emissions reductions in all the energy end use sectors. Its impacts on greenhouse gas emissions reduction have been calculated and reported for each of the relevant sectors - namely the cogeneration, industry and civil sectors - in the pertinent subparagraphs.
The system was firstly introduced in July 2001 by means of two ministerial decrees, later repealed and substituted by two new decrees approved in April 2004. The new decrees set the obligation on electricity and gas distributors with more than 100,000 customers as of 31 December 2001, to achieve the primary energy saving target of 2.9 Mt of oil equivalent per year by 2009. The overall national target was then scheduled annually according to the following table:

Table 4.1: National target for primary energy savings

	Target (Mtoe/year)	
Year	**Electricity distributors**	**Gas distributors**
2005	0,1	0,1
2006	0,2	0,2
2007	0,4	0,4
2008	0,8	0,7
2009	1,6	1,3

The distributor's quota of national savings is determined according to the ratio of own electricity/gas distributed to the national total in the previous year. The annual energy saving targets can be achieved *through the implementation of energy saving projects in all energy end-use sectors*. Projects contribute to the achievement of targets for 5 years; only for specific projects (buildings thermal envelope, bioclimatic design, reduction of cooling needs, etc) the time limit is raised up to 8 years. Compliance with the target is verified through the surrender to the competent authority of the corresponding amount of White Certificates by May 1 of every year, starting with 2006. Each Certificate testifies the saving of 1 t of oil equivalent. Only additional savings over legislative requirements can be taken into consideration: projects implemented to abide the law cannot be awarded White Certificates. Projects can be implemented either by distributors - directly or through controlled companies - or by energy saving companies (E.S.Co.). Target-bound distributors can therefore gain their own certificates, or buy them on the market from other parties. Certificates can be traded bilaterally or else through an organized market.
Eligible projects:
- Rephasing of electric systems;
- Electric motors and their applications;
- Lighting systems;
- Reduction of electricity leaking;
- Switching from electricity to other fuels when this produces primary energy savings;
- Reduction of electricity consumption for heating purposes;
- Reduction of electricity consumption for air conditioning;
- High efficient electric appliances;
- High efficient office equipment;
- Switching from other fuels to electricity when this produces primary energy savings;

- Reduction of primary energy consumption for heating, ventilation and air conditioning system;
- Promotion of end-use technologies fuelled by renewable sources;
- Electric and gas-fuelled vehicles;
- Information campaigns to raise awareness and promote energy savings.

The target set for the first year of application of the new system has been largely exceeded: between January 2005 and May 2006 the Regulatory Authority for the Electricity and Gas (AEEG) has certified savings for 286,837 toes. Almost 75% of these projects have been devoted to reduce electrical consumption, 22% to reduce natural gas consumption and 3% to reduce other energy sources.

The main measure types concerned the following areas:

- 33% - electric uses in the residential sector (energy efficient lightbulbs and appliances, etc..);
- 27% - improving energy efficiency in public lighting (high efficiency road lamps etc.);
- 21% - energy generation and distribution systems in the residential sector (PV installations, cogeneration plants, district heating systems, etc);
- 14% - reduction of energy consumption for heating in the residential sector (thermal insulation of buildings; installation of high efficiency boilers, etc.);
- 5% - energy saving projects in the industry sector.

The European Union Emission Trading Scheme

The EU Emissions Trading Scheme (EU ETS) was established in 2003 by Directive 2003/87/EC and is the largest emissions trading scheme in the world. It covers CO_2 emissions by all medium and large installations in the fields of energy conversion, refinery processes, coke ovens, and the steel, cement, glass, ceramic, cellulose and paper industries.

Installations in the EU ETS can meet their obligations either by implementing emission reduction measures of their own or by purchasing allowances, which might come from installations in other EU countries and credits from the Kyoto Protocol project mechanisms.

Since 1st January 2005, operators of installations have been required to monitor their emissions and to ensure that they surrender allowances equivalent to their emissions in any calendar year.

According to directive 2003/87/ each Member State must submit a National Allocation Plan for each trading period to set the total quantity of allowances to be issued and the number of allowances each installation will receive.

On 15 May 2007, the European Commission has accepted Italy’s National Allocation Plan for the period 2008-2012 on condition that certain changes were made, including a reduction in the total number of emission allowances proposed by 13.25 million tonnes of CO_2 equivalent per year, to 195.75 million tonnes.

In order to avoid a double counting in the estimation of the quantitative reduction effects of national policies and measures, the contribution of the ETS sector has been cautiously estimated in 13.2 million tonnes of CO_2 equivalent per year.

The Kyoto mechanisms – Joint Implementation (JI) and Clean Development Mechanism (CDM)

Italy recognises that the Kyoto Mechanisms play an essential role in meeting commitments under the Protocol. The actual Government has affirmed its will to achieve its emissions reduction target mainly through the adoption of national policies and measures[11]. The contribution of the Kyoto mechanisms to the national emissions reduction target has been assessed at 20.75 $MtCO_2$.

The credits, predominantly CERs and ERUs, will be mainly purchased through the Italian Carbon Fund (ICF), which was set up in 2003 following an agreement between the World Bank and the Italian Ministry for the Environment, Land and Sea. The ICF is open to the participation of the Italian private and public sector; the minimum contribution from each additional participant is set at US$1 million. Italy also contributes to the Community Development Carbon Fund (CDCF) and to the BioCarbon Fund (BioCF).

The average price of the credits purchased so far is about 6, 65 US dollars/tCO_2. Assuming the average price will remain stable in future years, by the end of the commitment period 2008 – 2012 the economic resources already transferred to the World Bank will allow the purchase of about 3,42 $MtCO_2$ per year.

Budget law 2007

The Budget law 2007 provided for the economic resources to support the implementation of emission reductions policies and measures, as summarised in the following table:

Table 4. 2 Funds

Fund	Legislative provision	Allocation	Target
Fund for new buildings	Art 351 - 352 Budget law 2007	15 million euro per year for three years (2007 – 2009)	Contribution of 55% of the extra costs incurred to reduce the energy consumption of new buildings with a surface of over 10.000 cubic meters) of at least 50% relative to the requirements provided for by legislative decree 192/05 . This Fund provides for 15 million euro per year for three years (2007 - 2009).
Fund for energy efficiency and fuel poverty	Art 353 - 364 Budget law 2007	100 million euro per year for the period 2007 - 2011; 50 millions per year have been allocated to the period 2007 - 2009; of these, only 11 million euro per year for three years (2007 - 2009) will finance energy efficiency intervention	The Fund (11 million euro per year for three years) will finance: - the tax incentive of 36% for any energy saving lighting systems installed by 2009 in non residential buildings; - the tax incentive of up to 200 € for any A+ refrigerator and freezer purchased by 31.12.2007; - the tax incentive of up to 1500 € for highly efficient electric engines and inverters (5<power<90 kW) purchased and installed by 31.12.2007.

11 Parliamentary Resolution n. 6.00100 of 16 February 2006, confirmed in the political program of the new Government, which took office in May 2006.

Fund for competitiveness and economic development	Art. 841 - 843 Budget law 2007	The actual share of the Fund meant to finance energy efficiency and sustainable mobility related projects still has to be defined	Part of the Fund is destined to the implementation of energy efficiency and sustainable mobility high-tech projects
Rotation Fund	art 1110 - 1115	200 million euro for each year from 2007 to 2009	The Fund will finance a number of priority actions, among which: the promotion of high performance distributed microcogeneration plants for electricity and heat generation, small size RES plants (heat and electricity), replacement of industrial electric engines with a power of over 45 kW with highly efficient engines, end use energy efficiency in the domestic and tertiary sector; industrial processes nitrous oxide emissions reduction and pilot projects for the research and development of new low emissions or zero emissions energy sources and technologies.
Sustainable Mobility Fund	Art. 1122 Budget law 2007	90 millions euro per year for three years (2007-2009)	The Fund will finance primarily: the strengthening of public transport, with particular reference to low emissions transport means; the promotion of intermodality; the introduction of an incentive system to promote sustainable mobility; the promotion of mobility management and car sharing; the promotion of safe travel plans in every school; the improvement of the efficiency of goods transport and delivery; the setting up and/or improvement of methane, hydrogen, electricity and Lpg distribution networks; the promotion of urban cycling paths.
Interregional Operational Plan - Renewable energy and energy efficiency		803.9 millions euro for the period 2007- 2013	The following projects will be financed: renewable energy plants; distributed cogeneration and trigeneration plants; district heating and cooling projects; promotion of energy efficiency projects; biofuel production

Energy supply

This subsection describes the policies and measures implemented or planned in the energy supply sector to reduce its greenhouse gas emissions, with particular reference to renewable energy sources, cogeneration and energy efficiency of electric power plants.

Renewable energy sources

Policies and measures introduced to support the diffusion of renewable energy sources are an integral part of CO_2 emissions reduction policies.

The White Paper for Renewables[12], set a target of 20.3 Mtoe by 2008 – 2012 as a contribution of renewable energy sources to the national energy balance. The contribution of renewable electricity alone was set at 16.7 Mtoe by 2008 – 2012. The "Revised guidelines for national policy and measures for the reduction of greenhouse gas emissions", envisaged a contribution of renewable electricity to the national energy balance of 75 TWh by the period 2008 – 2012.

Since the early 90s several different schemes have been introduced to subsidise the diffusion of renewable energy sources. A feed in tariffs system was adopted in 1992 (Cip 6), but its high costs and unsatisfactory results suggested its suspension, provided for by the decree 24 January 1997. Under this decree, only those plants already operating or at least under construction at the time of its entry into force, could still be qualified for the CIP 6 incentives. A new incentive scheme, based on a market oriented mechanism, was later introduced with legislative decree 79/99.

The Green Certificates system

Legislative decree 79/99 introduced the obligation on electricity providers (generators and importers) to feed the grid with a minimum share of electricity produced from renewable energy sources. The obligation started in 2002. The initial share was set at 2% of the overall electricity produced or imported (exceeding 100 GWh), but the increase of this quota over time was already planned in the decree. As reported in the subsequent paragraphs, the law provides for an indirect bonus for cogeneration: in order to calculate the required quantity of renewable electricity, the electricity produced by cogeneration plants is subtracted from the total.

Providers are allowed to fulfil their obligation by different means:

- they can generate the required share of renewable electricity setting up new renewable capacity;
- they can import the required share of renewable electricity from foreign countries where a similar mechanism is in force, or;
- They can purchase the relative quota, represented by the so called Green Certificates, on the market.

Green Certificates are tradable rights issued for the first twelve years of incremental generation of renewable electricity (originally 8 years): in order to qualify for the issuance of Green Certificates the plant generating it must have started operation after April 1st, 1999. Each certificate represents 50 MWh and its price is determined by market forces. However, Green Certificates are still issued even to "Cip 6" plants and they are attributed to the GSE[13]. In case of insufficient supply of Green Certificates on the market, the GSE can sell these certificates at a prescribed price that is the difference between the take-

12 The White Paper was approved by the CIPE (Inter-ministerial Committee for Economic Planning) with Resolution No 126 of 6 August 1999.

13 Gestore dei Servizi Elettrici S.p.A.

up price paid to the generator and the average price paid in the same period to conventional producers. This price has become an upper boundary for the price of the certificates freely sold on the market.

Recent measures affecting the Green Certificate System

Several recent measures have brought in important changes to the system envisaged by legislative decree 79/99.

Legislative decree 387/03 increased the minimum 2% quota of renewable electricity to be fed into the grid by 0.35% per year for the period 2004 – 2006 and set the deadlines by which the increases for the periods 2007—2009 and 2010—2012 had to be updated. The Decree also allowed Green Certificates to be issued for biomass and waste-fuelled plants for 12 years (instead of the original 8 years).

Decree 24 October 2005 introduced the obligation on the GSE to purchase the Green certificates that could not be sold on the market, due to insufficient demand.

Legislative decree 152/06 extended the period during which the incremental production of renewable electricity entitles to the right to obtain Green Certificates from 8 to 12 years.

Budget law 2007 repealed the provision set forth in legislative decree 387/03 that qualified cogeneration plants combined with district heating and plants producing electricity from the non biodegradable fraction of waste and RDF for the issuance of Green Certificates.

Photovoltaic electricity The production of photovoltaic electricity benefits of a dedicated scheme. **Decree 28 July 2005**, later amended by **decree 6 February 2006**, introduced a feed-in tariff system for electricity produced by the photovoltaic conversion of solar energy fed into the grid. The decree provided for a specific twenty-year incentive tariff varying between 0.445 and 0.490 eur/kWh depending on the plant size and on the date of commissioning. The tariff declines 2% per year for the systems installed after December 2006. The declining compensation rate creates an incentive to reduce costs and to implement projects as early as possible. In addition to the twenty year feed-in tariff, system owners also retain the benefits of net metering or on-site consumption of the electricity generated.

The decrees established a target for the rated power to be installed of 1,000 MW by the year 2015 and a maximum limit of the cumulative electric power of all the plants that may benefit from the supporting measures of 500 MW.

The huge number of applications received and the potential for success of this policy paved the way for its revision and improvement. In February 2007 a new decree was passed that brought in several changes to the existing system. The previous decrees will still apply only to those plants which have already been granted the right to the incentive tariffs by the end of 2006. The **decree 19 February 2007** applies to all the applications received after that date.

The new scheme applies to all PV plants connected to the grid with a nominal capacity higher than 1 kWp. The tariffs are still guaranteed for 20 years but they have been slightly changed to further incentive installations integrated in buildings. They vary in relation to the nominal power and the type of the installation, as shown in the following table.

Table 4.3: Feed in tariffs for photovoltaic plants

	Feed-in tariff (euro cent/kWh)		
System size	not integrated	partially integrated	integrated
from 1 to 3 kWp	40	44	49
from 3 to 20 kWp	38	42	46
over 20 kWp	36	40	44

A 5% increase is granted to PV systems:

- installed in public schools and public health centres,
- used as a replacement for asbestos roofs;
- installed in public buildings owned by municipalities with less than 5000 inhabitants.

The tariffs can be further incremented in case of adoption of energy efficiency interventions, envisaged in the energy certificate of the building, that lead to a decrease in the energy performance index of at least 10%.

The new decree raised the national indicative target for PV installed capacity by 2016 to 3,000 MW. The new supporting mechanism will operate until an installed capacity of 1,200 MW is reached. Plants built within 14 months after the total capacity is reached will nonetheless continue to receive the incentive.

Another important provision to further support the installation of photovoltaic systems in new buildings was introduced by the **Budget Law 2007**[14]. Art. 350 of the new law introduces the obligation for municipal Building Regulations to allow the issuing of construction permits for new buildings only if the submitted plan provides for the installation of a PV system granting the production of at least 0.2 kW for each household.

As regards measures still at the planning stage, there is a new support system currently under discussion in Parliament that has a realistic chance to pass and be implemented in the near future. The new system, which most likely will still be based on the Green Certificates scheme, will reward the different renewable energy sources according to the different technologies and the different generation costs. This new approach is meant to consistently support the less competitive sources.

[14] Law 296 of 27 December 2006

Table 4.4: Summary of policies and measures in the energy supply sector - renewable energy sources

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas $MtCO_2eq$		
						2010	2015	2020
ENERGY SUPPLY								
Renewables								
Implemented								
Green Certificates (legislative decree 387/03)	Supporting the production of renewable electricity	CO_2	regulatory	implemented	GSE and electricity providers	measures already included in the trend scenario		
Green Certificates (legislative decree 152/06)	Supporting the production of renewable electricity	CO_2	regulatory	implemented	GSE and electricity providers			
Green Cerificates (decree 24 october 2005)	Supporting the production of renewable electricity	CO_2	regulatory	implemented	GSE and electricity providers			
PV systems (decree 28.07.2005 as amended by decree 6.02.2006)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 500 MW is reached	CO_2	regulatory	no longer in place	GSE	**0,58**	**1,60**	**1,92**
PV systems (decree 19.02.2007)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 1200 MW is reached	CO_2	regulatory	implemented	GSE			
PV systems (budget law 2007)	Supporting the installation of photovoltaic systems in new buildings	CO_2	regulatory	implemented	local authorities			
Adopted/Planned								
New supporting system for renewable energy sources	Fostering the production of electricity from all renewable energy sources; strenghtening the incentives for less competitive sources. The actual effect of this measure is assessed taking into consideration the trend scenario	CO_2	regulatory	planned	Government, GSE and electricity providers	**6,29**	**17,41**	**24,68**

Cogeneration

Cogeneration is currently supported by means of different incentive schemes, rewarding both the production of heat and the production of electricity. In particular, all cogeneration plants benefit from the White Certificate system while RES cogeneration plants are additionally entitled to receive Green Certificates to reward the green electricity produced.

As reported above, **legislative decree 79/99** introduced a Green Certificate system to support the production of electricity from renewable energy sources. Cogeneration plants using geothermal energy or firing/cofiring biomass (including the biodegradable fraction of waste) naturally benefit from this support system, while cogeneration plants firing/cofiring the non biodegradable fraction of waste and refuse derived fuel (RDF), have been recently excluded[15].

Law 239/04 entitled cogeneration plants combined with district heating to receive Green Certificates to reward the thermal energy actually used for district heating, but this provision was recently repealed by the Budget law 2007.

Legislative decree 20/2007, introduced to transpose directive 2004/8/CE into the national legal system, provides for a set of comprehensive measures designed to promote high-efficiency cogeneration based on a useful heat demand through the White Certificates system. High efficiency cogeneration is

15 The non biodegradable fraction of waste and RDF were originally included in the definition of renewable energy sources introduced by legislative decree 79/99. Cogeneration plants firing these two sources were therefore eligible for the issuance of Green Certificates. This definition was however in contrast with the definition introduced at European level by directive 2001/77/CE and was therefore later amended by Legislative decree 387/03. This new law excluded the non biodegradable fraction of waste and RDF from the definition of renewable energy sources but at the same time it allowed the issuance of Green Certificates for those plants firing them for the production of electricity, leaving the support system unaltered. The Budget law 2007 finally amended this provision excluding these two sources from the Green Certificates scheme.

defined as the simultaneous generation of thermal energy and electrical and/or mechanical energy that exceed the limit values specified in AEEG[16] Decision 42/02 (after 2010 these limits will be replaced by those provided for by Annex III of the same law). The new law confirms some previously adopted measures and introduces new ones.

The main benefits currently granted to co-generation are:

- dispatch priority;
- exemption from the obligation to purchase Green Certificates;
- incentive prices for the electricity produced by co-generation plants having a capacity of less than 10 MVA;
- right to obtain White Certificates for all cogeneration plants (the implementing measures of legislative decree 20/07, still at the drafting stage, will modify the current scheme to ensure stronger support);
- right to obtain Green certificates for those cogeneration plants using geothermal energy or firing/cofiring biomass;
- net metering for the electricity produced in high-efficiency cogeneration plants with a nominal capacity not over 200kW;
- simplified authorisation procedure (plants with a thermal capacity of over 300 MW are subject to the authorization procedure provided for by law 55/02, while new simplified procedures have to be adopted for smaller plants)
- obligation for new buildings and buildings subject to major renovation to lay down all the necessary works to allow the connection to district heating systems, when existing (and not further than 1 km) or planned.

As regards new measures still at the planning stage, the competent Ministries are currently working on a new decree to further support the diffusion of cogeneration plants and district heating systems, but the details of the new support scheme still have to be defined.

Since RES cogeneration plants benefit both from the Green Certificates system (for the production of electricity) and from the White Certificate system (for the energy saving effects), the expected emission reductions have been reported partly in the Energy Supply–Renewables sector and partly in Energy Supply–Cogeneration sector.

16 Regulatory Authority for Electricity and Gas.

Table 4.5: Summary of policies and measures in the energy supply sector - Cogeneration

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
ENERGY SUPPLY								
Cogeneration								
Implemented								
RES Cogeneration (legislative decree 387/03)	Supporting the production of electricity from RES cogeneration through Green certificates	CO_2	regulatory	implemented	GSE and electricity providers	measures already included in the trend scenario		
White Certificates (Decrees 20 July 2004)	Supporting energy saving through cogeneration	CO_2	regulatory	implemented	AEEG, GME and electricity and gas distributors			
Cogeneration combined with district heating (Law 239 of 23 August 2004)	Supporting CHP plants integrated with district heating through the issuing of Green certificates	CO_2	regulatory	no longer in place	GSE			
Adopted/Planned								
High efficiency cogeneration (Legislative decree 20/07)	Supporting CHP plants through the issuing of White certificates	CO_2	regulatory	adopted	AEEG, GME and electricity and gas distributors	1,65	5,44	9,33
Cogeneration	Further supporting cogeneration through the White certificates scheme	CO_2	not defined	planned	Government			

Energy efficiency of electric power plants

The liberalisation of the electricity sector brought in by Legislative decree 79/99 started a deep refurbishment of the power generation sector. The decree had the main purpose of reducing the dominant position of Enel, the former state monopolist, by forcing it to sell part of its generation capacity to new entrants.

Subsequent **Decree 4 August 1999** identified the plants that had to be sold to new entrants and specified those that had to be converted to from fuel oil steam plants to new combined cycle gas turbine plants (CCGT) using natural gas. This last provision was intended to increase the overall efficiency in power generation and to reduce CO_2 emissions of the energy supply sector. Out of a total capacity to be divested of 15,000 MW, 9,400 MW were forced to be converted to CCGT.

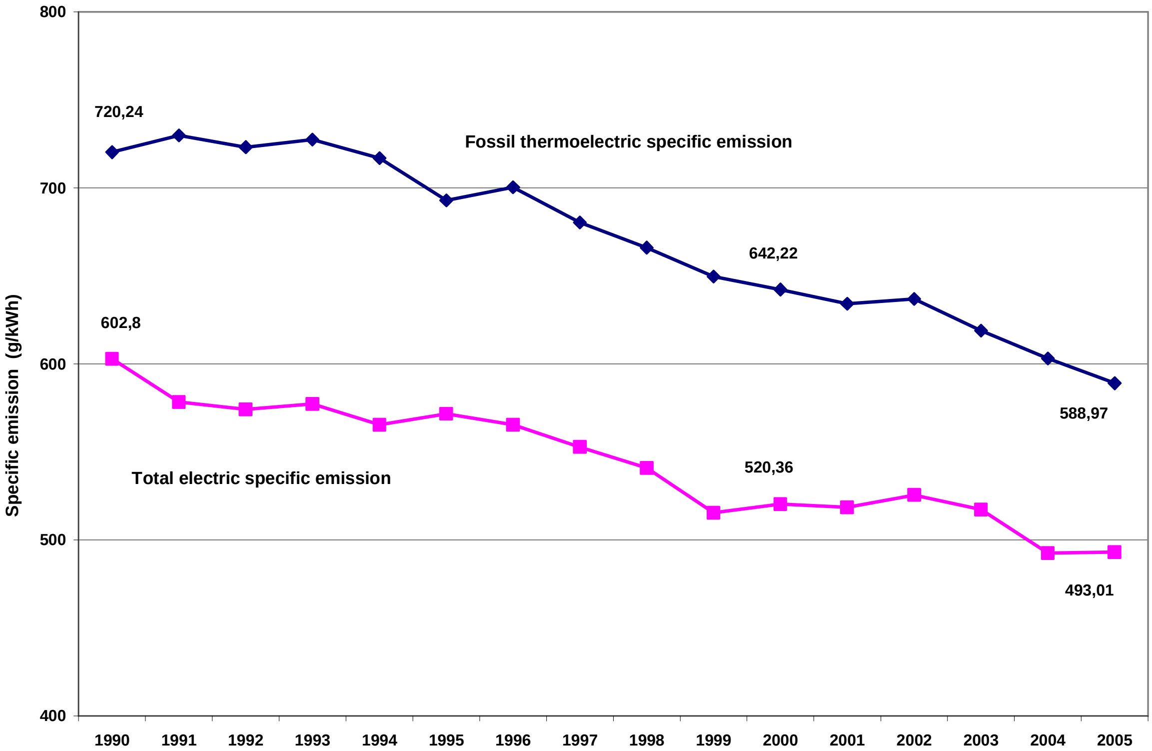
Law 55 of 9 April 2002 was introduced to simplify the authorisation procedure for the construction and operation of power plants with a capacity of over 300 MW. From 2002 to the end of 2006 the Ministry of Economic Development issued 45 authorisations for 21,400 MWe of new capacity; among these 23 authorisations, for an overall capacity of 9,897 MW, were issued according to the new procedure brought in by law 55/02.

Law 239 of 23 August 2004 introduced some important changes in the energy sector. One of its main purposes was to speed up the authorisation process for the construction of new power plants and energy infrastructures, particularly grid lines.

Since the entry into force of law 239/04, new energy infrastructures for approximately 2,300 MW have been developed and new CCGT plants for about 3,200 MW have been constructed, which led to consistent emissions reductions.

The short term effect of the implementation of these laws is already visible in the analysis of the historical data on electricity generation, while the "medium-long term" effect can be inferred by the analysis of the new power plants which are currently under construction and those whose entering into the production phase is scheduled for 2009.

Figure 4.1: Emissions of the thermoelectric sector



The decline in the specific emissions, essentially due to an increase in the overall efficiency in the thermoelectric production and a decline in the carbon content of the fuel used in the power plants, has contributed in limiting the increase of the emissions due to the increase of the overall thermoelectric production. In fact, in the period 1990-2005, the thermoelectric production has seen an increase of 38,3% while, in the same period, the energy consumption in the sector has shown an increase of 25,8% and the emissions have increased only of 12,6%.

Table 4.6: Energy efficiency in thermoelectrical plants

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Power Plant Efficiency (%)									
Solids	38.9	40.4	39.6	37.3	38.3	37.3	37.6	37.0	36.9
Liquids	40.8	40.7	40.5	39.3	39.6	39.8	39.8	39.4	39.1
Natural Gas	44.7	44.3	44.8	44.6	45.2	45.9	47.5	46.9	50.8
Total Efficiency	40.4	40.6	42.0	41.3	42.0	42.1	42.7	42.6	45.0

Source: ENEA elaboration of TERNA data

Figure 4.2: Electricity production (TWh) by energy source

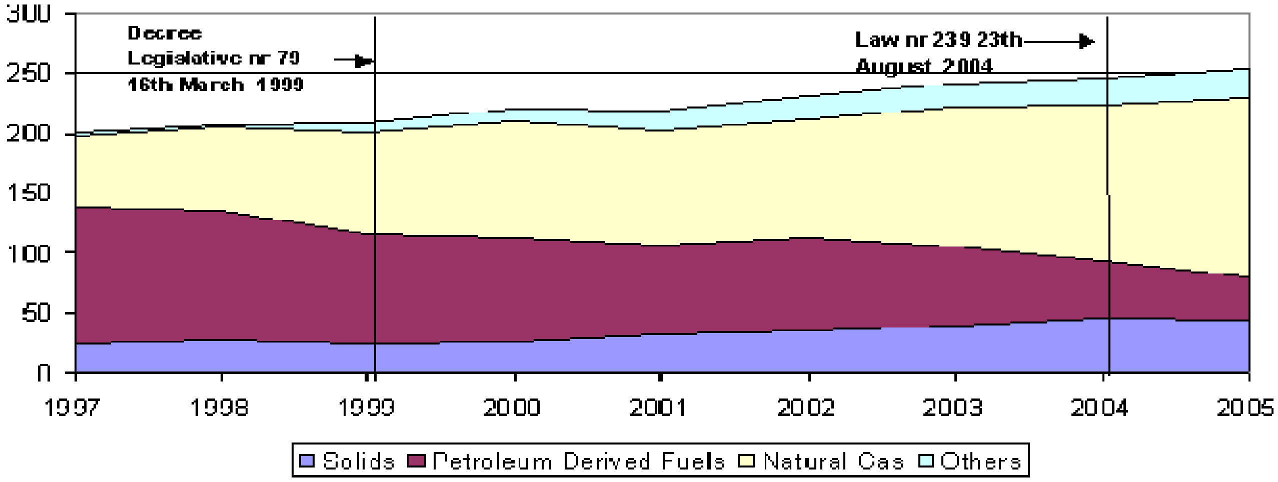
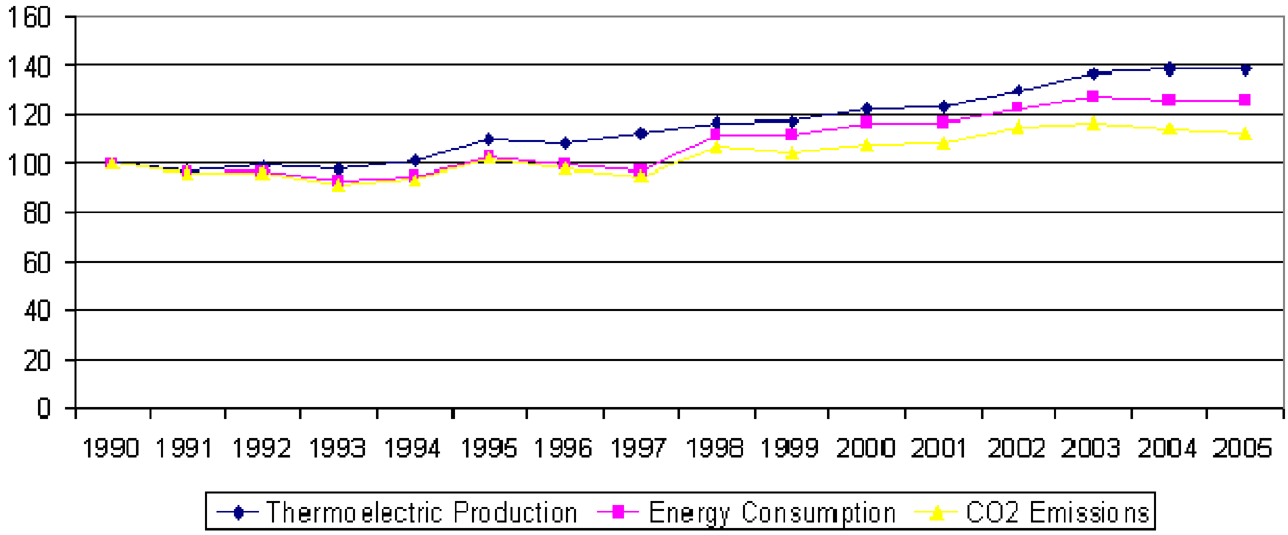


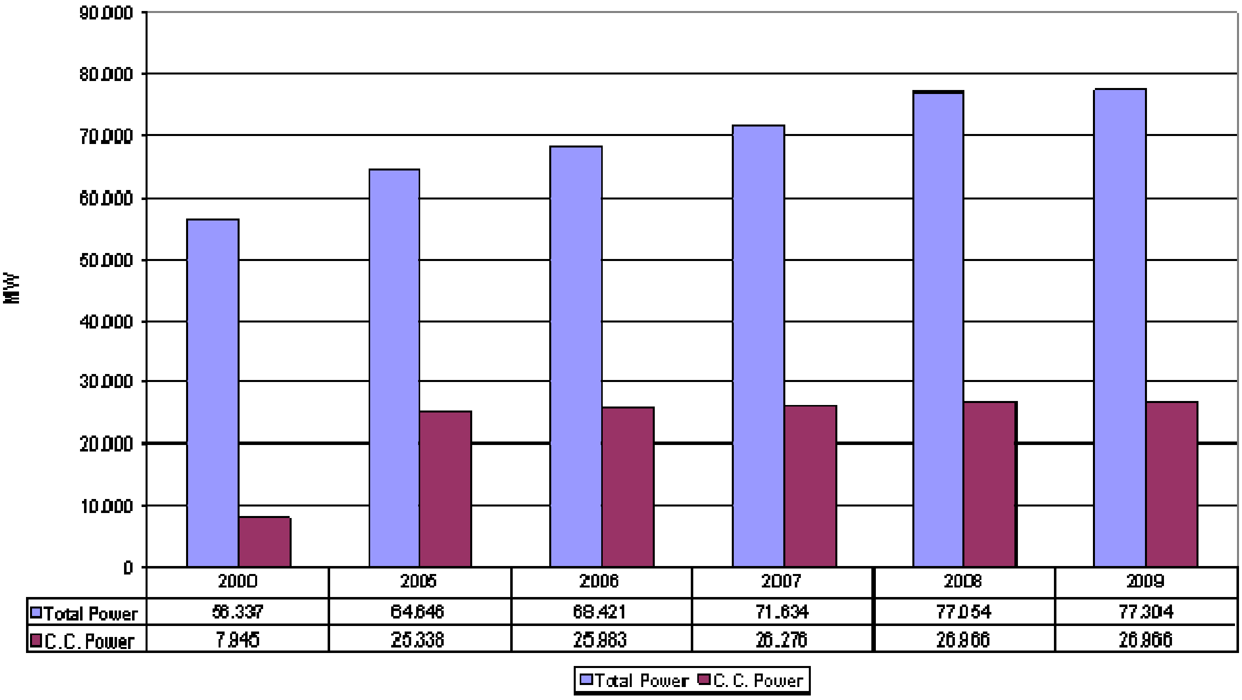
Figure 4.3: Electricity production, energy consumption and CO_2 emissions in the Thermoelectric sector (index numbers)



In 2005 a total of 64,646 MW of gross efficient power is installed. At 31st December 2006 power plants for a total of 12,658 MW have been authorized. Of these new plants 3,775 MW are completely built, while the remaining 8,883 MW are still under construction.

In figure 4.4 the trend of the installed power plants is shown together with the contribution of the combined cycle power plants to the total power installed.

Figure 4.4: Gross efficient thermoelectrical power from fossil sources and combined cycles contribution



Regarding the period after 2009 it is foreseen that two new coal power plants of about 2,000 MW each should enter into operation; that is Civitavecchia by 2010 and Porto Tolle by 2015. These two plants will substitute three old oil fired power plants. In the trend scenario the emissions from these two plants offset the phasing out of less efficient coal plants.

The striking increase in natural gas consumption requires the construction of new import infrastructure. In particular, among the several options considered, it is important to mention the planned construction of a pipeline coming from Turkey and the construction of new plants for LNG with a total capacity of about 10-20 Mtoe.

Table 4.7: Summary of policies and measures in the energy supply sector – Energy efficiency of electric power plants

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
ENERGY SUPPLY								
Energy efficiency of electric power plants								
Implemented								
Conversion to CCGT (Decree 4 August 1999)	Conversion of 9400 MW from fuel oil capacity to modern combined cycle gas turbine (CCGT)	CO_2	regulatory	implemented	Government, ENEL	measures already included in the trend scenario		
Simplification of authorisation procedures (Law 55 of 9 April 2002)	Simplifying the authorisation procedure for the construction and operation of power plants with a capacity of over 300 MW	CO_2	regulatory	implemented	Government			
Simplification of the authorisation procedures (Law 239 of 23 August 2004)	Further speeding up the authorisation process for the construction of new power plants and infrastructures	CO_2	regulatory	implemented	Government			

Industry

Policies affecting CO_2 emissions in the industry sector are generally designed to improve industrial energy intensity.

A main instrument is represented by the White Certificates system, which is aimed at promoting energy efficiency and deliver emissions reductions in all the energy end-use sectors. As already pointed above, notwithstanding the good results achieved by the scheme in its first year of application, only 5% of the energy saving projects that have been awarded White Certificates by the competent Authority was implemented in the industry sector. However, since the easiest and cheapest saving opportunities have already been exploited in other sectors, it is quite reasonable to assume that in the next years there will be an increase in the number of projects developed in the industry sector.

Another important initiative recently introduced by the Government concerns the replacement of existing inefficient electric motors with high efficient ones. This is a measure that can help achieve substantial CO_2 emissions reductions in the industry sector, but the engines' high purchase price and the lack of information about their energy saving potential represent a main obstacle to their diffusion. The Budget law 2007 therefore provides for tax credits of up to € 1,500 for high efficiency electric engines and inverters purchased and installed within 31.12.2007.

The implementation of this measure is guaranteed by the allocation of dedicated funds, as summarised in Table 4.2.

Since the potential for energy saving in the industry sector is still consistent, several new additional measures are currently under discussion to try to exploit it. The extension to 2012 of the primary energy saving targets provided for by the White certificates system is quite likely to be approved in the next few months, while a further extension to 2016 and 2020 is still under discussion. Further measures will be introduced to implement directive 2006/32/CE on energy end use efficiency and energy services. Two more options currently under discussion concern the introduction of mandatory energy efficiency standards for machinery and the obligation to install highly efficient electric motors, inverters, etc when replacing the existing ones.

Furthermore, some specific measures have been envisaged in the aluminium and cement production industries. In the aluminium industry a major role in the emissions reduction effort will be played by an increase of its recycling rate while, in the cement production industry, consistent reductions will be obtained through the substitution of fossil fuels with waste derived fuels.

The following table does not take into consideration the expected emission reductions attributable to cogeneration which have been reported in the Energy Supply – Cogeneration sector.

Table 4.8: Summary of policies and measures in the industry sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
INDUSTRY								
Implemented								
White Certificates) Decrees 20 July 2004	Triggering energy saving in the industry sector	CO_2	regulatory	implemented	AEEG, GME and electricity and gas distributors	measures already included in the trend scenario		
Replacement of low efficiency motors and inverters (Budget law 2007)	Supporting the installation of highly efficient electric engines and inverters through tax incentives	CO_2	fiscal	implemented	Government, ENEA			
Adopted/Planned								
White certificates	Extention of the primary energy saving targets to 2012	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors	**0,93**	**5,92**	**9,50**
White certificates	Further extension of the primary energy saving targets to 2020	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors			
End use efficiency and energy services	Achieving an overall energy savings target of 9% within 2017 through the implementation of directive 2006/32/CE	CO_2	regulatory	planned	Government			
Energy use in machinery	Introduction of mandatory energy efficiency standards for machinery	CO_2	regulatory	planned	Government			
Replacement of low efficiency motors and inverters	Introduction of the obligation to install highly efficient electric motors, inverters, etc	CO_2	regulatory	planned	Government			
Aluminium	Reducing greenhouse gas emissions from the aluminium industry through a strong increase of its recycling rate	CO_2	regulatory	planned	Government	**0,60**	**0,70**	**0,80**
Waste derived fuels in cement production	Reducing CO_2 emissions through the substitution of fossil fuels with waste derived fuels in cement production	CO_2	regulatory	planned	Government	**0,40**	**0,80**	**1,20**

Civil (residential and tertiary)

The package of policies deployed in this sector aims at tackling energy efficiency through specific actions targeted both at existing and new buildings and at appliances. The most important regulatory measures affecting this sector are reported hereinafter.

White Certificate system The functioning of the White Certificates system has already been described above. As already pointed out there, the main measure types developed so far concerned the residential sector, where the main part of the emission reductions were delivered.

Decree 27 July 2005 implemented the provisions of article 4 of law n. 10 of 9 January 1991. It requested stricter standards for the construction and the renovation of buildings and promoted the implementation of the decrees on energy efficiency.

Energy performance of buildings Improving the energy efficiency of buildings and reducing the related emissions has become a priority policy in the last few years. The implementation of directive 2002/91/CE was an opportunity to introduce stricter energy requirements and to promote the diffusion of renewable energy sources in the building sector. The Directive lays down requirements on the application of minimum standards for the energy performance of new buildings and on the performance of large existing buildings undergoing major renovation. The directive also requires the provision of energy performance certificates when buildings are constructed, sold or rented out.

Legislative decree 192/2005 implemented the directive into national law but it required the adoption of further ministerial decrees to become fully operational. Measures introduced included: methodology for calculating the energy performance of buildings; application of performance standards on new and existing buildings; certification schemes for all buildings; regular inspection and assessment of boilers/heating and cooling installations.

At the end of 2006, legislative decree 192/2005 was amended by **legislative decree 311/2006** to strengthen the buildings thermal demand requirements. The new law applies to new buildings and to existing buildings subject to major renovation[17] and provides for some important measures. Amongst the main provisions, the following obligations are worth citing:

- Installation of technical blinds for solar protection and insulation of new buildings and buildings subject to overall renovation (limited to buildings over 1000 m^2);
- laying down of all the necessary works to allow the connection of new buildings (and buildings subject to major renovation) to district heating systems, when existing (and not further than 1 km) or planned;
- installation of solar thermal systems that cover at least 50% of hot water demand for all new buildings and in case of replacement or renovation of the existing heating system;
- Installation of PV systems (with a power capacity to be defined in a subsequent ministerial decree) in all new buildings and in existing buildings with a total floor area over 1000m^2;

Budget law 2007 The Budget law 2007 provides for the following fiscal incentives for the implementation of energy efficiency projects in the civil sector:

- tax incentive of up to € 100.000 for owners and tenants of existing buildings who reduce energy use by at least 20% relative to the requirements provided for by legislative decree 192/05 (end of project within 31.12.2007);
- Tax incentive of up to € 60.000 to improve the insulation of existing buildings (end of project within 31.12.2007);

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17 As regards the minimum energy performance requirements of existing buildings subject to major renovation, the decree applies only in case of large buildings of over 1000 m2 and in case of expansion of existing buildings (over 20%). The decree applies only partially to existing buildings under the 1000m2 threshold.

- Tax incentive of up to € 60.000 to support the installation of solar thermal applications (within 31.12.2007);
- Tax incentive of up to € 30.000 to replace the existing boilers with condensing boilers (within 31.12.2007);
- Tax incentive of up to 200 € for any A+ refrigerator and freezer purchased within 31.12.2007;
- Tax incentive of 36% for the installation of energy saving lighting systems in non residential buildings (within 31.12.2009);
- contribution of 55% of the extra costs incurred to reduce the energy consumption of new buildings (with a surface of over 10.000 cubic meters) of at least 50% relative to the requirements provided for by legislative decree 192/05 (end of project within 31.12.2010). The Budget law sets up a specific Fund and authorizes up to 15 million euro annually for three years (2007 – 2009).

As regards additional measures still under discussion, there is a realistic chance that the White certificate system will soon be extended to 2012. The competent Ministries are currently working on a proposal that would set stronger obligations for the period 2010 – 2012, lower the minimum customer's threshold and involve more distributors in the system. A further extension of the scheme to 2020 is also envisaged.
Further measures will be introduced to implement directive 2006/32/CE on energy end use efficiency and energy services in the civil sector. Consistent reductions are expected also from the introduction of mandatory energy efficiency standards for appliances, currently under discussion in the competent Ministries. Another measure that has a realistic chance to be introduced in the near future is the further strengthening of energy efficiency requirements for new and existing buildings, reducing energy consumption and promoting the diffusion of renewable energy sources.

In the following table the expected emission reductions attributable to cogeneration have been reported in the Energy supply – cogeneration sector.

Table 4.9: Summary of policies and measures in the civil (residential and tertiary) sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
CIVIL (residential and terziary)								
Implemented								
White Certificates (Decrees 20 July 2004)	Supporting energy saving in the residential and tertiary sector	CO_2	regulatory	implemented	AEEG, GME and electricity and gas distributors	measures already included in the trend scenario		
Building Regulation (Decree 27 July 2005)	Promoting energy saving in new and existing buildings	CO_2	regulatory	implemented	Government	**2,64**	**5,31**	**8,17**
Building Regulation (Legislative decree 192/05 as amended by legislative decree 311/06)	Improving energy performance of new and existing buildings	CO_2	regulatory	implemented	Government			
Energy efficiency in buildings (Budget law 2007)	Supporting energy efficiency improvements in existing buildings	CO_2	fiscal	implemented	Government			
	Supporting insulation measures in existing buildings	CO_2	fiscal	implemented				
	Supporting the installation of solar thermal applications	CO_2	fiscal	implemented				
	Supporting the installation of condensing boilers	CO_2	fiscal	implemented				
	Supporting energy saving in new buildings	CO_2	economic	implemented				
	Supporting energy saving lighting systems in non residential buildings	CO_2	fiscal	implemented				
	Improving market penetration of energy efficient electric refrigerators, frezeers and their combinations	CO_2	fiscal	implemented				
Adopted/Planned								
White certificates	Extending the current obbligation to 2012	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors	**1,81**	**10,19**	**13,25**
White certificates	Further extension of the primary energy saving targets to 2020	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors			
End use efficiency and energy services	Achieving an overall energy savings target of 9% within 2017 through the implementation of directive 2006/32/CE	CO_2	regulatory	planned	Government			
Energy efficiency standards	Introduction of mandatory energy efficiency standards for appliances	CO_2	regulatory	planned	Government			
Energy efficiency in buildings	Further reducing energy use in buildings and promoting the diffusion of renewable energy sources	CO_2	regulatory	planned	Government	**0,00**	**8,75**	**9,11**

Transport

Measure: Speed up of circulating fleet update, subsidy to change older cars with new ones with average emissions of 145 g CO_2/km.

With a fleet simulation model it has been estimated the effects of reducing the average CO_2 emissions of all new cars to 140 g CO_2/km.

The measure is starting from 1 January 2007, the actual circulating fleet will continue to be renewed at the same path of the more recent years (higher than the average of the last 10 years). The share of diesel and petrol car will be constant at 50-50 with a slight reversal of more recent trends. It is also hypothesized an increase of sales of new vehicles using LPG / natural gas, that contribute to the target emission value.

The results of this simulation are shown in table 4.10. This type of measure has a limited effect in the first years but it continues to deliver in the following years, up to 2020, with sizeable reductions. Actual (2004) average emissions are about 150 g CO_2/km. The emission reduction in the years after 2012 are not so high because also in the b.a.u. scenario it is expected an increase of efficiency of vehicles. So tighter standards are certainly needed after 2012.

Table 4.10: Emissions reduction with new cars at 140 gCO_2/km from 1-1-2007, Mt

CO_2 savings	2010	2012	2015	2020
Total	2.96	3.55	4.38	4.40

The case of a new fleet at a much lower emission rate, 120 gCO_2/km, from 2010, with additional reductions has been simulated too. In the table 4.11 the **additional** reductions possible with this tighter standard from 2010 are shown.

Table 4.11: Additional emissions reduction with new cars at 120 gCO2/km from 1-1-2010, Mt

CO_2 savings	2010	2012	2015	2020
Total	0.0	1.47	2.7	4.7

Measure: New infrastructure in public transport, up to an emissions reduction of 4.5 Mt of CO_2.

The impact of this measure is estimated under the trend scenario conditions, which include a moderate increase of efficiency of cars, an expansion of the demand for passenger transport, at a rate of 0.8% per year, and an expansion of public transport. This measure analyzes the impact of additional investment in infrastructure and vehicles in this sector.

It has been proposed to invest additional 20 billions of euro with the result of increasing the total p-km transported by public transport by 23%, 38 billion p-km in total, and reducing CO_2 emissions of 4.5 Mt. The breakdown of this figure in different types of transport is : 5 billion p-km in tram, other 5 billion in underground lines, and 20 billion in trains (both commuter and intercity) and 8 billion in buses.

All additional cost are included for tram, metro and buses, while only the additional costs for equipment is included for trains as the investment in infrastructure is supposed to be done anyway for other objectives. Such an investment would promote a impressive change in the respective modes of collective transport, with reference to actual figures (2005) the passenger in tram and metro will be doubled, total passengers using trains will increase by 50% and passenger in buses for public transport will increase by about 20%.

The time frame of such a group of measure is of medium – long period, due to the long construction time of infrastructure. The total impact of those measures can be considered only in year 2020, with about 1/3 in 2015.

Measure: use of biofuels

The estimate of the impact of this measure at 2010 is of 2.39 Mt CO_2 per year. In Italy there is the industrial structure to produce this amount of fuel, with row material produced in Italy or imported. The impact is lower than the total potential of the measure because the trend scenario for 2010 already includes a small quantity of biodiesel. The impact of this measures at 2020 is assessed taking into account a share of biofuels of about 10% to replace diesel or petrol for transport purposes.

Table 4.12: Summary of policies and measures in the transport sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
TRANSPORT								
Implemented								
Biofuels	Promoting the use of biofuels	CO_2	regulatory	implemented	Government	**2,39**	**2,41**	**2,17**
Adopted/Planned								
Use of biofuels	Promoting the use of biofuels	CO_2	regulatory	planned	Government	**0,00**	**6,03**	**8,69**
Fleet update	Subsidy to change older cars with new ones with average emissions of 140 g CO_2/km	CO_2	regulatory	planned	Government	**2,96**	**4,38**	**4,40**
Fleet update	Further subsidy to change older cars with new ones with average emissions of 120 g CO_2/km	CO_2	regulatory	planned	Government	**0,00**	**2,70**	**4,70**
New infrastructure in public transport	Reducing private car use and traffic congestion	CO_2	regulatory	planned	Government	**0,00**	**1,35**	**4,50**

Emissions from non-energy sources

The paragraphs that follow focus attention on policies to be adopted in the no energy sectors, specifically in the industrial processes, agriculture and waste sectors. None of the measures listed are included in the trend scenario, but they could be considered as additional measures.

Industrial Processes

Reduction of N_2O emissions in plants for the production of nitric acid

This measure can result in significant reductions in processing emissions from the industrial sector, with the cost of the decrease proving extremely limited.

In the production of nitric acid, the most advanced technology calls for installation of SCR (selective catalytic reduction) systems for the treatment of process gases with the adoption of the BAT-TALuft standard equal to (2.5 kgN_2O/tHNO_3). The measure could be applied to the main production plant in Italy. In table 4.13 estimated emissions reduction are reported for 2010, 2015 and 2020 as a consequence of the adoption of the measure.

Table 4.13: Summary of policies and measures in the industrial processes sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
NON ENERGY SECTORS								
INDUSTRIAL PROCESSES								
Adopted/Planned								
Nitric Acid	Reduction of N2O emissions in nitric acid production plants	N_2O	regulatory	planned	Government	**1,40**	**1,48**	**1,57**

Agriculture

Emissions of nitrous oxide from agricultural soil

Emission reduction from the Agricultural soil source is mainly related to the rationalisation in the use of fertilizers. In order to achieve the objective is essential to consider ongoing efforts to heighten awareness of the practise, the adoption of the code of agricultural practice, and the integrated production of agricultural holding and organic farming. On the other hand, the CAP reform process, since Agenda 2000 is characterized by a progressive reinforcement for integrating environmental objectives in the framework of market policy and rural development. By combining different recommendations, still additional measures with mitigation potential can be encouraged for reducing the use of fertilizers. In Table 4.14 estimated reductions with additional measures, expressed in CO_2 eq., from the rationalisation in the use of nitrogen fertilizers measure are reported. Further reductions of 2.5% (2010) and 5% (2010, 2015) in the use of nitrogen fertilizers have been considered as additional measure for the reduction of nitrous oxide emissions.

Emissions of methane from manure management

Electricity generation from animal waste has increased in Italy up to 25.7 GWh in 2005, thanks to the support provided by the feed-in prices granted by Resolution no. 6/92 of the Inter-ministerial Price Committee (CIP 6/92) and the renewable quota obligation for electricity producers/importers established by the Legislative Decree of March 16, 1999, No. 79, and subsequent legislation. In 2005, methane from biogas recovery has reduced methane emissions from manure management in 3.9%. In future years, further intervention will be required to sustain this trend, and to extend the covering of animal waste storage systems, equipped with devices allowing collection and use of biogas, not only in new farms but also in major existing ones. Additional measures for the reduction of methane emission are concentrated in two animal categories: cattle and swine. We have considered percentage of reduction for the manure management source of 10% (2010), 15% (2015) and 20% (2020). In Table 4.14 estimated reductions with additional measures, expressed in CO_2 eq., are reported for the recovery of biogas from animal storage systems.

An investment analysis, taking into account the value of the electricity produced, generates a positive VAN, though the result is not enough to convince operators tested to invest. Therefore, the dimension of the initiative would depend on: the level of incentives available for the production of electricity from renewable energy sources, plus, the availability of subsidies for the construction of the systems, and a clear regulation with respect to the authoritative procedure for the final destination of the effluents.

Another measure oriented towards the same objective is the Integrated Pollution Prevention and Control Directive (96/61/EC), which calls for the introduction of an authorisation process based on the adoption of the Best Available Technology (BAT) 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 the Rural Development Plans (PSR) financed by the EAGGF[18].

[18] EAGGF, European Agriculture Guidance and Guarantee Fund

Table 4.14: Additional measures for the agriculture sector

Description	Estimated reduction (Mt CO_2 eq.)		
	2010	**2015**	**2020**
Rationalisation in the use of nitrogen fertilizer	0.18	0.36	0.36
Recovery of biogas from animal storage systems	0.32	0.47	0.62

Table 4.15: Summary of policies and measures in the agriculture sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
NON ENERGY SECTORS								
AGRICULTURE								
Adopted/Planned								
Nitrogen fertiliser	Rationalisation in the use of nitrogen fertiliser	N_2O	regulatory	planned	Government, MATTM, MIPAF	**0,50**	**0,83**	**0,98**
Animal storage	Recovery of biogas from animal storage systems	CH_4	regulatory	planned	Government, MATTM, MIPAF			

Waste Sector

Two initiatives are proposed:

Compliance with separate collection targets and biodegradable waste disposed of into landfills

- fulfilment of the deadlines set for MSW separate collection, reported in Table 4.16
- fulfilment of the deadlines set for biodegradable waste sent to landfill, reported in Table 4.17

Table 4.16: Targets for separate collection (%)

	2005	2006	2007	2008	2009	2011	2012
Separate collection	24.3%	**35%**	**40%**	**45%**	**50%**	**60%**	**65%**
Law disposition	*APAT-ONR, 2006*	*D.Lgs. 152/2006*	*L. 296/2006*	*D.Lgs. 152/2006*	*L. 296/2006*	*L. 296/2006*	*D.Lgs. 152/2006*

Table 4.17: Targets for biodegradable waste to landfills (kg/person*year)

	2008	2011	2018
Biodegradable waste (kg/person*year)	**173**	**115**	**81**
Law disposition	*D.Lgs. 36/2003*	*D.Lgs. 36/2003*	*D.Lgs. 36/2003*

Only bio-stabilized waste disposed of into landfills

A further measure regards the pre-treatment of all the biodegradable wastes which will be disposed into landfills, encouraging the anaerobic digestion of MSW also in co-digestion with other type of waste such as sludge from municipal waste water treatment plants and animal waste. This practice will increase also the energy recovery from the biogas production.

In Table 4.18 are summarized emissions reduction from both measures proposed.

Table 4.18: Evolution scenario with measures of the emissions of greenhouse gases from the waste sector (Mt CO_2 equivalent)

Greenhouse gas emissions (Mt CO_2 equivalent)	1990	1995	2000	2005	2010	2015	2020
Landfills	13.3	15.8	16.8	14.4	11.8	10.8	9.6
Wastewater treatment	3.8	3.9	4.2	4.2	4.5	4.7	4.9
Waste incineration	0.8	0.9	0.6	0.6	0.5	0.5	0.5
Waste composting	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total waste sector (trend scenario)	**17.8**	**20.6**	**21.6**	**19.3**	**16.8**	**16.0**	**15.0**
Compliance with separate collection targets and biodegradable waste disposed of into landfills					1.8	2.4	2.7
Only bio-stabilized waste disposed of into landfills						4.6	4.4
Total waste sector (scenario with measures)					**15.0**	**13.6**	**12.3**
Total waste sector (scenario with additional measures)						**11.4**	**10.6**

Table 4.19: Summary of policies and measures in the waste sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
NON ENERGY SECTORS								
WASTE MANAGEMENT								
Implemented								
Separate collection	Compliance with separate collection targets and biodegradable waste disposed of into landfills	CH_4	regulatory	implemented	Government, local authorities	1,80	2,40	2,70
Adopted/Planned								
Bio degradable waste	Treatment of all biodegradable waste prior to landfill	CH_4	regulatory	planned	Government, local authorities	0,00	4,60	4,40

Forestry

As already communicated to European Commission in the "*Report on the determination of Italy's assigned amount under Article 7, paragraph 4, of the Kyoto Protocol",* Italy has elected Forest Management as an activity under Article 3.4 of Kyoto Protocol, while has not elected Cropland Management, Grazing Land Management or Revegetation.

Forest management and art 3.3 activities shall be tracked and certified by the National Registry for forest carbon sinks in order to be accountable.

A brief description of the activities and the National Registry is given in the following.

Forest management (art. 3.4)

The Italy's forest area is the total eligible area under forest management activity. Italian forest area has to be considered managed forest lands, as explained in FAO TBFRA2000 (page 129)[19].

Credits from forest management were capped, in the first commitment period, to 0.18 Mt C per year times fives. The figure was clearly underestimated and Italy submitted country-specific data on forest management activity under Article 3, paragraph 4, of the Kyoto Protocol.

Under SBSTA conclusion FCCC/SBSTA/2006/L.6 and related COP/MOP2 decision (FCCC/KP/CMP/2006/10/Add.1), additions to and subtractions from the assigned amount, resulting from forest management under art. 3.4 shall not exceed 2.78 Mt C/year, times five.

Afforestation and reforestation activities (art. 3.3)

For the first commitment period, Article 3.3 applies to land that is subject to an afforestation, reforestation or deforestation activity at any time between 1 January 1990 and 31 December 2012. All the data concerning the growing stock and the related carbon are assessed by a model[20], estimating the evolution in time of the Italian forest carbon pools, according to the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry classification and definition: living biomass, both aboveground and belowground, dead organic matter, including dead wood and litter, and soils as soil organic matter.

National Registry for forest carbon sinks

The so-called "National Registry for forest carbon sinks" is part of the Italian National System; it is the instrument to estimate, in accordance with the COP/MOP decisions, the IPCC Good Practice Guidance on LULUCF and every relevant IPCC guidelines, the greenhouse gases emissions by sources and removals by sinks in forest land and related land-use changes and to account for the net removals in order to allow the Italian Registry to issue the relevant amount of RMUs.

- National Land-Use Inventory (IUTI), aimed at identifying and quantifying:
    - Forest land areas;
    - Land in conversion from forest land category since 31 December 1989;
    - Land in conversion to forest land category since 31 December 1989.

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19 Notes and comments relating to chapter II in pag 129 of FAO TBFRA2000 says: "*These data on the managed areas of forests in tables 9 to 17 refer only to forest managed with specific plans. Nevertheless, all other Italian forests are submitted to general sylvicultural prescription (Prescrizioni di massima e di polizia forestale). These prescriptions are adopted at Provincial level and determine the practical forms of management to be applied*".

20 Federici S., Vitullo M., Tulipano S., De Lauretis R., Seufert G. , 2005. *A tool for estimate of forest carbon stocks under UNFCCC: the Italian case*, submitted.

- National Inventory of Carbon Stocks (ISCI), aimed at quantifying carbon stocks and carbon stock changes in any land-use category in the first commitments period.
- National Census of Forest Fires (CIFI), aimed at identifying and quantifying forest land areas affected by fires.
- National Inventory of non-CO_2 emissions from forest fires (IEIF), aimed at estimating non-CO_2 emissions from forest land areas affected by fires.

A Scientific Committee has been set up in order to support the design and implementation of the activities related to the National Registry for forest carbon sinks. The Committee involves all major national, regional and local institutions in charge on carbon cycle studies, inventories and monitoring.

In Table 4.20 estimated maximum annual removals obtained through forest management (art. 3.4) and afforestation and reforestation activities are reported, identifying two different categories to be considered under article 3.3:

a) Plantations already established and areas subject to induced recolonization of the vegetation;

b) New plantations

Table 4.20: Summary of policies and measures in the forestry sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
FORESTRY								
Adopted/Planned								
Forestry (2015 -2020: values to be reviewed according to pending international negotiations)	Forest management	CO_2	regulatory	planned	Government, MATTM, MIPAF, APAT	10,2	0,00	0,00
	Afforestation and reforestation (old plantations) and induced recolonisation areas	CO_2	regulatory	planned	Government, MATTM, MIPAF, APAT	15,1	0,00	0,00
	Afforestation and riforestation (new plantations)	CO_2	regulatory	planned	Government, MATTM, MIPAF, APAT			

Table 4.21: Summary of implemented policies and measures

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
IMPLEMENTED								
ENERGY SECTOR								
ENERGY SUPPLY								
Renewables								
Green Certificates (legislative decree 387/03)	Supporting the production of renewable electricity	CO_2	regulatory	implemented	Government, GSE and electricity providers	measures already included in the trend scenario		
Green Certificates (legislative decree 152/06)	Supporting the production of renewable electricity	CO_2	regulatory	implemented	Government, GSE and electricity providers			
Green Certificates (decree 24 october 2005)	Supporting the production of renewable electricity	CO_2	regulatory	implemented	Government, GSE and electricity providers			
PV systems (decree 28.07.2005 as amended by decree 06.02.2006)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 500 MW is reached	CO_2	regulatory	no longer in place	Government and GSE	0,58	1,60	1,92
PV systems (decree 19.02.2007)	Supporting the expansion of photovoltaic plants through feed in tariffs until a maximum capacity of 1200 MW is reached	CO_2	regulatory	implemented	Government and GSE			
PV systems (budget law 2007)	Supporting the installation of photovoltaic systems in new buildings	CO_2	regulatory	implemented	Government and local authorities			
Cogeneration								
RES Cogeneration (legislative decree 387/03)	Supporting the production of electricity from RES cogeneration through green certificates	CO_2	regulatory	implemented	Government and GSE	measures already included in the trend scenario		
White Certificates (decrees 20 July 2004)	Supporting energy saving through cogeneration	CO_2	regulatory	implemented	Government, AEEG, GME and electricity and gas distributors			
Cogeneration combined with district heating (law 239 of 23 August 2004)	Supporting CHP plants integrated with district heating through the issuing of Green certificates	CO_2	regulatory	no longer in place	Government and GSE			
Energy efficiency of electric power plants								
Decree 4 August 1999	Conversion of 9400 MW from fuel oil capacity to modern combined cycle gas turbine (CCGT)	CO_2	regulatory	implemented	Government	measures already included in the trend scenario		
Law 55 of 9 April 2002	Simplifying the authorisation procedure for the construction and operation of power plants with a capacity of over 300 MW	CO_2	regulatory	implemented	Government			
Law 239 of 23 August 2004	Further speeding up the authorisation process for the construction of new power plants and infrastructures	CO_2	regulatory	implemented	Government			
INDUSTRY								
White Certificates (decrees 20 July 2004)	Supporting energy saving in the industry sector	CO_2	regulatory	implemented	Government, AEEG, GME and electricity and gas distributors	measures already included in the trend scenario		
Replacement of low efficiency motors and inverters (Budget law 2007)	Supporting the installation of highly efficient electric engines and inverters through tax incentives	CO_2	fiscal	implemented	Government, ENEA			
CIVIL (residential and tertiary)								
White Certificates (decrees 20 July 2004)	Supporting energy saving in the residential and tertiary sector	CO_2	regulatory	implemented	Government, AEEG, GME and electricity and gas distributors	measures already included in the trend scenario		
Building Regulation (decree 27 July 2005)	Promoting energy saving in new and existing buildings	CO_2	regulatory	implemented	Government	2,64	5,31	8,17
Building Regulation (legislative decree 192/05 as amended by legislative decree 311/06)	Improving energy performance of new and existing buildings	CO_2	regulatory	implemented	Government			
Energy efficiency in buildings (budget law 2007)	Supporting energy efficiency improvements in existing buildings	CO_2	fiscal	implemented	Government			
	Supporting insulation measures in existing buildings	CO_2	fiscal	implemented				
	Supporting the installation of solar thermal applications	CO_2	fiscal	implemented				
	Supporting the installation of condensing boilers	CO_2	fiscal	implemented				
	Supporting energy saving in new buidings	CO_2	economic	implemented				
	Supporting energy saving lighting systems in non residential buildings	CO_2	fiscal	implemented				
	Improving market penetration of energy efficient electric refrigerators, frezeers and their combinations	CO_2	fiscal	implemented				
TRANSPORT								
Biofuels	Promoting the use of biofuel	CO_2	regulatory	implemented	Government	2,39	2,41	2,17
NON ENERGY SECTOR								
WASTE MANAGEMENT								
Separate collection	Compliance with separate collection targets and biodegradable waste disposed of into landfills	CO_2	regulatory	implemented	Government, MATTM	1,80	2,40	2,70
TOTAL - IMPLEMENTED						7,40	11,72	14,97

Table 4.22: Summary of adopted/planned policies and measures

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
ADOPTED/PLANNED								
ENERGY SECTOR								
ENERGY SUPPLY								
Renewables								
New supporting system for renewable energy sources	Fostering the production of electricity from all renewable energy sources; strenghtening the incentives for less competitive sources.The actual effect of this measure is assessed taking into consideration the trend scenario.	CO_2	regulatory	planned	Government, GSE and electricity providers	6,29	17,41	24,68
Cogeneration								
High efficiency cogeneration (legislative decree 20/07)	Supporting CHP plants through the issuing of White Certificates	CO_2	regulatory	adopted	Government	1,65	5,44	9,33
Cogeneration	Further supporting cogeneration through the White Certificates scheme	CO_2	not defined	planned	Government			
INDUSTRY								
White Certificates	Extention of the primary energy saving targets to 2012	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors	0,93	5,92	9,50
White Certificates	Further extension of the primary energy saving targets to 2020	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors			
End use efficiency and energy services	Achieving an overall energy savings target of 9% within 2017 through the implementation of directive 2006/32/CE	CO_2	regulatory	planned	Government			
Energy use in machinery	Introduction of mandatory energy efficiency standards for machinery	CO_2	regulatory	planned	Government			
Replacement of low efficiency motors and inverters	Introduction of the obligation to install highly efficient electric motors, inverters, etc	CO_2	regulatory	planned	Government			
Aluminium	Reducing greenhouse gas emissions from the aluminium industry through the increase of its recycling rate	CO_2	regulatory	planned	Government	0,60	0,70	0,80
Waste derived fuels in cement production	Reducing CO_2 emissions through the substitution of fossil fuels with waste derived fuels in cement production	CO_2	regulatory	planned	Government	0,40	0,80	1,20
CIVIL (residential and tertiary)								
White Certificates	Extending the current obbligation to 2012	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors	1,81	10,19	13,25
White Certificates	Further extension of the primary energy saving targets to 2020	CO_2	regulatory	planned	Government, AEEG, GME and electricity and gas distributors			
End use efficiency and energy services	Achieving an overall energy savings target of 9 % within 2017 through the implementation of directive 2006/32/CE	CO_2	regulatory	planned	Government			
Energy efficiency standards	Introduction of mandatory energy efficiency standards for appliances	CO_2	regulatory	planned	Government			
Energy efficiency in buildings	Further reducing energy use in buildings and promoting the diffusion of renewable energy sources	CO_2	regulatory	planned	Government	0,00	8,75	9,11
TRANSPORT								
Use of biofuels	Promoting the use of biofuels	CO_2	regulatory	planned	Government	0,00	6,03	8,69
Fleet update	Subsidy to change older cars with new ones with average emissions of 140 g CO_2/km	CO_2	economic	planned	Government	2,96	4,38	4,40
Fleet update	Further subsidy to change older cars with new ones with average emissions of 120 g CO_2/km	CO_2	economic	planned	Government	0,00	2,70	4,70
New infrastructure in public transport	Reducing private car use and traffic congestion	CO_2	regulatory	planned	Government	0,00	1,35	4,50
NON ENERGY SECTORS								
INDUSTRIAL PROCESSES								
Nitric Acid	Reduction of N_2O emissions in nitric acid production plants	N_2O	regulatory	planned	Government	1,40	1,48	1,57
AGRICULTURE								
Nitrogen fertiliser	Rationalisation in the use of nitrogen fertiliser	N_2O	regulatory	planned	Government, MATTM, MIPAF	0,50	0,83	0,98
Animal storage	Recovery of biogas from animal storage systems	CH_4	regulatory	planned	Government, MATTM, MIPAF			
WASTE MANAGEMENT								
Bio degradable waste	Treatment of all biodegradable waste prior to landfill	CH4	regulatory	planned	Government, MATTM	0,00	4,60	4,40
TOTAL - ADOPTED/PLANNED						16,54	70,57	97,12
FORESTRY								
Forestry (2015 -2020: values to be reviewed according to pending international negotiations)	Forest management	CO_2	regulatory	planned	Government, MATTM, MIPAF, APAT	10,20	0,00	0,00
	Afforestation and reforestation (old plantations) and induced recolonisation areas	CO_2	regulatory	planned	Government, MATTM, MIPAF, APAT	15,10	0,00	0,00
	Afforestation and rforestation (new plantations)	CO_2	regulatory	planned	Government, MATTM, MIPAF, APAT			

Table 4.23: Summary of all policies and measures Mt CO_2 eq.

	2010	2015	2020
Total PAMs implemented	7,40	11,72	14,97
Total PAMs adopted/planned	16,54	70,57	97,12
Emissions Trading	13,25		
Forestry	25,30		
Flexible Mechanisms	20,75		
implemented	*3,42*		
adopted/planned	*17,33*		
TOTAL	**83,24**	**82,30**	**112,09**

Regional energy plans

General Aspects

The Regional Energy Plan (PER) is the main tool through which the Regions can plan their intervention in the energy sector in their territory and regulate the functions of the Local Agencies, harmonizing the important decisions at regional and local level. The energy-environmental Plans are structured to guarantee coherent targets with the national energy policy and to insure that environmental and public health considerations are taken into account. They constitute the reference framework for private and public entities that operate in the energy sector at local level. The PER describes the regional guidelines, targets, available tools, legislative and normative references and financial opportunities.

The energy and environmental planning are necessarily connected because of the direct and indirect effects that energy production, transformation, transport and final consumption have on the atmosphere. For this reason, the Regional Energy Plan (PER) has evolved into a Regional Plan for Energy and the Environment (PEAR).

The Italian Regions that have already adopted a PEAR are fourteen, plus the two Independent Provinces of Trento and Bolzano.

Most of these Plans were adopted in the period from 2000 to 2003, and include:

- the European, national and regional legislative framework;
- the targets of the Turin Protocol;
- Other planning instruments with particular reference to those concerning air quality and waste management;
- The national and regional energy balance, and the relative BAU scenarios.

The Energy Plans take 2010 as a time limit for their planning activities because by that year all the short and medium term Community Programmes in the energy sector will have to be concluded. The Plans represent a reference framework for the present, but need to be continuously updated in consideration of the evolving international and national framework. Their implementation needs to be constantly monitored and checked.

The main objectives of the PEAR are represented by environmental protection, the development of renewable energy sources and the rational use of energy.

Main Regional actions for Renewable Energy Sources

All Italian Regions activated initiatives in the renewable energy sources field through two main instruments. The first instrument is represented by the "Photovoltaic Roofs" Programme and the "Solar thermal" Programme, which were introduced in 2000 to implement the provisions of a decree issued by the Ministry for the Environment, Land and Sea. The second instrument is represented by the specific measures of the Regional Operative Programme (POR) financed through the Structural funds of the Community Support Framework 2000-2006.

Emilia Romagna The Region has implemented the "Photovoltaic Roofs" Programme through two tendering procedures which were opened in 2001 and 2004. The Region has also adhered to the "Thermal Solar" Programme.

In October 2006, 1.5 million euro was allocated to incentive the agricultural enterprises for the realization of biomass plants for the production of electricity and/or thermal energy. In 2005 the production of electricity from RES was 1698.9 GWh. Most of this production came from biomass (53.5%), the rest from hydroelectric systems.

Abruzzo The actions in the field of RES, mainly concern the participation to the "Photovoltaic Roofs" and "Solar thermal" Programmes launched by the Ministry for the Environment, Land and Sea. The electric power production from RES in the Region in 2005 was, 2141.5 GWh deriving nearly exclusively from hydroelectric systems (91.7%), with a small production also from wind power (8.3%).

Basilicata The actions for the RES regard the Structural Funds and the "Photovoltaic Roofs" and "Solar Thermal" programs. In 2001 the Region started a first tendering procedure for the Photovoltaic Roof Programme, while a second tender was opened in 2003. The "Solar thermal" programme started in July 2004. In December 2004 new "Guidelines for the location of Wind farm on the regional territory" were adopted.

In 2005 the production of electricity from RES in the Region was 505.2 GWh, obtained from hydroelectric (66.4%), wind (29.2%) and biomass (4.4%). In Basilicata there was a strong demand of incentives for photovoltaic systems.

Calabria In 2001 a regional tender for the "Photovoltaic Roofs" programme was launched. The electricity production from renewable sources in the region in 2005 was 2156.7 GWh, 65.1% of which was hydroelectric and 34.9% came from biomass. In the last few years there has been a strong increase in the production of electricity from biomass, which passed from 80.2 GWh in 2001, to 228.4 GWh in 2002, 441.4 GWh in 2003, 690 GWh in 2004 and 752.4 GWh in 2005.

Campania. The actions in the field of renewable sources concern the participation to the "Photovoltaic Roofs" and "Solar thermal" Programmes and the use of the funds derived from the "Carbon Tax". The electrical production from RES in 2005 was 1215.9 GWh, obtained from hydroelectric (45.1%), wind power (46.1%), biomass (8.7%) and photovoltaic (0.2%).

Molise. Also in this region the actions of RES, above all, regard the participation to the "Photovoltaic Roofs" and "Solar thermal" Programmes.

In 2005 the production of electric power from RES was 358.1 GWh, 48.1% of which came from hydroelectric systems, 15.9% from wind power and the remaining quota, 36.1%, from biomass.

Sardegna. The actions to support the diffusion of RES were mainly the participation to the "Photovoltaic Roofs" and "Solar Thermal" Programme.

Lazio The actions in the field of renewable sources concern the participation to the "Photovoltaic Roofs" and "Solar thermal" Programmes. The regional law n. 15/2004 contains several provisions to encourage the use of solar thermal energy and to reduce water use in buildings. The regional law n. 4/2006 contains provisions concerning intelligent energies (comprising the energy from renewable sources and energy efficiency) and hydrogen and set up the Consortium "Regional Agency for intelligent energies". In 2005 the production of electric power from RES was 1541.6 GWh, obtained above all from hydroelectric systems (75.5%), biomass (24.2%) and the rest from wind power.

Puglia Two regional tenders were launched in 2001 and 2003 in the framework of the "Photovoltaic Roofs" Programme. In 2004 another tender was launched under the "Solar Thermal" Programme. The electric power production from RES in 2005 was 1,008.2 GWh, with an increase of 25.5% relative to 2004, 58.2% of which coming from wind and the rest from biomass. There has been a strong increase in the production of electricity from biomass, which passed from 258.1 GWh in 2004, to 421.3 GWh in 2005.

Sicilia The main actions in the renewable energy sources field regard the use of the Structural Funds, the participation to the "Photovoltaic Roofs" Programme and the conclusion of a “Framework Programme Agreement on Energy” between the Ministry for the Environment, Land and Sea and the Region. In July 2006, the Region launched a tender for financial contribution to implement energy saving projects in small and medium local enterprises. In 2005 the electric power produced from RES was 617.4 GWh, approximately 86.2% more relative to 2004, 158.7 GWh of which from hydroelectric systems, 382.3 from wind power and 76.3 from biomass. Remarkable is the increase of the electric power production from wind power in 2004 (151.2%).

Liguria The Region in 2002 approved a law to regulate the local tasks of regional environmental and health protection Agencies. The Region participated to the ministerial "Photovoltaic Roofs" and "Solar thermal" Programmes.

In 2005 the production of electricity from RES was 182.9 GWh, 23,6 GWh of which came from biomass, 8.7 GWh from wind and the remaining part from hydroelectric systems.

Marche From 2000 to 2003 the Region has introduced several provisions to support the development of renewable energy sources and energy efficiency. In 2005 the production of renewable electricity was 628 GWh, 45.8 GWh of which from biomass, and the remaining part from hydroelectric.

Piemonte The Region developed many initiatives in the energy sector, particularly in the energy saving and renewable energy sources field, through the participation to the "Photovoltaic Roofs" and "Solar thermal" Programmes.

In July 2004 the Region launched a tender to finance strategic actions in the RES and energy saving sectors. These tenders were financed through the regional law n. 23/2002. In December 2005 a tendering procedure for an easy terms and conditions loan for the construction and enhancement of district heating nets was launched.

In 2005 the Province of Turin started several tendering procedures regarding the use of renewable energy sources and energy saving. In July 2006 the Province of Verbania launched a tender for the concession of contributions, to public and private entities, for solar thermal installations. In 2005 the production of renewable electricity was 5,838.8 GWh, 269.6 GWh of which from biomass and the remaining part from hydroelectric systems.

Umbria The Region in 2001 launched a tender under the Program "photovoltaic Roofs", while in 2003 a public notice was published for the allocation of contributions for biomass use and for solar energy installations.

In 2006 a tendering procedure was announced for grants to installation of heat generators fed with solid bio-fuel. In 2005 electric power produced from RES was 1676.3 GWh, 130.2 GWh of which from biomass, 2.6 GWh wind and the remaining part hydroelectric systems.

Valle d’Aosta The Region already from 1993 adopted provisions in the energy saving and RES development field. In January 2006 the Region approved the Regional Law 3/2006 "New dispositions for the promotion of rational energy use". Tendering procedures were launched in 2001 and 2003 under the "Photovoltaic Roofs" and "Solar thermal" Programmes respectively. In 2005 the production of renewable electricity was 2,717.7 GWh, nearly all of hydropower.

Lombardia The Region participated to the "Photovoltaic Roofs" and "Solar thermal" Programmes through regional tendering procedures.

In January 2004 the Region launched a tender using the funds coming from the "Carbon Tax" law, with the aim to support the diffusion of innovative systems and technologies for the production of renewable electricity and for energy savings. The Province of Mantua approved a Voluntary Agreement for the promotion of solar thermal applications in agriculture and adopted an appropriate scheme for financing.

In 2005 the production of renewable electricity was 9,116.8 GWh, 18.8% less than 2004, 1968.4 GWh of which from biomass and the remaining part from hydroelectric systems.

Veneto In 2000 the Region passed a law for energy planning, containing several provisions on energy saving and renewable energy sources development. In 2003 a law was passed for agriculture and forests participation to biomass production. Two tendering procedures under the "Solar thermal" Programme were launched in 2003 and 2004. In 2005 the production of renewable electricity was 3,397.8 GWh, 374 GWh of which from biomass and the remaining part from hydroelectric systems.

Toscana The Region promoted and activated various regional and local programmes for RES development. In particular with the deliberation of October 2001 the region defined the voluntary agreement schemes for the development of thermal and photovoltaic solar energy. The voluntary agreements have been defined also to use biomass from woods, forests and agricultural land. In 2005 the electricity produced from RES was 6,074.1 GWh, 5.324,5 GWh of which from geothermal systems, 290.4 GWh from biomass, 456.1 GWh from hydroelectric and 2.2 GWh from wind.

Independent Province of Bolzano The Province introduced provisions for RES development already since 1993. It participated to the "Photovoltaic Roofs" Programme, launching a first tendering procedure in 2001 and another one in 2003. The Province developed strongly the use of RES, as it is demonstrated by the large number of the solar collectors per inhabitants. Excellent results have also been achieved in the biomass sector.

Independent Province of Trento The Province has always been particularly active in the field of RES promotion, especially for mini-hydro and biomass. In 2005 in the independent Province of Trento and Bolzano the production of renewable electricity was 6,676.7 GWh, 80.4 of which from biomass and the remaining part from hydroelectric systems.

Energy in the Structural Funds

The Structural Funds contribute to realize the objective of economic and social cohesion of the European Union. Their resources are used in order to reduce the difference between the Regions of the Union and to promote the equal professional opportunities of the various social groups. The action of Structural Funds is concentrated mainly on a series of priority objectives. The general document that defines the strategic lines for the programming of the Structural Funds is the Community Support Framework (QCS, in Italian), that contains an analysis of the initial situation, the strategy of interventions for the joint action of the European Union and the Member States, the priority actions of intervention, their specific objective, the expected impact assessment, the financial equipment, the identification of the Operative Programs and the their conditions of realization. The Structural Funds are four: FESR (European Fund for Regional Development), FSE (European Social Fund), FEOAG (European Fund Agricultural of Guideline and Guarantee) and SFOP (Financial Instrument of Guideline of the Fishing).

Objectives

For the programming period 2000-2006, the provisions of the Structural Funds, approved by the Council in 21st June 1999, concentrate the structural actions on three priority objectives. Objective 1 is oriented to promote, to raise and to adapt the structural development of the Regions in delay, where the Gross Domestic Product he is lower than 75% of the European Union average. Two thirds of the actions of the Structural Funds are used in application of Objective 1. Approximately 20% of the total European population is involved by the measures adopted in the framework of such an objective (As Funds: FESR, FSE, FEOAG and SFOP). The Italian Regions involved, are: Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna and in transitory regimen Molise.

Objective 2 is finalized to favour the economic and social re-conversion of the areas with various structural difficulties, different from those admissible by Objective 1. It regards the areas in phase of economic mutation, the rural zones in decline, the zones depending on fishing that are in a crisis situation or suburban areas in difficulty. In such objective is approximately included 18% of the population of the European Union (FERS, FSE). In Italy the involved municipalities are situated in the Centre-North Regions. Objective 3 is finalized to favour the adaptation and the modernization of the political and the national systems of instruction, formation and occupation. It is part of the European strategy for the occupation and it represents the reference framework of all the actions to support the human resources (FSE). Objective 3 is applied to the whole European territory, to exception of the zones comprised in Objective 1.

Operative Programs

The Regions have had assigned a central role for the identification of the operative programmes that put into effect the development strategy and of the consequent attribution of tasks and functions. The choice of territory centrality and, consequently, of participation “by region”, from a side is reinforced by the total normative design in the decentralization direction, from the other side it improves the exercise of the address role and of coordination attributed to the central Administrations for each phase of the programming cycle: programming, management and realization, monitoring and evaluation.

The actions provided for by **Objective 1** are contained in 7 Regional Operative Programmes (POR) and in the relative Complements of Programming (that contain detailed information useful for the implementation of the Operative Programmes). For Objective 1, apart from the POR, the lines of participation are: "Safety for the development of Southern Italy"; "Scientific Research, Technological Development, High formation"; "Transports"; "the School for the Development"; "Fishing"; "Local Entrepreneurial Development"; "Technical Attendance and Actions of System". These last programs, written up by the interested Ministries, are formulated and put into effect in the respect of the partnership principle of the Regions. Regions involved in **Objective 2**, are those not included in Objective 1. The programming documents of **Objective 3** are, as for Objective 1, the POR and the Complements of Programming.

Actions in energy sector provided for by the for Regional Operative Programmes Objective 1.

In Basilicata the POR envisages, apart from the actions for the promotion of the renewable energy sources, energy saving and the efficiency of the electrical system, energy saving in the public, private and productive building patrimony and the realization of RES energy production plants. In Calabria the actions of the POR regard an integrated series of participations for the greenhouse gas emissions reduction, that embrace the energy production by renewable sources, the energy saving and other investments however finalized to this objective. Moreover interventions of improvement of the electrical and methane gas system.

Also in Campania the POR envisages actions to support the realization and/or the widening of systems for the electric power production from renewable sources. The improvement of the electrical grids to favour the small and medium enterprises (PMI), the improvement of energy efficiency of the PMI are envisaged moreover interventions of energy saving in the residential building. The financial resources approximately available are 37% of all the financial resources in the energy sector for the Objective 1.

In Molise the energy measure of the POR envisages the realization of the distribution network of the gas methane. The measure energy of the POR of the Puglia Region, previews incentives for the production of energy from biomasses, wind and photovoltaic systems, and solar and thermal one. For the energy sector in the POR Sardegna, there is the modernization of the existing systems of hydroelectric production and realization of new micro systems connected to the irrigation and the aqueducts systems. Ulterior interventions are addressed to the firms in the renewable energies sector in particular for the realization of systems pilot experience with reference to the photovoltaic, solar, thermal one and the biomass. Other actions regard the agencies and the firms that develop energy saving and rational energy use programs.

The Sicilia Region previewed in POR two distinguished energy measures. The first one envisages the improvement of the gas methane and the electric power. The second one envisages the realization of interventions, finalized to the renewable energy sources production with high index of energy saving and very low level of polluting emissions (biomasses, solar energy, wind and geothermal). The financial resources of the two measures in Sicilia are approximately 38% of all the financial resources available for the Objective 1 in the energy sector. Altogether the financial resources provided for by the Structural Funds in the energy sector amount to 757.6 million euro, which nearly 89% assigned to the regions of Objective 1.

Table 4.24: Financial data of the energy measures contained in the POR of Objective 1

REGION	*MEASURE*	*TOTAL COST (M€)*	*TOTALE PUBBLIC RESOURCES (M€)*	*COMUNITAIRE RESOURCES (M€)*	*STATAL RESOURCES (M€)*	*REGIONAL RESOURCES (M€)*	*PRIVATE CONTRIBUTI ONS (M€)*	*PARTICIPATION RATE STRUTTURAL FUND*
BASILICATA	*1.6*	*24.6*	*24.6*	*12.3*	*12.3*	*0*	*0*	*50%*
CALABRIA	*1.11*	*71.2*	*71.2*	*35.6*	*34.2*	*1.4*	*0*	*50%*
CAMPANIA	*1.12*	*245.1*	*245.1*	*122.6*	*122.6*	*36.8*	*0*	*50%*
MOLISE	*1.8*	*7.2*	*7.2*	*3.1*	*2.9*	*1.2*	*0*	*43%*
PUGLIA	*1.9*	*43*	*43*	*21.5*	*15*	*6.5*	*0*	*50%*
SARDEGNA	*1.6*	*21.9*	*21.9*	*10.9*	*7.7*	*3.3*	*0*	*50%*
SICILIA	*1.16*	*125*	*125*	*56.2*	*48.1*	*20.6*	*0*	*45%*
SICILIA	*1.17*	*127.2*	*127.2*	*57.2*	*49*	*21*	*0*	*45%*

The data in the table do not take into account the financial resources that will be destined to the energy recovery from waste, because they are not available.

Interventions in energy sector previewed by the Regional DOCUP for Objective 2.

The regions of Objective 2 that inserted measures in energy sector in their DOCUP with the financial data are reported in table 4.25. The interventions envisaged by the Region Friuli Venezia Giulia, include the realization of hydroelectric systems with power inferior to 3 MW, the exploitation of the present geothermal energy in the lagoon area for the heating publics buildings and the realization of some first systems of district heating. Liguria programmed actions that regard the realization of: thermal, wind systems, solar and photovoltaic solar systems, recovery of hydroelectric centrals, systems of co-generation and distribution of the heating by district heating with power not over 5 MWt fed by forest-biomass and by biogas as well, distribution of district heating. Many interventions also in nearly all the sectors of the renewable sources and the energy saving.

Toscana previewed in its DOCUP two measures with the same one objectives, but with various address: the measure 3,1 is addressed to the territorial Local Agencies, the measure 3,2 to the firms. The programmed actions are the realization of small-medium hydroelectric power, wind farms, solar parks, electrical and thermal power by biomasses and geothermal fluid to low enthalpy use project; moreover they have been programmed city district heating projects, co-generation power for civil, industrial and mixed users plans and projects finalized to the optimization of energy consumptions. Lombardia with the interventions in the renewable sources sector previewed, in measure 3,4 of the DOCUP, the activation of wind solar, geothermal, hydroelectric energy production systems and many actions of improvement the energy efficiency, in the public's buildings. Veneto programmed several interventions on the renewable sources comprised the exploitation of the geothermal power, actions to support the energy saving and improvement of the energy efficiency systems, the realization of district heating system and energy saving plans.

Table 4.25: Financial data of the measures in energy sector, contained in the DOCUP of Objective 2

REGION	*MEASURE*	*TOTAL COST (M€)*	*TOTALE PUBBLIC RESOURCES (M€)*	*COMUNITAIRE RESOURCES (M€)*	*STATAL RESOURCES (M€)*	*REGIONAL RESOURCES (M€)*	*OTHER PUBBLIC CENTRES*	*PRIVATE CONTRIBUTIONS (M€)*	*PARTICIPATION RATE STRUTTURAL FUND*
*FRIULI**	*3.1.2*								
LIGURIA	*2.3*	*6.4*	*6.4*	*1.9*	*2.1*	*1.1*	*1.3*	*0*	*30%*
TOSCANA	*3.1*	*4.6*	*4.6*	*1.6*	*1.4*	*1.6*	*0*	*0*	*35%*
TOSCANA	*3.2*	*22.0*	*22.0*	*7.6*	*6.9*	*7.5*	*0*	*0*	*34%*
LOMBARDIA	*3.4*	*15.8*	*15.8*	*7.9*	*5.5*	*2.4*	*0*	*0*	*50%*
MARCHE	*2.8*	*8.4*	*7.9*	*3.3*	*4.6*		*0*	*0.4*	*40%*
VENETO	*2.2*	*19.1*	*19.1*	*9.6*	*6.7*	*2.9*	*0*	*0*	*50%*
TRENTO	*2.2*	*6.1*	*5.1*	*1.5*	*2.5*	*1.1***	*0*	*1.0*	*25%*
LAZIO	*1.3*	*10.3*	*10.3*	*5.1*	*3.6*	*1.0*	*0.5*	*0*	*50%*

**The relative data to the Action 3.1.2 are not available*
*** Provincial Resources*

The Province of Trento previewed actions in the biomasses sector (obtainable by the forests or materials deriving from the refuse of workings maintenance). In the solar sector activated thermal, photovoltaic and hydroelectric plans. The region stimulates moreover the thermal isolation of buildings.

Lazio programmed in the DOCUP, actions of energy production from renewable sources (photovoltaic and solar thermal, wind, geothermal fluid use, small hydroelectric power, biomass) and interventions finalized to the directed rational energy use for energy saving, for improving the energy efficiency of the technological processes and moreover co-generation and energy saving in the lighting system and the air conditioning of buildings. Marche, in Measure 2.8, programmed interventions for the exploitation of solar energy and biomass finalized to the electric power production and thermal energy, interventions of energy saving, control systems, co-generation, district heating and other more actions for the efficiency, energy saving and development of the renewable sources. The final beneficiaries of the measure are the territorial local agencies and the sanitary companies.

CHAPTER 5
PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

Introduction

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 Italian target is to reduce total GHG emissions by 6.5% over the 2008-2012 period with respect to 1990.

The international and European context

In foreshadowing national intervention strategies to mitigate climate changes, it is important to consider other countries' prospective emission growth: the emissions of greenhouse gases in Italy in 2004 account for about 3% of the Annex 1 Parties emissions and for 13.8% of European Union (EU 25) actual emissions. Data on other countries' actual emissions are presented in chapter 2; the present paragraph takes accounts of the temporal evolutions estimated for the next years.

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[21]. A comparison between the information contained in the National Communications of 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). Taking into account emissions without LULUCF, three main effects are highlighted in figure 5.1:

a) In 2004, the emissions of Annex I countries were 2.2 % lower than the levels of 1990;
b) The emissions of Annex II countries increased approximately by 11% from 1990 to 2004 and they are expected to continue to increase at the same rate;
c) the estimated emissions of EIT countries in the 1990-2000 where reduced of about 38%; those data, contained in the inventories provided, diverge remarkably from the projections of their national communications that stated that they should reach in 2010 the levels of 1990; it is likely that they remain significantly lower than 1990 levels but with an increasing trend.

The likely outcome for the Kyoto period is an emission increase of Annex I countries of 1-2% between 1990 and 2010, according to most recent data. According to art. 3.1 of the Kyoto Protocol, the Annex 1 Countries should reduce their emissions of "at least 5%".

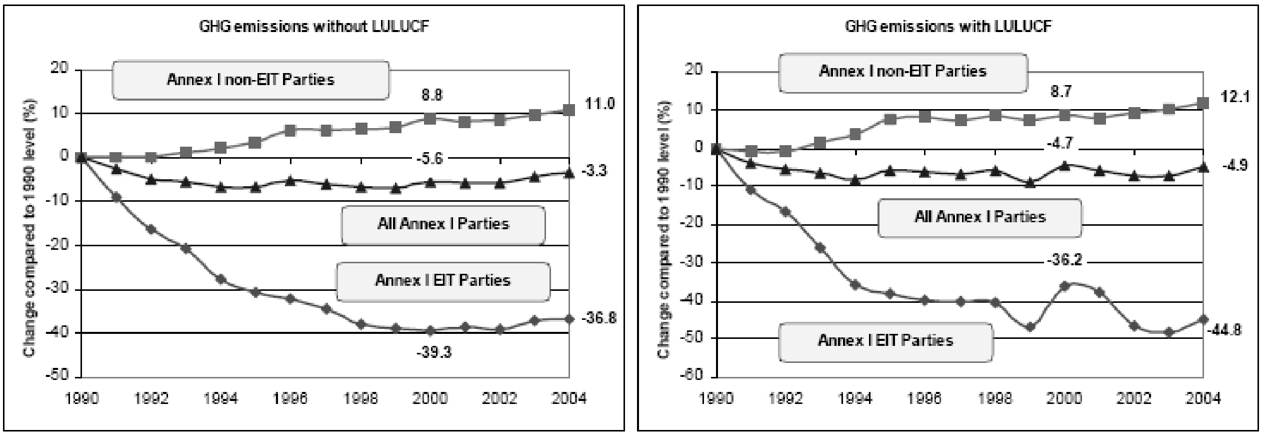
[21] FCCC SBI/ 2006/ 26, National greenhouse gas inventory data for the period 1990–2004 and status of reporting

The European context

The European Commission started since year 2000 a monitoring mechanism of the greenhouse gas emissions, which summarises the emissions of Member States on an annual basis. In the more recent report [22](2006) 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.

Two figures, 5.2 and 5.3, are reported with reference to the 2005 situation. They summarize the evolution at aggregate level and the details at sector level, respectively. The first figure highlights that a stabilization of greenhouse gas emissions can be actually attained through the policies that have been implemented in many countries. The Kyoto objective for EU is to attain a 8% emissions reduction. This target will be met taking into account the measures for the forestry sector and the use of flexible mechanisms.

Figure 5.1: 1990 – 2004 trends and actual emissions of Annex 1 Parties

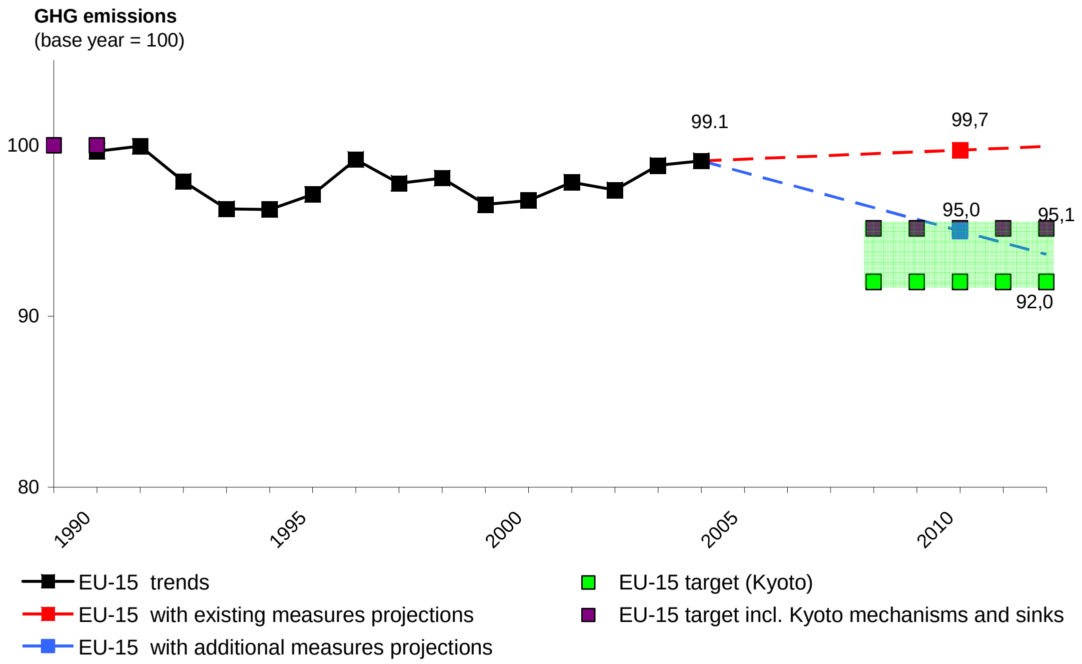


Note: For greenhouse gas (GHG) emissions with land use, land-use change and forestry (LULUCF), data for Estonia, Lithuania, Luxembourg, Poland, Slovenia, Switzerland and Turkey are not included because of the unavailability or incompleteness of some LULUCF data in the period 1990–2004.

Source: FCCC SBI/ 2006/ 26, Fig. 3

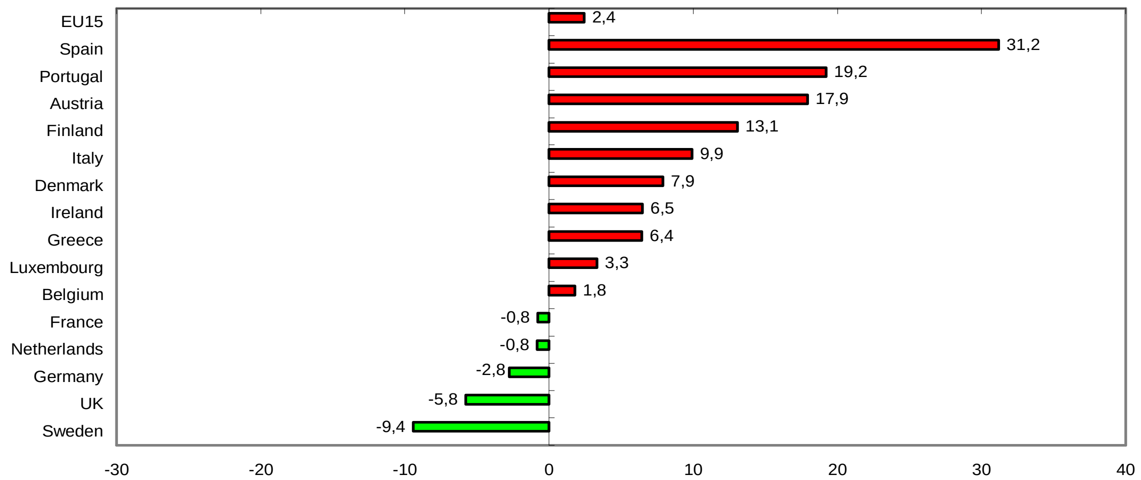
[22] Greenhouse gas emission trends and projections in Europe 2006, EEA Report N° 9/2006 and Greenhouse gas emission trends and projections in Europe 2006, EEA Report N°5/2007

Figure 5.2: Actual and projected EU-15 greenhouse gas emissions compared with Kyoto target for 2008–12, including Kyoto mechanisms and carbon sinks



Note: *Target paths are used to analyse how close 2004 emissions were to a (hypothetical) linear path of emission reductions or allowed increases from the base-year to the Kyoto Protocol target, assuming domestic policies and measures as well as use of Kyoto mechanisms. The EU-15 target including Kyoto mechanisms and sinks is based on an estimated projected use of Kyoto mechanisms and activities under Article 3.3 and 3.4 (carbon sinks). The Kyoto mechanisms account for 2.5 % of the EU target of 8%, and 3.3/3.4 activities contribute additional 0.6 %. Thus the (theoretical) target for the EU-15 including Kyoto mechanisms and sinks is presented in the graph as 92 + 3.1. Source: EEA, 2006.*

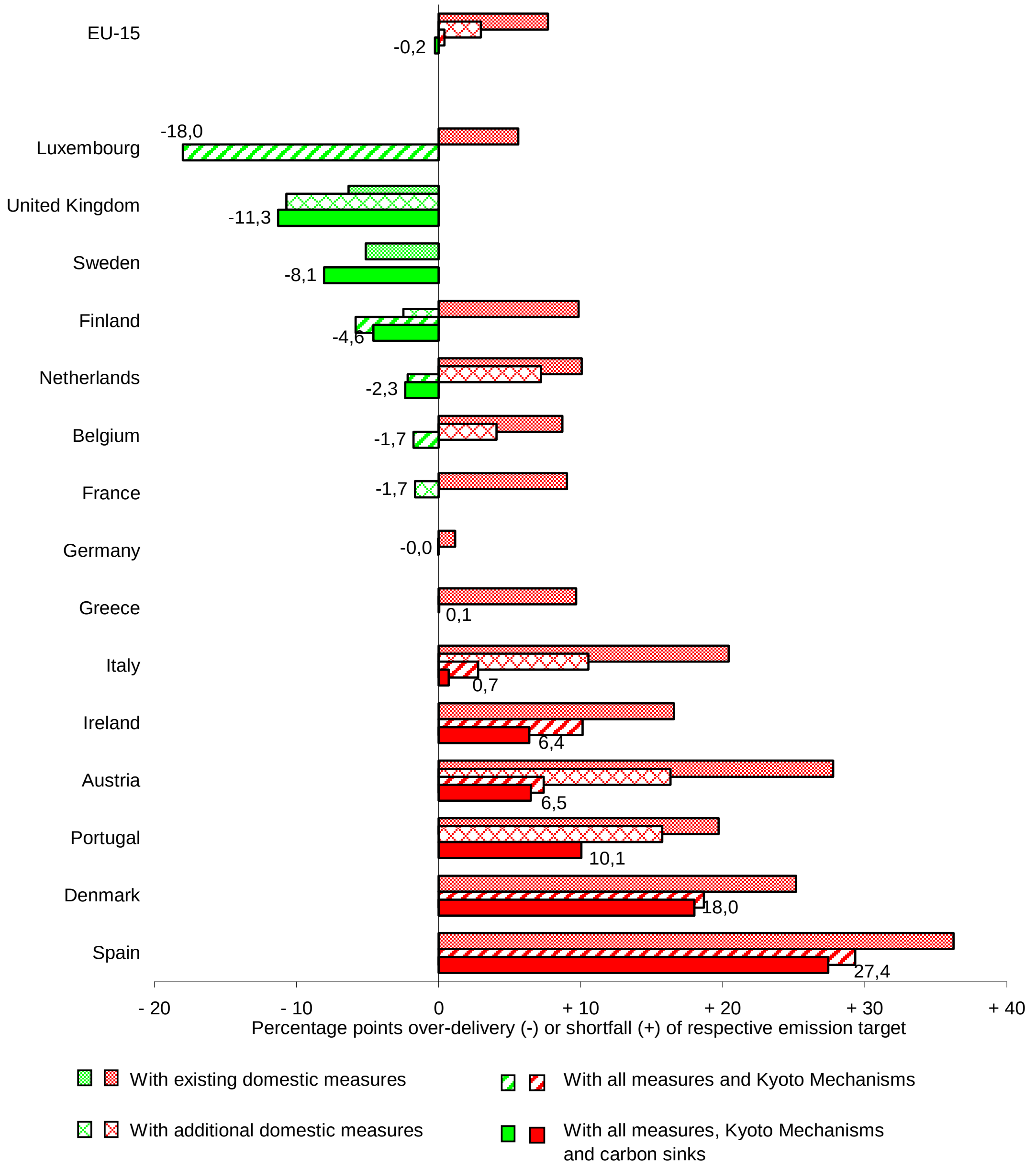
Figure 5.3: Distance-to-target (burden-sharing targets) for EU-15 Member States in 2004, including Kyoto mechanisms and carbon sinks



Note: *The distance-to-target indicator (DTI) measures the deviation of actual emissions in 2004 from a (hypothetical) linear path between base-year emissions and the burden-sharing target for 2010. A positive value suggests an under-achievement and a negative value an over-achievement by 2004. The DTI is used as an early indication of progress towards the Kyoto and Member States' burden-sharing targets. For the following Member States the additional effects of the use of Kyoto mechanisms are included: Austria, Belgium, Denmark, Finland, Ireland, Italy, Luxembourg, the Netherlands and Spain.* ***Source:*** *EEA, 2006.*

The situation to 2010 is available at disaggregate level for each Member State, see Figure 5.4, 5.5. In Figure 5.5 the estimated impact of additional measure and the effect of LULUCF and flexible mechanisms is evaluated for each State.

Figure 5.4: Relative gaps (over-delivery or shortfall) between greenhouse gas projections based on domestic policies and measures and 2010[23] targets for EU-15 Member States including the effects of Kyoto mechanisms and net emissions and removals from carbon sinks.



Note: *All EU-15 Member States provided projections assuming existing domestic policies and measures. Several countries provided projections with additional domestic policies and measures. The effect of the Kyoto mechanisms is shown separately for the ten countries that intend to use them for reaching their target data. For more information see Chapter 7. Projections for Spain are available for CO_2 only. Data on the net effect of emissions and removals from carbon sinks under Article 3.3 and 3.4 of the Kyoto Protocol were provided by ten countries and were considered where available. Adjustments of the reduction target due to Article 3.7 were performed for Portugal, UK and the Netherlands. Source: EEA, 2006.*

[23] In the Council decision (2002/358/EC) on the approval by the EU of the Kyoto Protocol the various commitments of the Member States are expressed as percentage changes from the base-year. In 2006 the respective emission levels will be expressed in terms of tonnes of CO2-equivalents.

Figure 5.5 is noteworthy, especially because it highlights the substantial decarbonization of energy supply achieved in the 1995-2004 period by EU - 15. With the exception of transport sector a sizeable decoupling between energy supply and carbon emissions has been achieved in recent years. Certainly not enough because it has been achieved a stabilization not a reduction of emissions, but in any case the picture summarize the results of all policies and measures implemented in the more recent years.

Figure 5.6 points to transport sector that seems unaffected by implemented policies. Emissions of EU–15 shows a constant rate of increase in the last 14 years and the trend is expected to continue in the Kyoto commitment period (2008 – 2012). The use of energy sources to meet the increasing demand from the transport sector will likely produce by 2010 an emissions increase of about 30% , despite the inclusion of the ACEA agreements and other measures, on account of the remarkable growth of the road and air sectors.

Figure 5.5: EU-15 greenhouse gas emissions from energy supply and use (excluding transport) compared with energy demand. Source EEA, 2007

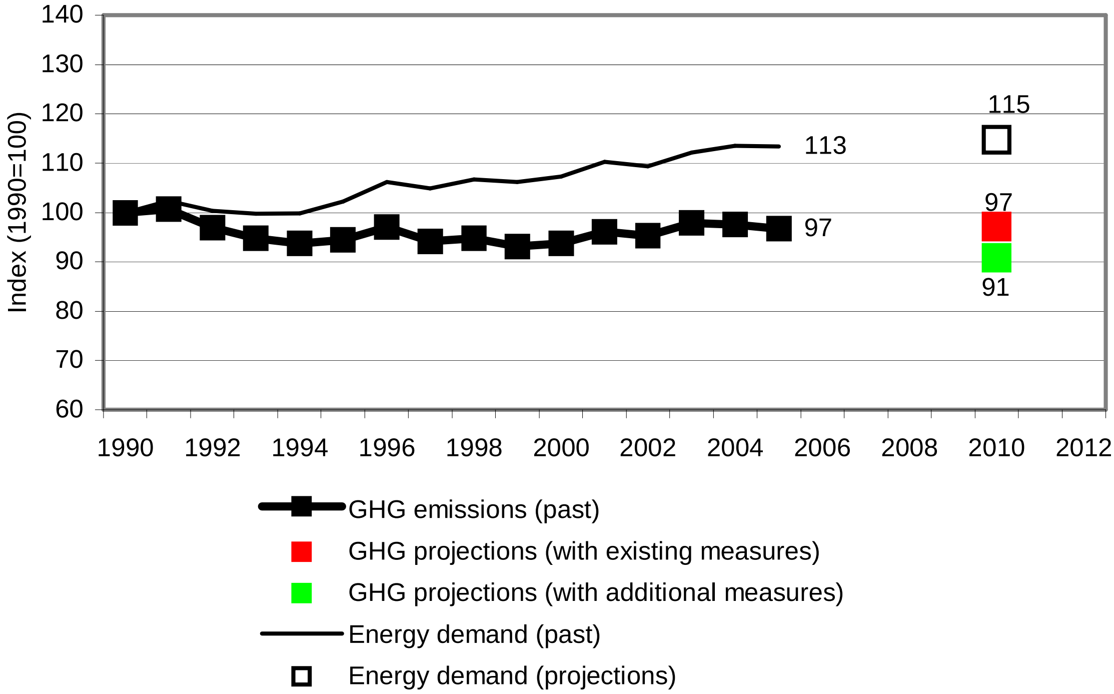
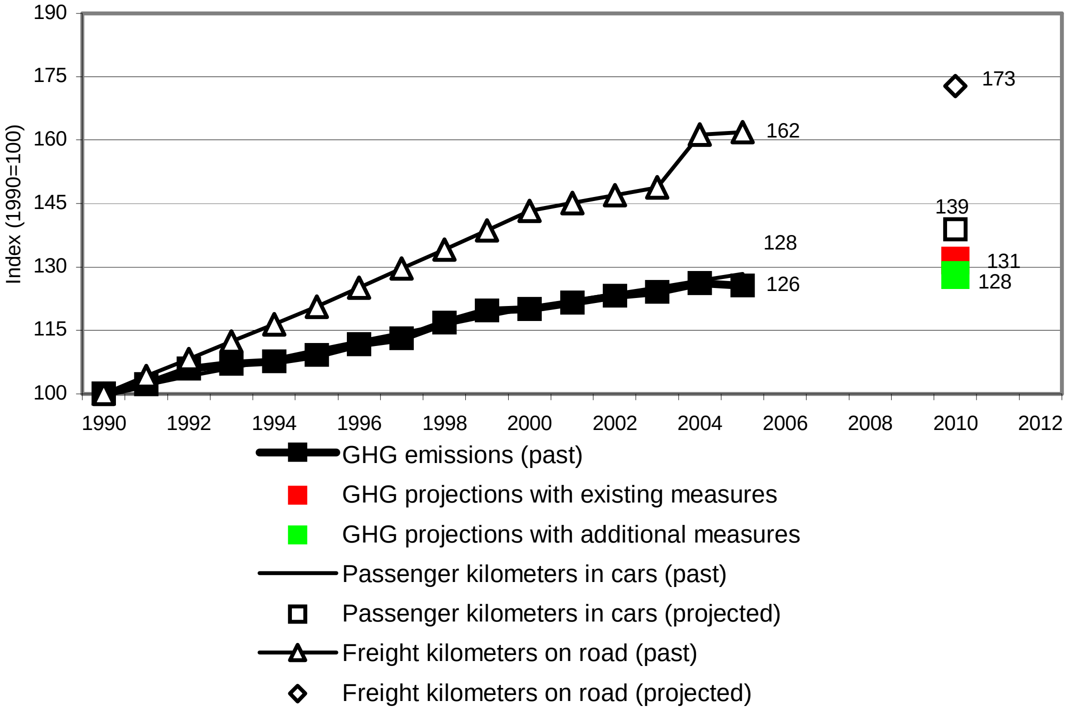


Figure 5.6: EU-15 greenhouse gas emissions from transport compared with transport volumes (passenger transport by car and freight transport by road). Source EEA, 2007



Overall, a slight decrease in carbon dioxide emissions from the energy supply and use sectors (without transport) and a sizeable increase from transport sector are estimated at European level. Methane and nitrous oxide emissions are expected to decrease whereas HFC, PFC and SF6 emissions are already increasing.

In conclusion we have described in this paragraph the difficulties and shortfalls in meeting the Kyoto target with internal measures at international and EU level. The up to date Italian scenario shows further increase in emissions, relatively to EU average, due to specific national circumstances.

Trend emission scenario

The following emission projections have been geared taking account of the energy scenarios described in "Energy scenarios and effects of policies and measures" paragraph, and specific estimates on non-energy source emissions. Annual average emission data, disaggregated per gas, are reported in table 5.1 : the overall emission increase after year 2005 is characterized by a rising trend, with a 2% increase in the next 5 years, a 4% increase in the 2010-2015 period and a 2% increase up to 2020. Those trends are considerably lower than the registered growth in the 2000 – 2005 period (+5.8%) and, on the average, lower than the 1990 – 2000 historical trend (+6.6%).

The gases which recorded the higher growth rate between 2000 and 2010 are HFCs, +250%, followed by PFCs and SFs6, but the rise in carbon dioxide emissions, + 9.2%, is much more relevant from a quantitative point of view. A significant share of carbon dioxide emissions is generated by energy consumptions, analyzed in details at sectoral level in the following paragraphs. Methane emissions and, to a lower extent, nitrous oxide emissions,are decreasing.

The increase in overall emissions between 2010 and 2020 continues, with more remarkable increases in carbon dioxide emissions (+6.9%) and a slowdown in HFC, +43%, PFC and SF6 increases.

Table 5.1: GHG emission from 1990 to 2020, disaggregated by gas. (Mt CO2 eq.)

	YEAR - base	1995	2000	2005	2010	2015	2020
Carbon dioxide	434.8	445.8	463.6	493.4	506.1	526.9	541.5
Methane	41.6	44.0	44.3	39.7	36.7	35.0	33.6
Nitrous oxide	38.0	39.3	40.9	40.4	34.8	34.7	34.8
HFCs	0.4	0.7	2.0	5.3	8.6	10.5	12.6
PFCs	1.8	0.5	0.3	0.4	0.4	0.4	0.4
SF6	0.3	0.6	0.5	0.5	0.4	0.4	0.5
TOTAL	516.8	530.9	551.6	579.5	587.0	607.8	623.4
Changes with respect to the - base year, 6 gases			6.7%	12.1%	13.6%	17.6%	20.6%
Changes with respect to the - base year, CO2 only			6.6%	13.5%	16.4%	21.2%	24.5%

Source : APAT elaboration

Sectoral emissions

With reference to table 5.2, about 83%, of the GHG emissions are caused by fossil energy use, characterized by an upward trend. In 1990, they amounted to a total of 422,8 Mton., in 2000 to 455.8 Mton. and to 484.0 Mton. in 2005. Fossil energy emissions as a whole have increased by 14.5% over the 1990-2005 period, with the highest growth rate (+26.5%) recorded by the transportation sector, followed by the civil sector (residential, services) (+23.3%) and by energy industry sector (+ 19.5%). On the contrary, the emissions from the manufacturing and construction industries have decreased by 7.6%. The cause of this emission increase will be analyzed sector by sector in the following paragraph.

The trend is expected to continue, with an increase of 2.6% from 2005 to 2010 and another increase of 8.1% from 2010 to 2020, with the transport sector showing the higher growth, followed by energy supply sector and civil.

A summary of sectoral emissions divided per emission sector and final uses is contained in Table 5.3 and in Figure 5.7. In this table the emissions caused by the production of electricity and transportation fuels are distributed in relation to the final consumption sector. The table allows illustrating the underlining driving forces of the emissions increase, in terms of final consumptions:

- a 3% decrease is recorded by the industrial sector between 1990 and 2005, a 4% increase is expected up to 2010 and a further 13% 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;
- the domestic and services sectors are increasing remarkably the emissions during the three decades from 1990 to 2020, that is by +9.7, +4.9% and +16% respectively; the most relevant increases are in the services sector.

For the GHG emissions not directly connected with energy use the picture is rather different. Those emissions have registered an increase of 2.2% from 1990 to 2005, due to the increase in HFCs use and emissions from waste. Emissions from Agriculture and solvents did decrease. The scenario up to 2010 shows a reduction of emissions of 2% and a substantial stabilization in the following period up to 2020. Most of the reduction will occur in the waste sector, see the sectorial analysis for further details.

Table 5.2 : GHG emissions from 1990 to 2020, disaggregated by emission sector (Mt CO2 eq.)

	1990	1995	2000	2005	2010	2015	2020
FROM ENERGY USES, of which:	**419.4**	**432.6**	**452.8**	**480.1**	**490.8**	**510.4**	**524.1**
- Energy industries, of which:	134.8	138.8	148.4	160.6	165.7	174.6	180.9
- public power plants	107.5	109.9	116.0	121.0	126.7	136.1	142.3
- refinery	16.5	18.8	22.4	26.7	26.2	25.7	25.7
of which thermoelectric	2.7	3.0	4.8	6.5	6.5	6.5	6.5
- other, coal gas	10.7	10.1	10.0	12.8	12.8	12.8	12.8
of which thermoelectric	8.4	6.3	9.5	12.9	12.9	12.9	12.9
- Industry	90.6	89.4	89.5	83.6	88.9	88.5	90.3
of which thermoelectric	10.7	17.4	11.0	6.7	6.7	6.7	6.7
- Transport	104.0	115.1	124.5	131.5	138.9	148.1	151.8
- Residential and commercial	69.1	68.2	71.6	86.0	79.4	81.5	83.3
- Agriculture (energy use)	9.2	9.6	8.9	9.3	9.7	10.2	10.5
- Other	11.9	11.5	9.9	9.1	8.2	7.5	7.3
FROM OTHER SOURCES, *of* which:	**97.4**	**98.3**	**98.8**	**99.4**	**96.1**	**97.4**	**99.3**
Industrial Processes + F-gas	36.5	34.6	35.0	40.8	40.7	43.7	46.8
Agriculture	40.6	40.9	39.9	37.2	36.6	35.8	35.6
Waste	17.9	20.6	21.6	19.3	16.8	16.0	15.0
Other	2.4	2.2	2.3	2.1	1.9	1.9	1.8
TOTAL	**516.8**	**530.9**	**551.6**	**579.5**	**587.0**	**607.8**	**623.4**

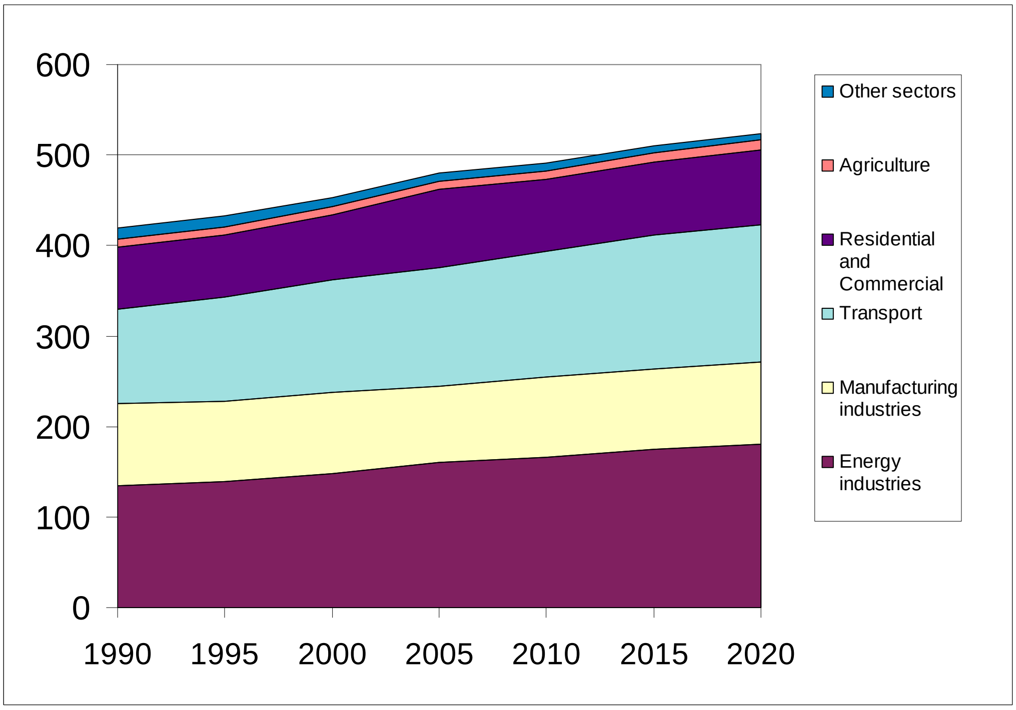
Source: APAT elaborations

Table 5.3: GHG emissions from 1990 to 2020, disaggregated by end-use sector (Mt CO2 eq.)

	YEAR	1995	2000	2005	2010	2015	2020
Industry	154.0	151.0	154.0	153.3	158.6	162.5	167.3
Transport (include refineries)	121.4	134.6	146.5	156.2	163.0	172.0	176.0
Civil	120.7	123.5	131.3	149.7	149.1	156.1	161.0
Industrial Processes	36.5	34.6	35.0	40.8	40.7	43.7	46.8
Agriculture, energy	11.5	11.9	11.2	11.7	11.8	12.3	12.5
Agriculture	40.6	40.9	39.9	37.2	36.6	35.8	35.6
Waste	17.9	20.6	21.6	19.3	16.8	16.0	15.0
Other	14.2	13.7	12.2	11.2	10.2	9.4	9.1
TOTAL	516.8	530.9	551.6	579.5	586.9	607.8	623.4

Note: Emissions from electricity and fuels production have been distributed to final consumption sectors
Source: APAT

Figure 5.7: GHG emissions from energy use, MtCO2 eq.



Emissions from energy use

Energy sector

This sector according to IPCC guidelines includes the production of electric energy from fossil fuels, refineries and the production of coke and of electricity from coal gasses in integrated steel plants. For consistency with the national energy balance in this paragraph all the emissions linked to the production of electric energy will be considered. The CRF data in section 1.A.1 a-c (see also chapter 3) do not include self-generated and self-consumed electricity, which are included among industrial emissions. Up to year 2000 the contribution of this source to the total emissions of electricity generation was quite substantial, oscillating between 7.7% and 10%. After the process of privatization of electricity production most of the industrial plants become independent producers, with cogeneration becoming a minor part of their output. In 2005 the electricity self generated and consumed by industrial producers, excluding refineries and steel plants, amount to only about 4.5% of total emissions of electricity generation.

The overall emission trend of total electricity production is shown in Figure 5.9. Between 1990 and 2005 a noticeable increase, from 130.6 to 148.9 Mt CO2 eq. is reported, +14.2%, about 0.9% yearly. From 2005 to 2010 the yearly increase is expected to continue at the same rate with a total further increase of 4.5%. From 2010 to 2020 a yearly increase of 1.2% in emissions is expected, due to limited scope remaining for technologies to increase the generation energy efficiency and for fossil fuel switch to gas.

The increase in emissions is lower than the growth of electricity production, due to the relevant increase in efficiency of electricity production since 1990 and in the future. The different slope of the two lines in Figure 5.9, one relative to emissions and the other relative to production clearly illustrate this fact:

- the growth rate of the electric energy demand it was quite high from 1990 to 2005, more than 2.7% per year, a higher rate is expected from 2005 to 2010, +3.1%, and a lower rate , +2.6%, is expected after 2010;
- In absolute values the increase in “electricity demand from the network” (including imports) was about 40% between 1990 and 2005 and will grow from 330 to 430 TWh (+30%) in the period 2005 - 2020.

According to the trend scenario the expected increase in demand will be covered by a rapid increase in installed power in the first part of this period, due to the introduction of new combined cycles, both brownfield, (particularly as a result of repowering activities of older plants), and greenfield, for the implementation of new initiatives.

Total power capacity, including renewables, goes from 70,755 MW in 2000 to 75,000 MW in 2010 and 93,000 in 2020. The trend scenario of the electric energy sector considers the effects of the measures implemented before 2005, 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 doubled capacity, from 1700 to 3700 MW. The growth essentially affects the wind and waste-related capacity, and it reflects the 2% standard set forth by Decree 79/99 on renewable sources and the further increase up to 3.05% approved recently. Hydroelectric production shows a small reduction., due to scarce rainfall and increased minimum water flow requirement for rivers, to 42 TWh. The trend scenario also assumes the cogeneration production to increase slightly.

The demand of electric energy from end use sectors, reported in figure 5.8, drive the electricity production over the time horizon covered by the scenario (2000-2020). In the period from 1990 to 2005 the main increases in percentage and absolute value where from the industrial sector. In recent years a strong growth of electricity consumption is registered in the service sector. The trend scenario register in the 2005 – 2020 period a consistent increase of demand from industrial sector, from 136 to 187 Twh, +38%, and a huge increase from the services, from 51 to 96 Twh, + 88%. Domestic sector consumption is also increasing, but with a lower rate, from 61 to 79 Twh, + 30%. Among main drivers of this demand there are cooling, quickly and pervasively expanding in both domestic and service sectors, the building of new shopping malls outside cities and the expansion of light industrial activities.

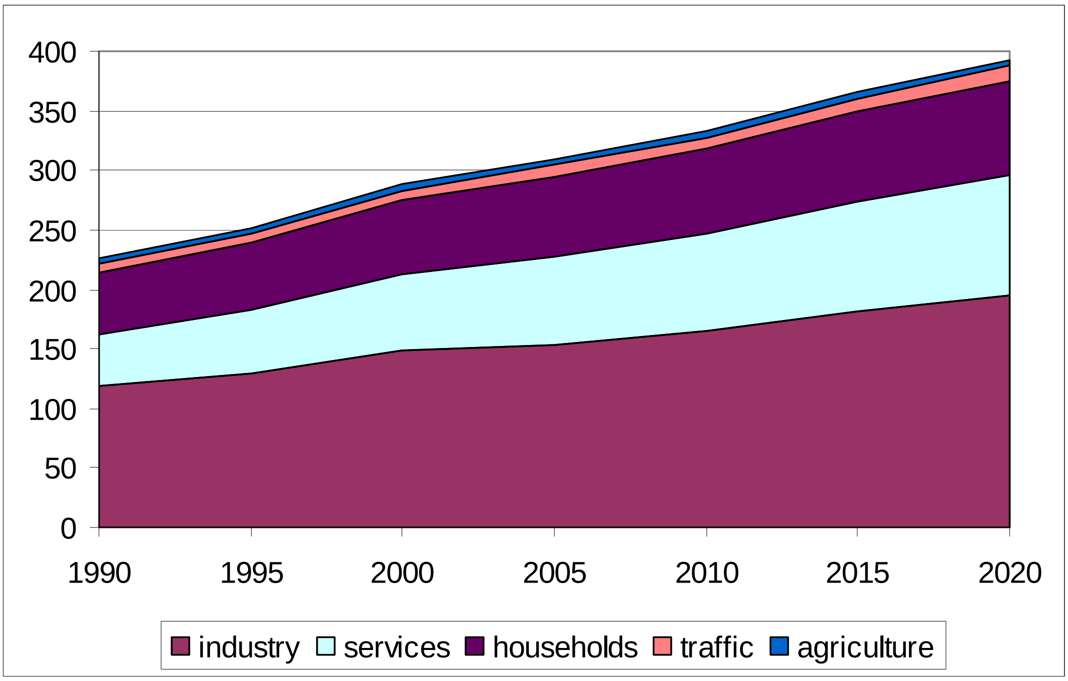
Some additional measures already established or planned and related to the production of electric energy have been considered in chapter 4. The effect of these measures on the overall emissions growth from the energy industry is synthesized in table 5.4. An in - deep crosscheck with the measures already considered in the trend scenario shows that the estimate for "additional renewables" is, partially, already included in the trend scenario. Only 2/3 of the effect of this measure will be considered in the estimation of the overall effect of policies and measures, pending further checks.

Refinery sector

As far as the refinery sector is concerned the demand in energy consumption was increasing between 1990 and 2000 due to an increase in output. After year 2000 the demand for energy in the refineries is mainly driven by the demand of more clean fuels and from the increased share of transportation fuels in the output, at the expense of fuel oil. The results are an increased "complexity" of the process, the installation of deep conversion units or of integrated gasification units that can use heavy residuals from processing to produce electricity, heat and hydrogen.

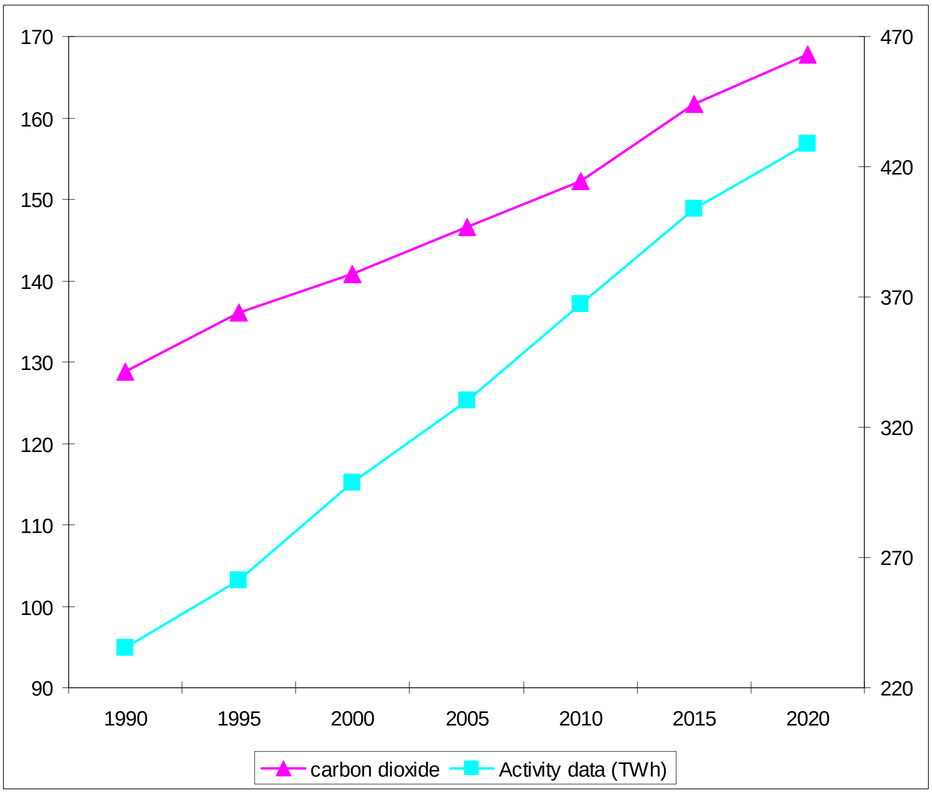
This trend is expected to continue up to 2010, with the increase in efficiency balanced by the additional processing required by more clean fuels. After 2010 the overall activity data should decrease, with a corresponding slight reduction in emissions. No additional measures have been estimated for this subsector.

Figure 5.8: Consumption of electricity in end use sectors, TWh



Source, APAT

Figure 5.9: Power sector, CO_2 emissions growth (Mt CO_2 eq.)



Source, APAT

Table 5.4: Energy Industry (MtCO2). Additional measures already established or planned

	2010	2015	2020
Total GHGs emissions from energy sector (trend scenario)	**168.0**	**177.1**	**183.2**
Implemented measures: expansion of renewable uses	0.58	1.60	1.92
Adopted / planned: additional renewables	6.29	17.41	24.68
cogeneration	1.65	5.44	9.33
Energy sector total emissions (with measure scenario)	**159.5**	**152.6**	**147,4**

The industrial sector

The industrial sector considered herein excludes refineries and includes blast furnaces and coking plants, following IPCC guidelines and the data reported in section 1.A.2 . The only exception are the emissions due electricity self-production, that where included in the previous paragraph about electricity production. Reference is made only to emissions connected to energy use, excluding process emissions reported in section 2.A-C of CRF.

The emission growth is reported in figure 5.10 Generally speaking, the industrial sector is going through a period of slowdown in the levels of efficiency increases – already exploited in the previous years – a slight additional penetration of natural gas and a differentiated evolution of the levels of activity of the sub-sectors that see some sectors as mechanical, food, specialized chemicals manufacture and other light industries expanding at a higher rate than average. We underline that the particularly low emissions registered in 2005 are due to a low production of steel from BOF plants only in that year and it does not represent an indicator of change in the sector's trends.

A primary tool to reduce the emissions of greenhouse gases is to improve the level of energy efficiency of the industrial processes. As can be seen in many European indicators (i.e. Odyssee database) high levels of efficiency are exhibited by the Italian industrial sector with respect to other European countries in main energy intensive sectors as steel, cement, tiles, paper. This 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 low levels have already been recorded. On the contrary, further decreases characterize 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 between 2005 and 2010 and in the following period. Contemporaneously, the reduced use of fuel oil contributes to slow down the emission rates from the industry sector against the upward trend affecting energy consumptions.

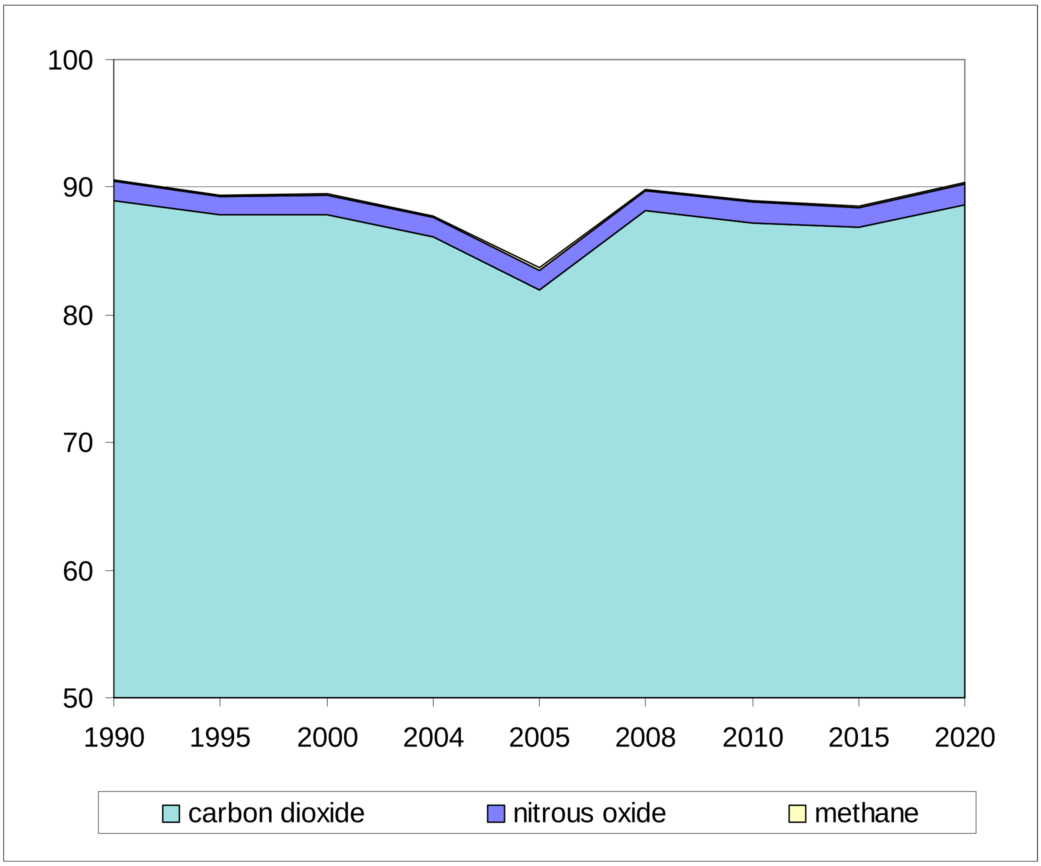
As for any other sector, the base scenario of the industry sector considers the measures that have already been started to date. The effects of law 10/91 on the appointment of energy managers, for instance, have been inserted. We also consider the effects of the new EU standards on Italian steel plants, 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 nearly stationary trend for CO2 emissions in the 2005-

2020 period. The outcome of the effects of the additional policies presented in chapter 4, up to 2020 is shown in the following table.

Table 5.5: Industry (MtCO2). Additional measures already established or planned

	2010	2015	2020
Total GHGs emissions from industry (trend scenario)	**89.2**	**88.8**	**90.5**
Implemented measures : included in trend scenario	-	-	-
Adopted / planned measures:white certificates	0.9	5.9	9.5
Process mod. and use of waste derived fuels	1.0	1.5	2.0
Industrial sector total (with measure scenario)	**87.3**	**81.4**	**79.0**

Figure 5.10: Industrial sector, emissions from the use of fuels (Mt CO2 eq.)



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 emissions are those reported in table 1.A.3 of CRF.

The CO_2 emission from this sector register the highest historical growth, +26.5% from 1990 to 2005, and this trend is expected to continue, as shown in figure 5.11. 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 (ACEA agreement)
- fuel optimization: enforcement of protocols agreed on between government and producers for the deployment of low-zero carbon fuels in the market (natural gas, LPG, liquids from biomass);
- modal optimization: car sharing, car pooling and shared taxi initiatives for passenger transport
- infrastructures: extension and modernization of the local railway network.

The expected activity scenario for passenger transport – to be considered as the most plausible for Italy – substantially follows the historical record, with an annual increase of about 1% with respect to "active" population. On the average, due to a population that is becoming older, the over all increase is lower, between 0.8 and 0.5% a/y, as reported in table 5.6.

For goods, considering that estimates on GDP growth for the next 10 years are in the range of +1.6% a/y, an average growth of 1.7% is foreseen, accounting for little more elasticity than the EU average. Table 5.7 shows the historical growth rates and national forecasts according. 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 enlargement of the free trade area and the high impact on transport of globalization. .

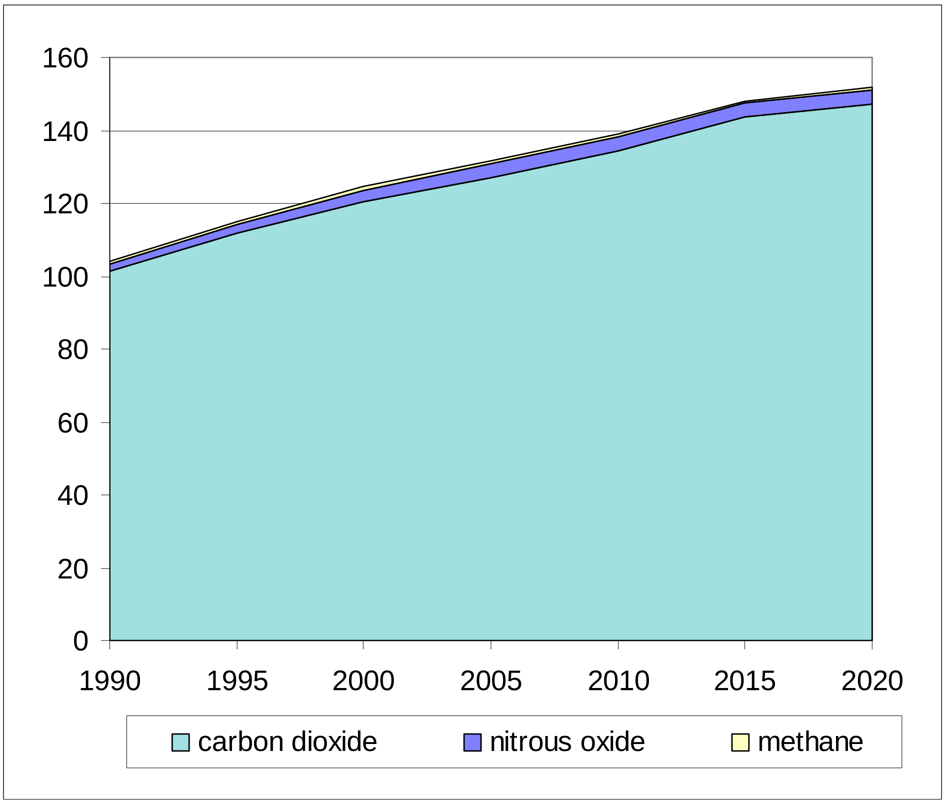
Table 5.6: Growth rates in different scenarios.

	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Passengers, Gp-km						
Historical	2.5%	0.4%	0.9%			
Trend scenario (REA 2006)				0.83%	0.67%	0.6%
White paper UE, bau (GDP +3%a/y)				1.83%	1.83%	1.83%
Gooods, Gt-km						
Historical (> 50 km)	2.4%	3.2%	1.1%			
Trend scenario (REA 2006)				1.2%	2.2%	1.7%
White paper UE, bau (GDP +3%a/y)				2.74%	2.74%	2.74%

Source: APAT

Note: *The methodology adopted by ISTAT to survey goods traffic was thoroughly revised between 2000 and 2005; therefore precaution must be taken in considering the historical goods growth rate.*

Figure 5.11: Transportation sector, GHG emissions growth (Mt CO2 eq.)



The modal split, Table 5.8, is substantially unchanged for passengers, whereas a significant increase in goods railway / ship 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. The Table 5.8 shows the breakdown of the emission increases from different subsectors and the modal split. Estimates for car and truck stocks are reported in Table 5.9. Their growth, insufficiently offset by a reduction in unit consumptions, is driving the emission increase in the transport sector.

Table 5.7: Increase of road vehicle use (G veh-km)

	1990	2000	2004	2010	2020
Passenger	339	431	471	500	558
Yearly increases		1,81	2,25	1,25	1,26
Goods	66	82	90,5	103	123
Yearly increases		2,16	2,50	2,00	1,48

Table 5.8: CO2 emissions from the transportation sector, per sub-sector

	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
	%						
Passenger	62.0	64.2	64.7	60.3	60.0	57.8	55.9
Goods	33.9	32.4	34.8	36.5	37.0	39.3	41.0
Other (P.A., fisheries)	4.1	3.4	0.5	3.2	2.9	2.9	3.1
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	%						
Road	95.3	95.4	96.8	96.3	96.1	95.8	95.5
Other modes	4.7	4.6	3.2	3.7	3.9	4.2	4.5
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The implementation of the policies presented in chapter 4, concerning carbon dioxide emissions alone, would imply a reduction in emission rates as described in table 5.10.

Table 5.9: Circulating fleet

	1990	1995	2000	2005	2010	2015	2020
Cars							
Oil	22,502	25,753	26,584	23,888	20,181	18,311	16,397
LPG	1,314	1,413	1,302	959	1,001	1,033	1,018
Diesel	3,600	3,524	4,881	9,811	13,642	15,679	16,714
Natural Gas	230	293	289	330	500	750	1,000
tot. fleet	27,645	30,983	33,057	34,988	35,324	35,772	35,129
Motorcycles	2,092	2,575	3,380	4,881	6,005	6,563	6,703
LDV	1,671	1,873	2,396	3,122	3,274	3,346	3,441
HDV	946	976	921	1,034	1,066	1,129	1,151
Total circulating fleet	**32,354**	**36,407**	**39,754**	**44,025**	**45,669**	**46,810**	**46,424**

Table 5.10: Transport (MtCO2) , Additional measures already established or planned

		2010	2015	2020
Total GHGs emissions in transport sector (trend scenario)		**139.7**	**148.6**	**152.2**
Implemented measures:	biofuels	2.39	2.41	2.17
Adopted / planned measures:	additional biofuels	-	6.03	8.69
	Lower emitting vehicles	2.96	7.08	9.10
	New infrastructure for public transport	-	1.35	4.50
Total emissions from transport sector (with measure scenario)		**134.3**	**131.8**	**127.8**

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 (0.7% year), and moderate penetration of gas, with consequent slight growth in CO_2 emissions (from 8.9 in 2000 to 9.7 Mton. in 2010 and 10.5 in 2020);
- buildings: a 0.5% yearly increase in the total square meters of all residential and services buildings is expected. The increase will be only partially offset by the estimated natural gas expansion, and by the expected efficiency gains, with a consequent increase in CO2 emissions (from 73.2 in 2000 to 81.1 Mton CO_2 in 2010 and 85.2 in 2020); The scenario is based on average weather conditions, in case of a severe winter emissions could be much higher, as was the case in 2005.
- electricity consumptions: consumptions from the residential sector are slightly increasing, 1.4% a/y, 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 2.5% a/y.

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 installation 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.

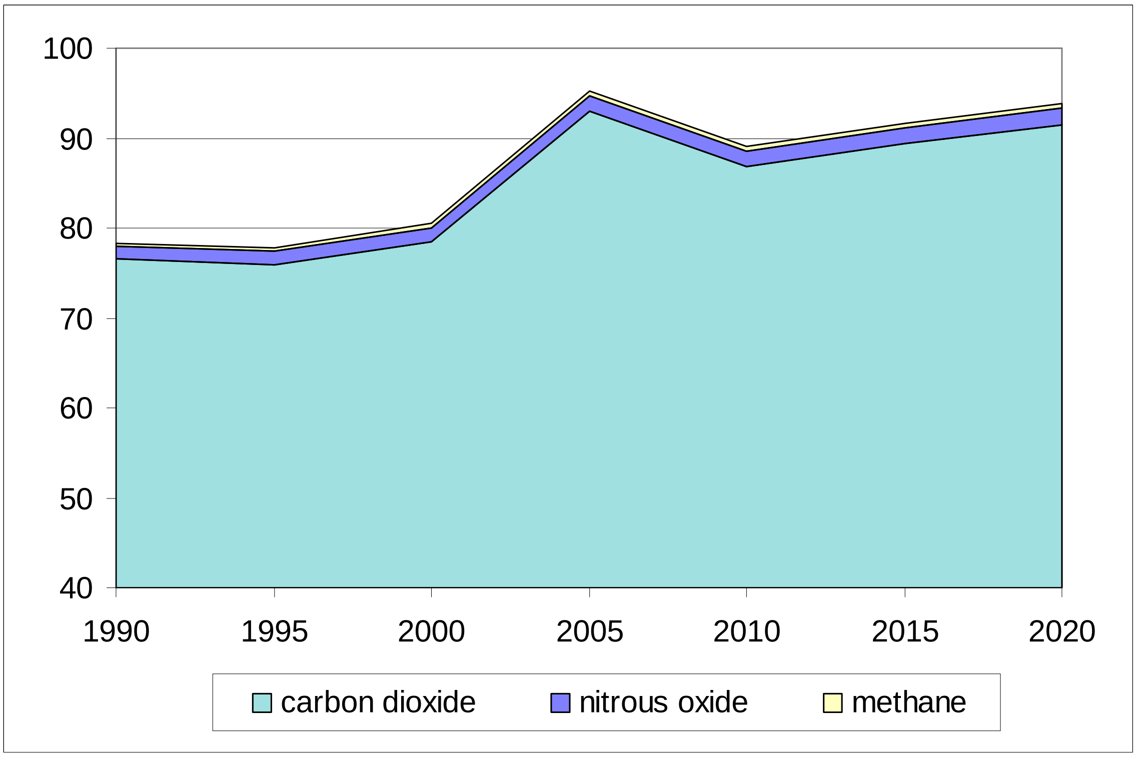
The effect of additional measure already established or planned in the civil sector is summarized in table 5.12. The measure indicated as energy efficiency in buildings, both implemented and planned, refers to the additional insulation of building shells, while the white certificates point to the increase of efficiency. The increase considered for building efficiency is partially already included in the trend scenario estimates and also the estimate consider a rather optimistic view of the possible effect of the measures. In this case it is difficult to define the amount of the double counting, so the entire effect of the measure is left in.

Table 5.11: Civil (MtCO2) , Additional measures already established or planned

		2010	2015	2020
Total GHGs emissions from civil (trend scenario)		**81.1**	**83.4**	**85.7**
Implemented measures:	energy efficiency	2.64	5.46	8.32
Adopted / planned measures:	white certificates	1.81	10.19	13.25
	energy efficiency in buildings	-	8.75	9.29
Total GHGs emissions, civil sector (with measure scenario)		**76.7**	**59.0**	**55.8**

The measure indicated as energy efficiency in buildings, both implemented and planned, refers to the additional insulation of building shells, while the white certificates point to the increase of efficiency. The increase considered for building efficiency is partially already included in the trend scenario estimates. In this case it is difficult to separate individuate the amount of the double counting, so the entire effect of the measure is left in for 2010.

Figure 5.12: Civil and agriculture sector, GHG emissions growth (Mt CO2 eq.)



Note: emission in 2005 shows a remarkable increase due to climatic conditions

Emissions from other sectors

Projections of emissions from industrial processes

Emission projections to 2020 for most industrial processes have been estimated using the growth rates shown in the Table 5.13 here below. They are consistent with those used in the Business as Usual scenario prepared by the Ministry for Economic Development. For aluminium production and for production and consumption of F-gases, information directly communicated from industry has been used. For SF_6 used in magnesium and aluminium foundries and for solvent and other product use, future trends have been estimated by means of an extrapolation of most recent data.

Table 5.13: Growth rates for the industrial processes 2005-2020

	1990 - 1994	1995 - 1999	2000 - 2004	2005	2006 - 2007	2008 - 2010	2011 - 2015	2016 - 2020
A. Mineral Products								
1. Cement Production	-2,59%	-0,04%	2,17%	*1,90%*	*1,90%*	*0,50%*	*0,50%*	*0,50%*
2. Lime Production	0,88%	-2,20%	4,33%	*2,00%*	*2,00%*	*0,50%*	*0,50%*	*0,50%*
3. Limestone and Dolomite Use	-1,76%	-1,10%	3,59%	*0,80%*	*0,80%*	*0,50%*	*0,50%*	*0,50%*
4. Soda Ash Production and Use	-3,61%	-1,31%	-2,60%	*1,20%*	*1,20%*	*1,20%*	*1,20%*	*1,20%*
5. Asphalt Roofing	0,00%	0,00%	3,00%					
6. Road Paving with Asphalt	-1,15%	4,63%	3,32%					
7. Other								
Glass Production (decarbonising)	2,20%	1,80%	1,01%	*2,50%*	*2,50%*	*1,20%*	*1,20%*	*1,20%*
Batteries Manufacturing	0,32%	12,33%	-1,14%					
B. Chemical Industry								
1. Ammonia Production	-11,59%	-7,60%	11,31%	*1,20%*	*1,20%*	*1,20%*	*1,20%*	*1,20%*
2. Nitric Acid Production	-9,74%	-5,33%	2,14%	*1,20%*	*1,20%*	*1,20%*	*1,20%*	*1,20%*
3. Adipic Acid Production	2,34%	1,50%	1,81%	*1,20%*	*1,20%*	*1,20%*	*1,20%*	*1,20%*
4. Carbide Production	-	-	-	-	-	-	-	-
5. Other								
Carbon Black	0,76%	0,50%	-0,21%	*0,60%*	*0,60%*	*0,60%*	*0,60%*	*0,60%*
Ethylene	2,36%	-1,76%	-0,82%	*0,60%*	*0,60%*	*0,60%*	*0,60%*	*0,60%*
Dichloroethylene	-2,05%	-4,00%	-20,00%	*0,60%*	*0,60%*	*0,60%*	*0,60%*	*0,60%*
Styrene	5,85%	1,61%	-2,38%	*0,60%*	*0,60%*	*0,60%*	*0,60%*	*0,60%*
Titanium dioxide	0,76%	-2,16%	-0,69%	*1,20%*	*1,20%*	*1,20%*	*1,20%*	*1,20%*
Propylene	-1,96%	0,03%	8,88%	*0,60%*	*0,60%*	*0,60%*	*0,60%*	*0,60%*
Caprolactame	0,00%	-3,17%	-20,00%	*1,20%*	*1,20%*	*1,20%*	*1,20%*	*1,20%*
C. Metal Production								
1. Iron and Steel Production								
Steel	0,48%	-2,15%	1,32%	*0,90%*	*0,90%*	*0,80%*	*0,80%*	*0,80%*
Pig Iron	-1,17%	-1,74%	-1,15%	*0,90%*	*0,90%*	*0,80%*	*0,80%*	*0,80%*
Sinter	-1,72%	-3,66%	-2,61%	*0,90%*	*0,90%*	*0,80%*	*0,80%*	*0,80%*
2. Ferroalloys Production	-9,89%	-5,58%	-11,57%	*1,80%*	*1,80%*	*1,80%*	*1,80%*	*1,80%*
3. Aluminium Production	-4,85%	1,06%	0,59%	*0,20%*	*0,20%*	*0,20%*	*0,20%*	*0,20%*
4. SF_6 Used in Aluminium and Magnesium Foundries	-	-	-9,04%					

Yellow	National Allocation Plan, 24 February 2005
Blue	Business as Usual scenario, Ministry for Economic Development
Pink	Alcoa (fino al 2012)

In the reference scenario the following measures have been included:

a) The reduction of 90% of N_2O emissions from the adipic acid production, starting from 2006, as a consequence of the introduction of a catalytic device abatement technology.

b) The implementation of the European Regulation n. 842/2006 regarding some F-gases.

c) The implementation of the European Directive 2006/40/EC regarding air emissions from air conditioning system on vehicles (MAC Directive)

d) The implementation of the European Directive 1999/13/EC regarding the reduction of VOC emissions due to the use of solvent (Solvent Directive)

e) The implementation of the European Directive 2004/42/EC to reduce VOC emissions due to the organic solvent use in decorative paint (DecoPaint Directive)

The resulting GHG emission scenarios by sector and by gases for 2010, 2015 and 2020 are reported respectively in Table 5.13 and in Table 5.14.

The specific intervention in the industrial sector, analyzed in chapter 4, imply a reduction in nitrous oxide emissions from the production of nitric acid with the adoption of the emission standard defined by BAT-TA Luft (2.5 kgN2O/tHNO3) to be applied to the main existing nitric acid production plants.
The effects of this measure are underlined in Table 5.15.

In Table 5.16 the trend scenario and scenario with additional measures are reported.

Table 5.13: Emission trend scenario of GHGs emissions by sector from the industrial processes and solvent use (MtCO2 equivalent)

	2005	**2010**	**2015**	**2020**
Mineral products	23.91	25.54	26.22	26.91
Chemical industry	9.08	4.13	4.36	4.60
Metal production	1.98	1.95	2.00	2.07
Production of halocarbons and SF_6	0.02	0.02	0.02	0.02
Consumption of halocarbons and SF_6	5.80	9.17	11.10	13.25
Total Industrial Processes	**40.79**	**40.80**	**43.69**	**46.85**
Solvent use	1.32	1.20	1.20	1.19
Total Industrial Processes and Solvent Use	**42.11**	**42.00**	**44.89**	**48.04**

Table 5.14: Emission trend scenario by gases from the industrial processes and solvent use (MtCO2 equivalent)

	2005	**2010**	**2015**	**2020**
CO_2	28.20	29.83	30.63	31.46
CH_4	0.06	0.06	0.07	0.07
N_2O	7.76	2.72	2.88	3.06
HFCs	5.27	8.59	10.48	12.59
PFCs	0.36	0.38	0.38	0.38
SF_6	0.46	0.42	0.44	0.48
Total GHG	**42.11**	**42.00**	**44.89**	**48.04**

Table 5.15: Evolution scenarios of N2O emissions from the industrial sector (MtCO2 equivalent)

	2005	2010	2015	2020
Reduction of N2O emissions from nitric acid plants	0,00	-1.40	-1.48	-1.57
Total additional measures	**0.00**	**-1.40**	**-1.48**	**-1.57**

Table 5.16: GHG trend scenarios with and without additional measures from the industrial processes and solvent use (MtCO2 equivalent)

	2005	2010	2015	2020
Total Industrial Processes and Solvent Use	**42.11**	**42.00**	**44.89**	**48.04**
Planned Measure: Emission reduction from nitric acid plants	0,00	1.40	1.48	1.57
Total Industrial Processes and solvent use with additional measures	**42.11**	**40.61**	**43.40**	**46.47**

Projections of emissions from the agriculture sector

Greenhouse gas (GHG) emission figures are different with respect to the Third National Communication because in the last years the agriculture emission inventory has been updated and improved thanks to different national research studies (Chapter 6 - APAT, 2007[24]). Besides, we have kept consistent methodologies for the preparation of national inventories under the Convention on Long-Range Transboundary Air Pollution and the United Nations Framework Convention on Climate Change (Cóndor and De Lauretis, 2007[25]; Cóndor, 2006[26]). Emission trends and projections up to 2020 have been estimated with data and models used for the preparation of the agriculture emission inventory (GHG and ammonia inventories).

Greenhouse gas emissions from the agriculture sector have decreased by 8.3% between 1990 and 2005. Furthermore, between 1990 and 2005, methane (CH_4) and nitrous oxide (N_20) emissions have decreased by 10.1% and 7.0%, respectively (see Table 5.18). Main sources have reported a reduction in emissions: enteric fermentation (-10.9%), manure management (-7.4%), agricultural soils (-7.2%) and rice cultivation (-6.3). Emission trends, between 1990 and 2005, are due to the reduction in activity data such as the number of animals and cultivated surface/crop production, mainly linked to CAP measures.

Between 1990 and 2005, the most important animal categories have experienced a reduction in number: dairy cattle (-30.3%) and non-dairy cattle (-13.7%); however, for swine and poultry there has been an increase of 9.5% and 8.8%, respectively. Consequently, emissions from enteric fermentation and manure management sources are mainly driven by a decrease in the number of animals. On the other hand, agricultural soils are the main source of N_2O emissions. Between 1990 and 2005, there has been a reduction (-7.2%) due to the decrease of N_2O emissions from the different sub-sources (animal waste applied to soils, n-fixing crops, crop residue, animal production, atmospheric deposition and nitrogen leaching and run-off). Only the synthetic fertilizer sub-source has experienced an increase of 2.8%. Then, N_2O emissions are mainly related to the reduction of number of animals (see Table 5.17) and the use of nitrogen fertilizers (see Figure 5.14).

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[24] APAT, 2007. Italian Greenhouse Gas Inventory 1990-2005. National Inventory Report 2005. APAT Report 2007. Rome - Italy.

[25] Cóndor, R. D., De Lauretis, R. 2007. Agriculture air emission inventory in Italy: synergies among conventions and directives. In: Ammonia Conference abstract book. Ed. G.J. Monteny,E. Hartung, M. van den Top, D. Starmans. Wageningen Academic Publishers. 19-21 March 2007, Ede - The Netherlands

[26] Cóndor R.D. 2006. Agricoltura. Oral presentation "Cambiamenti Climatici e inquinamento atmosferico. L'inventario nazionale delle emissioni come strumento di conoscenza e verifica dello stato dell'ambiente", 23-24 October 2006 Rome - Italy. Available at: http://www.apat.gov.it/site/_files/Doc_emissioni/RocioCondor.pdf

Table 5.17: Emission trend of main animal categories from 1990 to 2005

Year	Dairy cattle	Non- dairy cattle	Swine	Poultry
1990	2,641,755	5,110,397	8,406,521	173,341,562
1991	2,339,520	5,581,998	8,548,800	173,060,622
1992	2,146,398	5,425,617	8,244,400	172,683,589
1993	2,118,981	5,322,148	8,348,100	173,261,404
1994	2,011,919	5,156,841	8,023,400	178,659,192
1995	2,079,783	5,189,304	8,060,676	184,202,416
1996	2,080,369	5,093,563	8,171,092	183,044,930
1997	2,078,388	5,094,846	8,292,792	186,815,499
1998	2,116,176	5,013,332	8,322,625	198,799,819
1999	2,125,571	5,036,190	8,414,483	196,573,062
2000	2,065,000	4,988,000	8,307,000	176,722,211
2001	2,154,000	4,848,000	8,451,000	209,187,654
2002	1,910,948	4,599,149	9,166,258	205,524,395
2003	1,913,424	4,591,279	9,156,724	196,511,409
2004	1,838,330	4,466,271	8,972,072	191,315,963
2005	1,842,004	4,409,921	9,201,273	188,595,022

Source: ISTAT

Greenhouse gas emission trends have experienced a reduction of CH_4 and N_2O of 4.2% and 4.6%, respectively, with respect to 2005 (Table 5.18), having as a main driver the CAP 2003 reform. On the other hand, the agriculture sector has the possibility to further reduce GHG emissions. Therefore, two possible incentives have been considered for the preparation of emission projections: the rationalization in the use of nitrogen fertilizers (agricultural soils), and the recovery of biogas from animal storage systems (manure management), including already existing farms.

In Table 5.19, estimated reductions with additional measures are presented. We have applied a further reduction in the use of nitrogen fertilizer of 2.5% (2010) and 5% (2015, 2020), which accounts for reduction of N_2O emissions. For CH_4 emissions we have considered 10% (2010), 15% (2015) and 20% (2020) emission reduction from manure management, specifically applied to cattle and swine animal categories. In conclusion, the agriculture sector has opportunities to further reduce GHG emissions with additional measures, and simultaneously produce renewable energy.

Table 5.18: Emission projections (trend scenario)

	1990	1995	2000	2005	2010	2015	2020
Total CH4 emissions (Gg)	819.8	820.1	801.7	737.1	732.3	710.7	705.9
Total N2O emissions (Gg)	75.4	74.6	74.5	70.1	68.6	67.5	66.9

Figure 5.14: Consumption of nitrogen fertilizers in Italy from 1990 to 2005

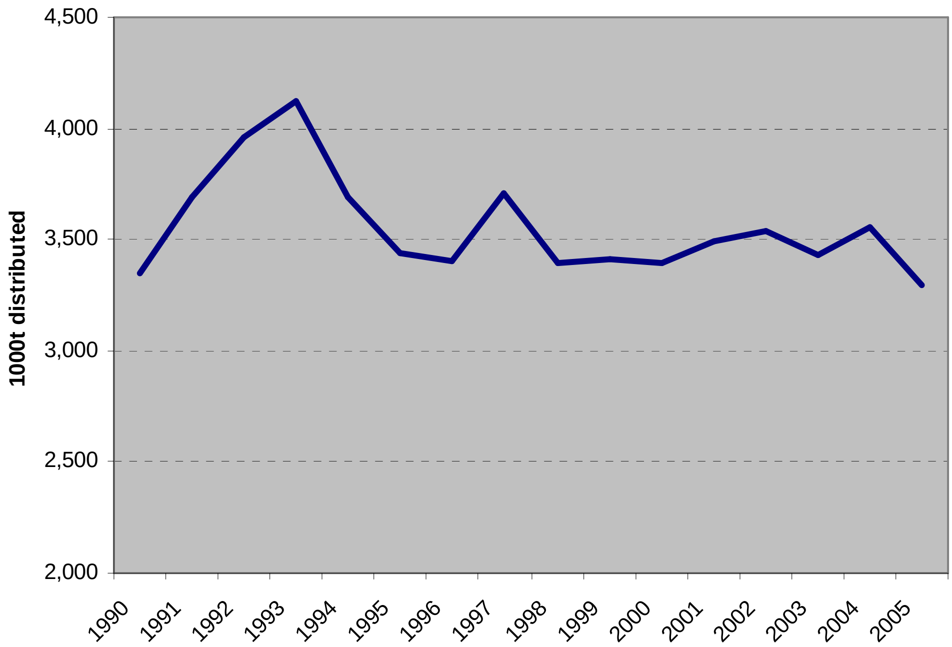

Table 5.19: Emission projections (trend scenario)

Greenhouse gas emissions (Mt CO_2 eq.)	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Enteric Fermentation	12.18	12.27	12.16	10.85	10.76	10.29	10.24
Manure Management	7.38	7.07	7.14	6.84	6.81	6.80	6.75
Rice Cultivation	1.56	1.66	1.38	1.46	1.45	1.49	1.49
Agricultural Soils	19.44	19.34	19.24	18.04	17.61	17.26	17.07
Field Burning of Agricultural Residues	0.02	0.02	0.02	0.02	0.02	0.02	0.02
TOTAL agricultural sector (trend)	**40.58**	**40.35**	**39.94**	**37.21**	**36.65**	**35.85**	**35.56**
Planned measure: Reduction of N_2O from agricultural soils					-0.18	-0.36	-0.36
Planned measure: Reduction of CH_4 from manure management					-0.32	-0.47	-0.62
TOTAL agricultural sector (with measures)					**36.15**	**35.02**	**34.58**

Projections of emissions from the LULUCF sector

CO_2 emissions and removals projections data for 2005, 2010, 2015 and 2020 have been provided for a *Business as usual scenario* (BAU) scenario, estimated by keeping emission factors consistent with inventory data as suggested by UNFCCC[27].

The driving forces for projections estimations are activity data linked to the LULUCF sector; in particular, given the decision about the elected activities under Article 3.4 of Kyoto Protocol, "*Forest Land*" activity data constitute the key variables to project removals by sinks.

Key drivers have been identified in

- → forest management: assessment of forest area for the period 2005-2020 was made through data extrapolation, starting from the consolidated time series 1990-2005.
- → afforestation/reforestation: area has been defined following the positive trend individuated in the period 1990-2005.
- → harvested area, burned area by forest fires: data extrapolation was made, from the available time series.

All the data concerning the growing stock and the related carbon are assessed by a model[28], estimating the evolution in time of the Italian forest carbon pools, according to the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* classification and definition: living biomass, both aboveground and belowground, dead organic matter, including dead wood and litter, and soils as soil organic matter. The model has been applied at regional scale (NUT2), for the period 1985[29] – 2020.

Total commercial harvested wood, for construction and energy purposes, as well as burned area, for forest fires, have been obtained from national statistics.

Consistency with data reported in GHG inventory latest submission has been checked.

The analysis takes into account CO_2 removals related to articles 3.3 and 3.4, including the forest carbon pools individuated in IPCC Good Practice Guidance for LULUCF, from 2000 to 2010.

Referring to art. 3.3 activities, CO_2 removals related to afforested and reforested land are reported. Value referring to 2010 has been obtained as an average of the period 2008-2012 values, coherently with chosen accounting method[30]. Activities planned in the framework of the *National Registry for Forest Carbon Sinks*[31] should provide data to improve estimate of carbon sequestration due to Afforestation/reforestation activities. Up to now, the data which has been reported constitutes the best available estimate.

It has to be noted as, regarding art. 3.4, the initial cap (for 2000 and 2005) has been reported, while current cap has been reported for 2010. Data concerning art. 3.4 for 2015 and 2020 have to be negotiated in the framework of the Convention on Climate Change in the context of the definition of the national engagement for the second commitment period.

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[27] UNFCCC, 2004. *Report on the workshop on emission projections from Parties included in Annex I to the Convention* (FCCC/SBSTA/2004/INF.15; 20 October 2004).

[28] Federici S., Vitullo M., Tulipano S., De Lauretis R., Seufert G. , 2005. *A tool for estimate of forest carbon stocks under UNFCCC: the Italian case*, submitted.

[29] The Italian Ministry of Agriculture and Forests (MAF) and the Experimental Institute for Forest Management (ISAFA) carried out the first National Forest Inventory in 1985. A second national forest inventory, using a grid of 1 km by 1 km, had been launched in 2001. Preliminary results of the first inventory phase, consisting in interpretation of orthophotos, were used as input data for the model. This source of information refers to the 2002.

[30] Italy intends to account for every Article 3.3 and 3.4 elected activities for the entire commitment period

[31] The so-called "National Registry for forest carbon sinks" is part of the Italian National System; it is the instrument to estimate, in accordance with the COP/MOP decisions, the IPCC Good Practice Guidance on LULUCF and every further IPCC advise, the greenhouse gases emissions by sources and removal by sinks in *forest land* and related land-use changes and to account the net emissions in order to allow the Italian Registry to issue the relevant amount of RMUs

Table 5.20: Evolution scenarios of carbon dioxide removals from land use, land-use change and forestry (LULUCF) activities under Article 3.3 and 3.4 of the Kyoto Protocol (MtCO2)

	2000	2005	2010*	2015	2020
			Mt CO_2		
Art. 3.3	-14.3	-14.8	-15.1	*to be negotiated*	*to be negotiated*
Art. 3.4	-0.66	-0.66	-10.2	*to be negotiated*	*to be negotiated*
Total	**-14.9**	**-15.5**	**-25.3**	**-**	**-**

* *Value referring to 2010 has been obtained as an average of the period 2008-2012 values*

Table 5.21: Evolution scenarios of carbon dioxide removals from land use, land-use change and forestry (LULUCF) sector (MtCO2)

Greenhouse gas emissions	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
				Mt CO_2			
Total **LULUCF (trend scenario)***	**-79.8**	**-97.1**	**-110.0**	**-110.0**	**-105.0**	**-106.5**	**-107.7**
Planned measure: Art 3.3 e 3.4**	-	-	-	-	**-25.3**	*to be negotiated*	*to be negotiated*

* Data are consistent with the UNFCCC GHG inventory

** Data are related to the LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol; data concerning art. 3.3 and art. 3.4 for 2015 and 2020 have to be negotiated in the framework of the Convention on Climate Change in the context of the definition of the national engagement for the second commitment period.

Projections of emissions from the waste sector

A 7.9% increase in the emissions of greenhouse gases from waste management has been recorded between 1990 and 2005 (0.5% average yearly increase), with increases due to landfills (8.6%), wastewater (12.2%), composting (1,777%) and decreases due to incineration (-24.9%), in terms of CO_2 equivalent.

The following projections have been prepared in conformity with most recent inventories and evaluations on the implementation of the mitigation measures foreseen in the Third National Communication. Due to the improvements in the methodologies used to estimate emissions from the waste sector, especially from landfills, emissions figures are different from those reported in the last National Communication.

The projections include a trend scenario based on the actions that have already been put into effect, and examine the effects of two possible mitigation interventions.

National circumstances regarding waste management are very different from northern to southern regions. The southern regions are late with the complying of national targets for separate collection and biodegradable waste disposed of into landfills: as a consequence, national emissions trend could not be based on the optimistic outlook of the fulfilment of the deadlines set up by the current legislation.

According to these projections, as shown in the trend scenario in Table 5.22, a 22% reduction can be expected in overall greenhouse gas emissions from the waste sector, expressed in terms of CO_2 equivalent, essentially as a result of a reduction in methane emissions from landfills. This reduction is clearly more significant than the increase in CO_2 emissions from waste incinerators with energy recovery.

In the reference scenario the total amount of waste has been estimated on the basis of official population forecasts provided by the National Institute of Statistics (ISTAT) and on the assumption of a sharply increase of the waste production until 2010 and a stable increase from 2010 to 2020.

As concerns waste management practices, it has been assumed that:

- separate collection of municipal solid waste (MSW) will increase but not in line with the target provided by current legislation (D.lgs. 152/2006, L. 296/2006), because of the situation of southern regions;
- consequently the amount of biodegradable waste disposed of into landfills is not totally complying with the target of landfill directive (D.lgs. 36/2003);
- the share of landfill gas collected will reach 50% in 2020;
- the amount of waste treated in MBT plants and incinerators will increase in line with the strategy to pre-treat wastes in order to obtain a bio-stabilized waste to dispose of into landfills and a dry-fraction and RDF to burn in waste to energy (WTE) facilities.

Furthermore, it has been assumed that as from 2010, every incinerator treating municipal waste will be equipped with an energy recovery system. Two additional interventions aimed at reducing greenhouse gas emissions, in particular methane emissions, from the waste-management cycle are also evaluated. Both interventions are linked to support the municipalities in the fulfilment of the deadlines set for the MSW source separate collection and consequently to setting in line of waste-management cycle, including the reduction of biodegradable waste into landfills.

Table 5.22: Emission forecasts for the Waste sector (trend scenario)

Carbon dioxide emissions (Gg)	1990	1995	2000	2005	2010	2015	2020
Waste incineration	536.9	483.0	201.6	165.5	123.7	104.0	84.3
Total waste sector	**536.9**	**483.0**	**201.6**	**165.5**	**123.7**	**104.0**	**84.3**
Methane emissions (Gg)							
Landfills	633.2	750.2	801.2	687.5	560.5	512.9	454.8
Wastewater treatment	93.7	104.5	108.7	110.6	119.3	128.2	136.8
Waste incineration	7.6	12.9	11.9	14.1	14.1	14.1	14.1
Waste composting	0.0	0.0	0.1	0.2	0.2	0.3	0.4
Total waste sector	**734.6**	**867.6**	**921.9**	**812.4**	**694.1**	**655.4**	**606.1**
Nitrous oxide emissions (Gg)							
Wastewater treatment	5.8	5.6	6.1	6.2	6.4	6.5	6.7
Waste incineration	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Total waste sector	**6.1**	**6.0**	**6.5**	**6.6**	**6.8**	**6.9**	**7.1**
Carbon dioxide emissions in the energy sector (Gg)	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Waste incineration	568.6	834.5	1,330.8	2,789.3	2,804.5	3,341.8	3,879.1

The first intervention consists in complying with the deadlines for the MSW separate collection, set in D.lgs. 152/2006 and in the last financial law (L. 296/2006), which fix an yearly increase of 5% of MSW separate collection, with the targets of 35% for 2006 and 65% for 2012. Actually, in 2005 the percentage of waste separation is 24.3%. Moreover, the MBT facilities will be able to work at full capacity and the measures should include the conforming of landfills to the new standards, in order to reach in time the targets of landfill directive.

A further measure regard the pre-treatment of all the biodegradable wastes which will be disposed into landfills, encouraging the anaerobic digestion of MSW also in co-digestion with other type of waste such as sludge from municipal waste water treatment plants and animal waste. This practice will increase also the energy recovery from the biogas production. The effects of the two aforementioned interventions on the emission growth from the waste sector are shown in the table 5.23.

Table 5.23: Evolution of emissions of greenhouse gases from the waste sector (MtCO2 equivalent)

	1990	1995	2000	2005	2010	2015	2020
Landfills	13.3	15.8	16.8	14.4	11.8	10.8	9.6
Wastewater treatment	3.8	3.9	4.2	4.2	4.5	4.7	4.9
Waste incineration	0.8	0.9	0.6	0.6	0.5	0.5	0.5
Waste composting	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total waste sector (trend scenario)	**17.8**	**20.6**	**21.6**	**19.3**	**16.8**	**16.0**	**15.0**
Implemented measure: compliance with separate collection targets and bio - degradable waste disposed of into landfills					1.8	2.4	2.7
Planned measure: Only bio-stabilized waste disposed of into landfills					-	4.6	4.4
Total waste sector (scenario with measures)					**15.0**	**13.6**	**12.3**

Energy forecasts and effects of policies and measures

Formulation of new scenarios – methodology

The scenarios of greenhouse gas emissions from the combustion of energy sources are drawn from the Markal – Italy model[32], based on the well known Markal software[33]. The trend scenario used for this National Communication is the latest reviewed output of the model available, published by ENEA in 2007 in its "Rapporto Energia e Ambiente – 2006"[34].

The model is a partial equilibrium model and represents the domestic energy system and it main emissions. It represents over 70 independent demand for energy services in four main sectors – agriculture, industry, transport, commercial and household – split by subsectors, type of service and material. For instance the industrial sector is split in the following subsectors: iron and steel, non ferrous, bricks and tiles, chemical, paper, mechanical, textile, building, and others. For instance the demand for space heating is expressed in square meters of new or existing households, single or multi-family, central or small boilers, at different level of insulation. Demand and supply curves of each commodity are specified stepwise by set of technologies, for a total of over one thousand. Import and export options are include in most demand / supply curves. Emissions of CO_2 are directly accounted for using IPCC "reference approach" methodology and national Emission Factors.

The basic year of the model is 2004, modelled years go up to 2050. The model follows a bottom-up technological approach: start from a single sector, or sub-sector, and 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).

Structure and data of the full model, including the very detailed parts on end use devices that satisfy the 70 demands for energy services are summarized in [Contaldi, Gracceva, 2004]. Below some additional details are reported for the two most important sectors from the emission trend point of view:

- **Transport**: modelling is based on detailed disaggregation, which accounts for both goods and passenger transport. All modes are included, road, railway, air and water. With regard to road, the modelling of the Italian car fleet (petrol, diesel, gas-powered cars), 2 –wheelers, heavy vehicles and busses is provided. The analysis also considers such variables as passengers-km, tons-km, mileage, occupancy rates and unit consumptions (litres-km). The latter perform a similar function than the role covered by energy intensity in other sectors**.**
- **Energy industry**: the technologies represent all fossil fuels power plants in operation in 2000, including diesel engines. In the following periods, when existing power plants gradually go out of service, the growing demand is met by copies of the main existing technologies or more efficient combined cycles, integrated coal gasification, fluid bed cycles, fuel cells, CHP plants or renewable power plants (geothermal, wind, PV, hydro run of the river, mini hydro, solid waste, biogas and biomass). CO_2 sequestration is modelled, but not active up to 2020.

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[32] The model has been first developed in the early nineties to evaluate GHG emissions reduction potential and costs [Contaldi, Tosato, 1995]. It has been used to prepare scenarios to evaluate mitigation policies in the first and second national communication to the UNFCCC [Gaudioso et al., 1995; Tosato et al., 1999]. In recent years it has been used to assess effectiveness and impact of different carbon tax schemes [Contaldi, Tosato, 1999] and to prepare energy input scenario to be used by Rains model at IIASA [Ministero Ambiente, 2003] for National Emission Ceiling directive update and CAFE program.

[33] Markal (MARKet ALlocation) has been developed by the Implementing agreement of the International Energy Agency for a programme of Energy Technology System Analysis (IEA/ETSAP). The "Second Assesment Report" of IPCC (IPCC, 1995) suggest using Markal models to evaluate impact of mitigation policies. Source code is open, regularly maintained and documented.

[34] http://www.enea.it/

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.

Trend scenario, main variables and energy consumptions

Economic assumptions

The economic development is shown in table 5.24 and 5.25. The growth forecast is prudent, takes into account the fact that Italy is growing always less than the other EU partners. In any case a constant growth of 1.6% for a long period can accommodate period of high growth as at present, balancing it with years of very low or 0 growth. The average of last three years (2004-2006) is about 1.3%.

Table 5.24 – Economic growth in trend scenario

	2004	2010	2020
GDP (billions €95)	1052	1151	1310
GDP (yearly aver.)	-	1,5%	1,6%

Table 5.25 – Evolution of production structure, by sector

	1990	2004	2010	2020
Agriculture	3,1%	3%	2,9%	2,6%
Industry	30,5%	27,9%	27,6%	26,8%
Services	66,4%	69%	69,5%	70,6%

In the last thirty years the energy intensity of GDP constantly developed at annual rates that only during oil crisis were larger than 1% per year (see figure 5.15). In the reference scenario the energy consumption increases by 1.2% per year until 2010, by 0.8% between 2010 and 2020. As a result the energy intensity decreases by an average 0.6% per year between 2005 and 2010 and at higher rate between 2010 and 2020. In other word reference scenario assumes important increases in energy efficiency, with a strong dynamics particularly after 2010.

In figure 5.16 the evolution of per capita energy consumption is reported, both historical and forecasted. By 2020 the per capita consumption could reach the average actual EU 15 level, in trend scenario, if no additional measures are implemented.

Figure 5.15: Energy intensity in trend scenario (ktoe/M€)

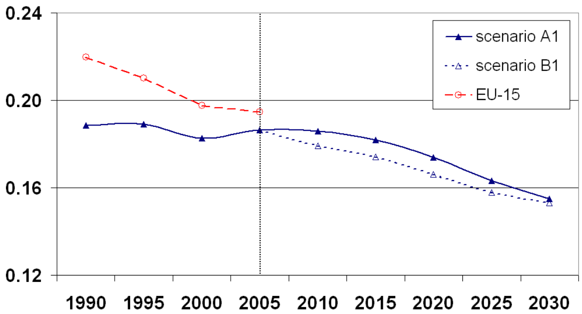
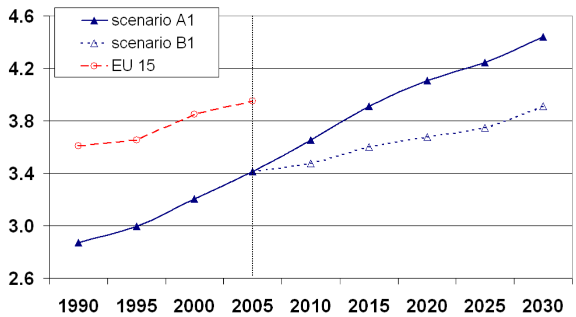
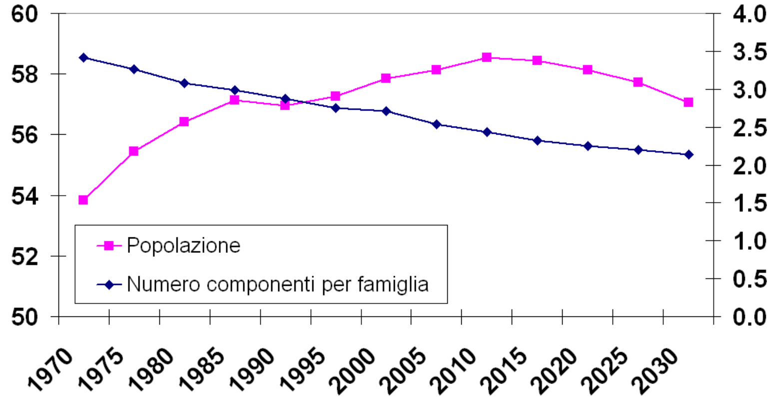


Figure 5.16: Per capita energy consumption, trend scenario (toe/cap)



The trend for population and the number of persons per family (important driver for household consumption) are reported in figure 5.17.

Figure 5.17: Population ("popolazione") and number of persons per household ("numero componenti per famiglia") (mln of people, number of persons per family)



A main variable concerns the estimate of 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 40–60 $/barrel, 2003 US dollars.

Forecasts on coal import prices in Italy are in the range of 34 $/ton and a light increase (half of oil prices) is foreseen in the period up to 2020. Gas prices at the Italian border have been forecasted also in relation with oil quotations: until 2020, 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 energy balances for the years 2005 (final balance), 2010 and 2020 (forecasts) are provided in Table 5.26 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 2005-2020 period can be summarized as follows:

- 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%).

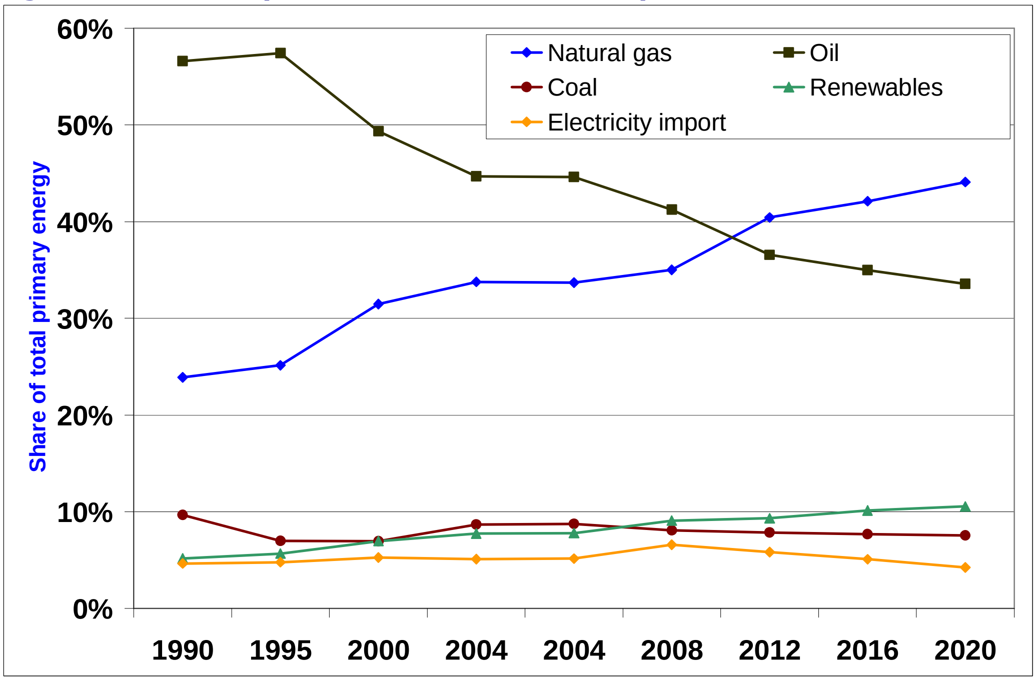
These trends indicate an increase in the relative burden of gas, whose quota, among fuels, passes from 24% to 28%. Oil and coal quota, instead, decrease from 37.7% to 33.7% and from 5.3% to 5%, respectively. The electricity quota is stationary, around 27%. The absolute value of renewable sources increases too, also on account of the obligation required through the green certificates.

Table 5.26: Trend scenario of energy consumption, national account methodology

Primary Energy		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Primary Energy								
Natural Gas	Mtoe	39.1	44.8	58.4	71.2	79.1	91.8	100.7
Oil	Mtoe	92.5	95.7	91.5	85.2	81.1	78.0	76.9
Coal	Mtoe	15.8	12.5	12.9	17.0	16.6	16.9	17.2
Renewables	Mtoe	8.4	10.4	12.9	13.5	19.2	22.0	24.4
Electricity import	Mtoe	7.6	8.2	9.8	10.8	12.8	11.5	9.7
Total	Mtoe	**163.4**	**171.6**	**185.4**	**197.8**	**208.7**	**220.3**	**228.9**
ELETTRICITY		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Request from grid	TWh	**235.1**	**261.0**	**298.5**	**330.4**	**367.1**	**408.0**	**443.0**
Fuels for electricity generation (include cogeneration and district heating)								
Natural Gas	Mtoe	8.0	9.3	20.8	28.5	33.8	42.5	47.3
Oil	Mtoe	22.5	26.1	20.6	9.4	7.3	4.4	1.9
Coal	Mtoe	8.4	6.1	7.3	11.7	12.3	11.8	12.3
Renewables	Mtoe	7.7	9.2	12.3	11.8	15.9	18.0	19.8
Others	Mtoe	0.2	0.4	0.6	0.9			
Total	Mtoe	**46.9**	**51.1**	**61.6**	**62.3**	**53.4**	**58.6**	**61.5**
Net electricity production								
From fossil fuels	TWh	166.7	183.6	206.3	234.9	243.5	276.9	311.5
Big Hydro	TWh	37.3	37.3	35.5	28.5	42.4	41.7	45.1
Small hydro	TWh	7.4	7.4	8.1	7.0	7.6	7.6	7.6
Geothermal	TWh	3.2	3.4	4.4	5.0	6.0	6.9	7.4
Wind + FV	TWh	0.0	0.01	0.6	2.3	8.4	12.9	16.0
Biomass / biogas	TWh	0.3	0.3	1.8	5.7	4.5	5.8	7.6
Sub total renewables	TWh	48.2	48.5	50.4	48.5	68.9	74.9	83.7
total	TWh	**214.9**	**232.0**	**256.7**	**283.4**	**312.4**	**351.8**	**395.2**
End Uses		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Industry	Mtoe	36.5	36.9	39.5	41.1	42.7	44.5	46.8
Civil	Mtoe	35.4	37.6	39.9	45.8	48.8	52.1	54.7
Transport	Mtoe	33.6	37.8	41.5	44.3	47.3	50.6	53.4
Agriculture	Mtoe	3.1	2.9	3.2	3.4	3.5	3.6	3.8
Non energy	Mtoe	8.3	7.9	7.5	8.2	7.9	8.0	8.0
Bunkers	Mtoe	2.6	2.4	2.7	3.5	3.8	4.3	4.6
total	Mtoe	**119.5**	**125.5**	**134.3**	**146.2**	**154.0**	**163.1**	**171.2**
Energy Emissions		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Tot. CO2 (direct model output), Mt					466.3	467.7	485.1	502.7
Indexes		**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Population		56,953	57,269	57,844	58,228	58,531	58,471	58,123
GDP, billion €95		867	923	1015	1066	1146	1240	1338
TPES / capita, Mtep/ cap.		2.87	3.00	3.21	3.41	3.55	3.75	3.92
CO2 / capita, t_{CO2}/cap.			7.87	7.89	8.01	7.99	8.30	8.65
TPES / GDP, Mtep/10^3 €$_{95}$		0.189	0.189	0.183	0.186	0.181	0.177	0.170
Electricity intensity		0.271	0.283	0.294	0.311	0.319	0.328	0.330
CO2 / TPES, Mt/Mtep			2.58	2.46	2.35	2.25	2.21	2.21

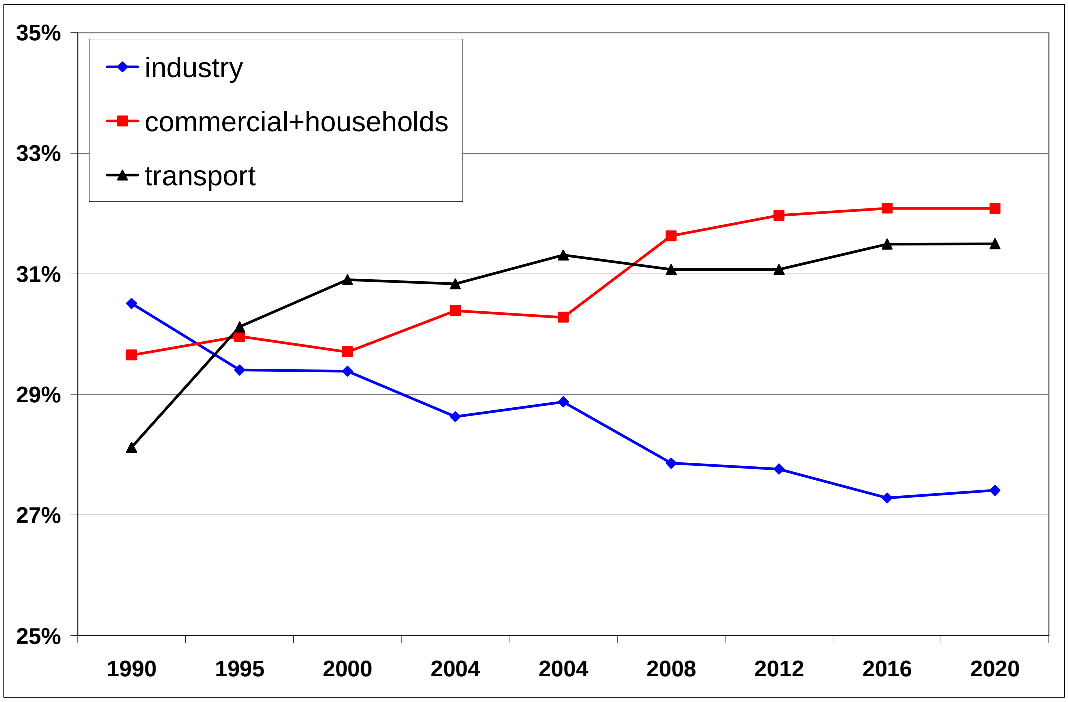
In fact, the slight growth in terms of primary energy corresponds to a more significant growth in terms of generated TWh, thanks to the increase in efficiency recorded over the years. Hydroelectric sources and other renewable sources, that yielded, respectively, 50 TWh and 7.5 TWh in 2000, will yield 42.5 and 11,5 respectively to 2010.

Figure 5.18: Primary sources in trend scenario (% on TPES, national accounting methodology)



At sectorial level industry is the sector with lower increase of energy consumption, also because the relative weight of energy intensive sector will decrease. Since 2010 the sector with the higher energy consumption will be the civil sector.

Figure 5.19:Final energy consumption, by sector (% on total final consumption)



Scenario with additional measures, the Kyoto objective

The effect on total emissions of all measures not considered in the trend scenario is reported in Table 5.28. The Table summarize the effects of the additional measures described in details in chapter 4 and also summarized in previous paragraphs that describe the emissions of trend scenario at sectorial level. The potential overall emission reduction achievable through the implementation of all those measures is reported separately for the implemented and the adopted / planned measures and the estimated reduction values take into account the potential double counting of emission reduction of renewable sources.

Additionally to those measures it has also to be considered the effect of the emission cap decided by the EU Commission for the industries subject to Emission trading Directive (195.7 Mt). This cap reduces of 13.2 Mt CO2 the emissions allowance from the value proposed in the NAP. The potential reduction of emissions due to Emission trading Directive is higher, because the total cap proposed by the Italian government was already lower than the trend scenario. The total potential effect of the emission trading directive could be estimated up to 34.4 Mt if the original trend value in the proposed NAP for 2008 – 2012 is considered. However there are to big uncertainties that prevent from considering the total possible effect:

- there is a potential double counting of emission reduction with all other additional measures already considered in chapter 4 for the industry / energy sector;
- at the date of the preparation of the estimates the relative weight of the installations subject to trading in the trend emission scenarios of industry / energy sector was unknown due to a lack of data;
- therefore only the effect of the cut in emission (13.2 Mt) decided by the Commission can be considered certainly not included in the trend scenario or in the additional measures.

In the table the effect of the actions on forestry sector is considered separately. This is due to an uncertainty present in the potential value of this measure for 2010 and in the years following the Kyoto period. The amount of avoided emissions due to art. 3.4 is due to a cap, negotiated during UNFCCC sessions and the reported value for art. 3.3 is the maximum possible.. The negotiate on the post Kyoto period is still to start and it outcome cannot be foresee. An additional uncertainty is due to the effective realization of the forestry inventory required to account for art. 3.4 emissions reduction. The needed actions have been decided but still have to be fully financed.

The additional measures already implemented would bring the total emissions to 539 – 611 Mt respectively in 2010 and 2020. Relatively to the Kyoto objective this would leave a gap of about 53 Mt.

Considering the effect of the additional measured already planned and the possible additional emissions reductions acquired abroad using the flexibility mechanisms up to the 20% of the gap between trend scenario and Kyoto objective, there will be a residual gap of about 20 Mt. The additional measures needed to close this gap are still under investigation by the competent institutions and they will be included in the national strategy to mitigate climate change, taking also into account the spring 2007 EU council conclusions.

Table 5.28: Summary table of trend scenario and effect of measures, Mt CO2 eq.

	1990	1995	2000	2005	2010	2015	2020
Total GHG emissions, all sectors, LULUCF excluded	**516.8**	**530.9**	**551.6**	**579.5**	**587.0**	**607.8**	**623.4**
increase from 1990		*2.7%*	*6.7%*	*12.1%*	*13.6%*	*17.6%*	*20.6%*
Emission reduction due to implemented measures					7.41	11.72	14.96
Emission reduction due to emission trading cap by EU Comm. for period 2008-2012					13.25	-	-
Certified emission reductions already acquired from the Italian Carbon Found					3.42	-	-
- emission reductions possible with art. 3.3 and 3.4, provided the national forestry inventory is prepared					25.30	-	-
Total effect of measures already implemented					49.38	11.72	14.96
Scenario with the effect of all implemented measures	**516.8**	**530.9**	**551.6**	**579.5**	**537.6**	**596.1**	**608.4**
increase from 1990		*2.7%*	*6.7%*	*12.1%*	*4.0%*	*15.3%*	*17.7%*
Kyoto objective					**483.3**	-	-
Distance from the objective					53.12	-	-
Emission reduction with planned measures					16.54	70.58	97.11
Certified emission reductions to be acquired by JI / CDM (20% of gap)					17.32	-	-
Assigned amounts units acquired from other countries					?	-	-
Scenario with the effect of all possible measures	**516.8**	**530.9**	**551.6**	**579.5**	**503.7**	**525.5**	**511.3**
increase from 1990		*2.7%*	*6.7%*	*12.1%*	*-2.5%*	*1.7%*	*-1.1%*

Source: APAT elaborations

Scenarios of the II / III NC (Second and Third National Communication)

As required by the methodology an outline of the emission scenarios contained in the SNC, published in 1998, and third NC, published in 2002 is reported in order not to leave anything out.

Table 5.29 below reports emissions from energy sector and total GHGs emissions in II, III and IV NC. As can be seen there is a remarkable stability of projections of the emissions from the energy sector for the year 2010, with a range of +-2%, confirmed by historical data up to 2005. For the other sector it has to be underlined that the methodology for the emissions calculations (IPCC guidelines) have been deeply changed between 1997 and 2004, therefore projection have been developed with different methodology and assumptions. In the following paragraphs a detailed description of methodology used to produce the energy scenario of second and third national communication is reported.

Table 5.29: Historical record of b.a.u. emissions scenario, Mt

	1990	1995	2000	2005	2010	2015	2020
Tot CO2 from energy, Mt, II NC	**399.0**	**413.0**	**430.0**	**445.0**	**485.0**	**-**	**-**
Tot CO2 from energy, Mt, III NC	**408.4**	**416.5**	**435.1**	**438.6**	**466.2**	**494.1**	**534.3**
Tot CO2 from energy, Mt, IV NC	**405.4**	**418.4**	**438.0**	**465.3**	**476.5**	**496.5**	**510.3**
TOTAL GHGs, II NC	**548.0**	**558.8**	**?**	**587.8**	**618.5**	-	-
TOTAL GHGs, III NC	**521.0**	**525.1**	**546.8**	**548.3**	**579.7**	**614.4**	**660.3**
TOTAL GHGs, IV NC	**516.8**	**530.9**	**551.6**	**579.5**	**587.0**	**607.8**	**623.4**

Second National Communication

Two methodologies had been adopted to formulate 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 organizational 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 or official projections on the energy sector alone up 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; the basic assumption of the model are described in the following paragraph and they are summarised in Table 5.30.

In the second approach, 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 abovementioned policies and measures. On the whole, similar measures were selected from the optimization model. This approach allowed to investigate the impacts of a series of policies approved or forecasted through interactions between the basic scenarios (defined as the "basis of calculation") and the Markal model. The use of the latter methodologies implies some approximation due to the difficulty to provide accurate evaluation of the effects of different overlapping measures on emissions.

The "basis of calculation" scenario of II NC

This scenario has reproduced, to some extent, the projections attainable from the b.a.u. 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 the most recent (in 1997) elasticity (consumption/income) values to 2010 for electricity and for the transport sector, which lead 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 MtCO2/year, with stability of coal quantities, methane increasing up 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 was assumed possible to reduce primary energy requirements to 193 Mtoe/year, and emissions to 470 MtCO2/year. 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 5.30: Main evolution hypotheses to 2010

	1990	1995	2000	2010
Population (millions)	56,7	57,3	57,3	56,5
GDP (thousand billions of 1990)	1311	1386	1530	1865
Annual average growth rate		1,1	2,0	2,0
Industrial production (index)	100,0	106,9	118	145
Family consumptions (thousand billions 1990)	1041	1093	1207	1471
Passengers Km (in billions of Pass. km)	717	824	878	994
Tons Km (in billions of Ton. km)	230	244	272	331

Source: Second National Communication, chapter 6

Third National Communication

The scenarios of greenhouse gas emissions from the combustion of energy sources are drawn from the CEPRIG model (Emission Calculation and Policies for the Reduction of Greenhouse Gases), based on the System Dynamics approach. The CEPRIG model formally elaborates statistical and/or econometric data, obtained by means of differential equations.

The basic year of the model was 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. The model follows a bottom-up approach: start from a single sector, or sub-sector, and 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 price scenarios divided per energy sources (coal, gas, oil, fuel oil, and electricity).

As far as fuel shares are concerned, they are dynamically linked to prices: the low price of a source of energy helps its expansion, and vice-versa. From these 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 synthesized 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.

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 breakdown, 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 plant level 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. 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.

Trend scenario, main variables and energy consumptions of III NC

At aggregate level, the scenario indicated a 2% increase in GDP. A stationary trend was expected for population. The yearly average growth rate of greenhouse gas emissions up to 2010 was 0.8%. The annual average growth rate of consumptions until 2010 was 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 estimate of 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 where forecasted to be in the range of 22 dollars/barrel. Forecasts on coal import prices in Italy were 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. 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 forecasted over the 2000-2010 period can be summarized as follows:

- 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% obligation required through the green certificates.

In fact, the slight growth in terms of primary energy corresponds to a more significant growth in terms of generated TWh, thanks 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 produce 52.5 and 11,5 respectively to 2010.

CHAPTER 6
IMPACTS, VULNERABILITY AND ADAPTATION

Environmental Changes Observed In Italy
Introduction

Italian climate is widely influenced by the presence of the Mediterranean Sea. It is the largest closed basin in our planet. It is, also, characterized by strong contrasts between the sea, principally by the eastern and western side separated by the Sicily channel, but also from the southern and northern part of the basin due to the key processes like deep convection in the Gulf of Lion and in the North Adriatic Sea, and the complex morphology of the coasts and the orography. Regarding the atmospheric circulation, the Mediterranean and Italy are, in summer, generally influenced by tropical air masses, and, in winter, mainly by western air masses.

The variability of these circulation patterns and the interactions with such a complex system, make the Mediterranean a particularly vulnerable region to climate change, and sensitive both to the global phenomena and to events at regional and local scale.

The following figures 1 and 2, show the values of atmospheric concentrations for some greenhouse gases measured at the ENEA climate stations in Lampedusa (35.5°N, 12.6°E) and Plateau Rosa (45.9°N, 7.7°E) and at the Air Force weather station in Monte Cimone (44.2°N, 10.7°E).

Figure 6.1: CO2 atmospheric concentration measured at Lampedusa e Plateau Rosa (ENEA), Monte Cimone (Air Force). Apadula, 2005

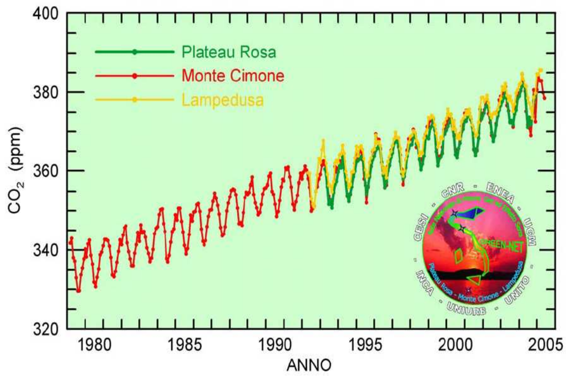
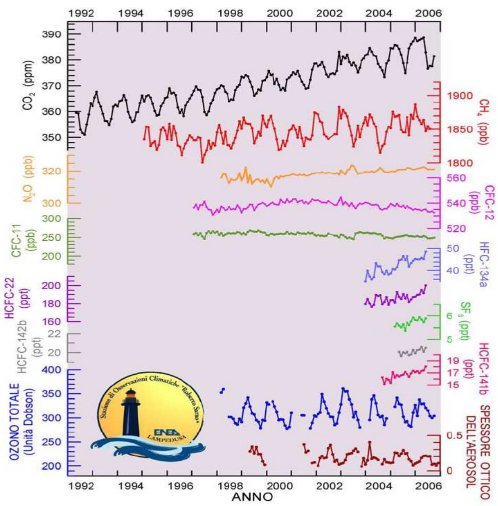


Figure 6.2 – Monthly mean of some greenhouse gases measured at Lampedusa. (Artuso, 2007; Chamard, 2003; Di Sarra, 2002; Meloni, 2007; Pace, 2006)



Observed trends

The identification and the estimate of the trends of the climatic variables are carried out by means of the statistical processing of time series detected by the monitoring stations on the national territory. For this purpose, although at different level of temporal continuity and completeness, spatial coverage and quality controls, the most reliable time series are those belonging to the Air Force Meteorological Service, to the Ufficio Centrale di Ecologia Agraria (UCEA), to the former Servizio Idrografico e Mareografico Nazionale and to several regional environmental protection agencies (ARPAs). The decadal, annual and monthly climatological statistics obtained from these time series are regularly assessed, checked, updated and released through the "Sistema nazionale per la raccolta, elaborazione e diffusione di dati Climatologici di Interesse Ambientale" (SCIA) (www.scia.sinanet.apat.it) developed by APAT in collaboration of Air Force Meteorological Service, UCEA and the ARPAs (Desiato et al., 2006 and 2007).

Temperatures

An estimate of mean temperature trend in Italy from 1865 to 2003 has been evaluated by Brunetti et Al. (2006a, 2006b) thanks to the reconstruction of time series from 67 weather stations. The analysis has been carried out on annual and seasonal basis and the stations have been grouped into 3 geo-climatological regions: Alps (AL), Po Valley (PP) and Peninsular Italy (PI). The results are summarized on Table 1. They show an overall mean heating of 1.0 ± 0.1 °C per century, with no significant differences (generally not higher than 0.3 °C/century) between seasons and regions. From the same analysis for minimum and maximum daily temperature, variations between the 3 regions of 1.1 ± 0.1 e 0.9 ± 0.1 °C/century are obtained, respectively. It means than minimum temperature have increased more than maximum temperature (particularly in the north), more in winter temperature (particularly in the South) than summer temperature.

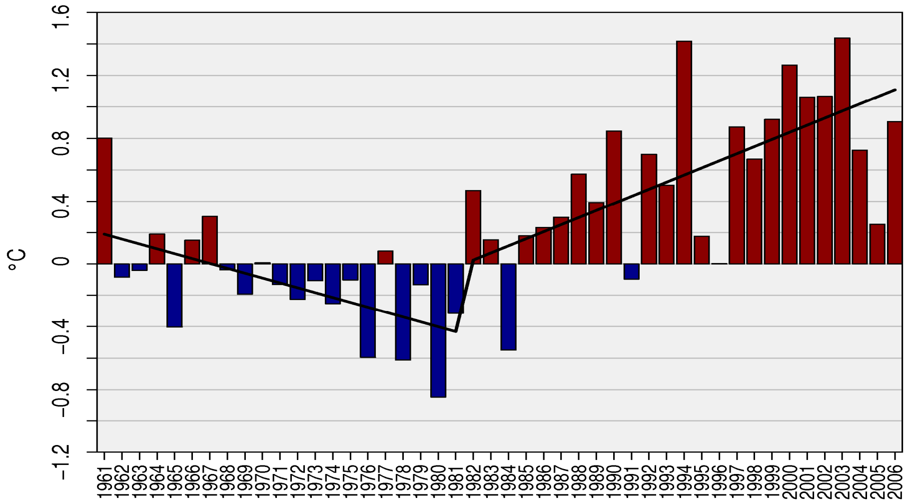
Table 6.1: Trends of mean temperatures over the 1865-2003 period. Values are expressed in °C per century. All values indicate trends with significance level higher than 99%.

	AL	PP	PI	ITA
Year	1.0±0.1	1.0±0.1	1.0±0.1	1.0±0.1
Winter	1.2±0.2	1.0±0.3	1.0±0.2	1.1±0.2
Spring	1.0±0.2	1.0±0.2	1.0±0.2	1.0±0.2
Summer	1.0±0.2	1.1±0.2	1.2±0.2	1.1±0.2
Autumn	0.8±0.2	0.8±0.2	0.9±0.2	0.8±0.2

Toreti e Desiato (2007a) have estimated the mean temperature trends in Italy from 1961 to date, by means of the application of several statistical models, even non-linear, and elaborating the time series of minimum and maximum temperature from 49 synoptic weather stations uniformly distributed over the national territory. The estimate, updated to 2006, shows a negative trend for the mean temperature from 1961 to 1980, with a decrease over this time period of about 0.6 °C, followed by a positive trend from 1980 to 2006, with a mean increase of +1.54 °C (figure 3). The net variation from 1961 to 2006 is slightly less than +1 °C, almost equal to 2 °C/century.

These estimates confirm that the mean temperature increase recorded during the last decades in Italy, as well as in the Mediterranean and in Europe, is higher then the global mean. In particular, in 2006 in Italy the mean temperature anomaly compared with the reference thirty-year period 1961-1990 has been about 1 °C compared with a global mean of about 0.5 °C. The year 2006 has been the 15th consecutive year with positive anomaly, and its value is the 6th from 1961 to date (APAT, 2007)

Figure 6.3: Mean Temperature anomalies in Italy. The broken line represent the trend estimated by the "sloped steps" statistical model (Toreti e Desiato, 2007a).



With regard to the trend of maximum and minimum temperature, in the recent years the situation is reversed compared to 1865-2003 data. As a matter of fact the maximum temperature has increased more than minimum and, as a consequence, also the daily temperature range. Also the summer heat waves have increased both in length and in intensity. 2003 has been not only the hottest years never recorded during the last 200 years, but has shown the strongest and prolonged heat waves. On the other hand, the winter cold spells have decreased, especially in frequency.

Precipitations

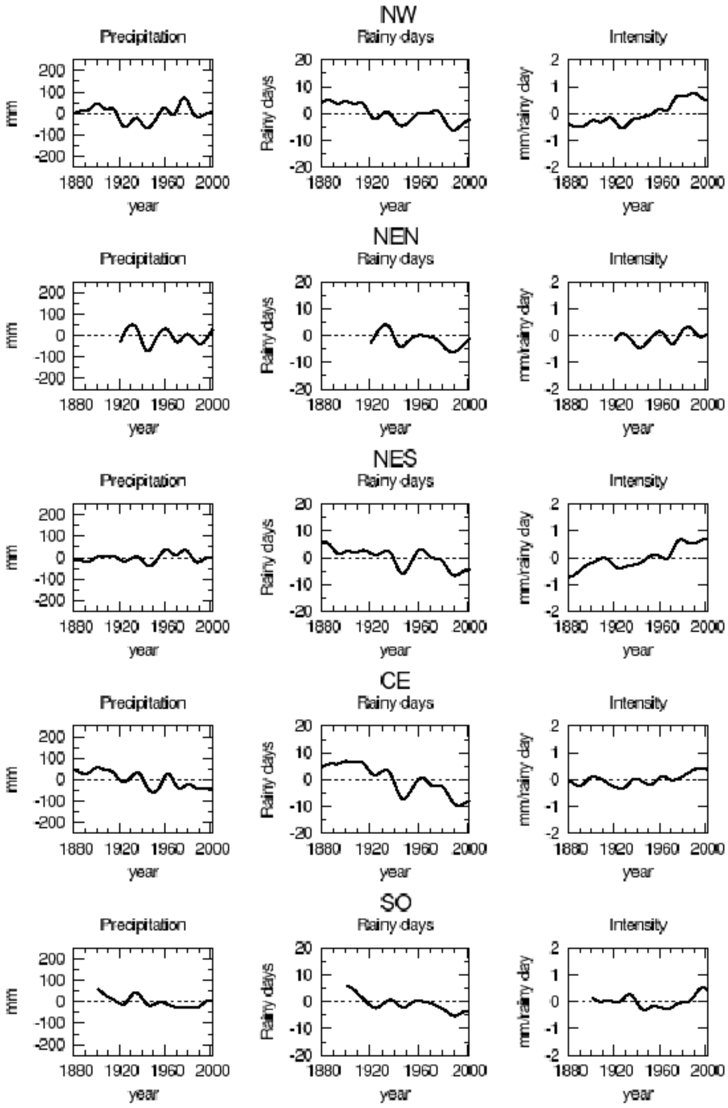
Differently from temperature, the accumulated precipitations do not show neither pronounced nor univocal trend on the Italian territory. On the basis of monthly or daily data from 111 weather stations, Brunetti et Al. (2006a) have analysed the trends of the seasonal and annual precipitations accumulated from 1865 up to 2003 over 6 different regions. The main results are summarised on table 2. Generally, these trends are not very significant. Regarding the mean Italian annual series, the estimate of the trend, expressed in percentage variation, is –5 ± 3 %/century; only two regions (Central Italy and South-East Italy) show a significant reduction trend for precipitations (-10 ± 3 %/century e –8 ± 5 %/century, respectively).

Table 6.2: Precipitation trends over the 1865-2003 period. The values are expressed in percentage per century relative to the mean of the reference period 1961-1990. Only values with significance level greater than 90% are indicated; for lower values of significance only the sign of the trend is indicated. Bold numbers indicate trends with significance level higher than 99%, numbers in italics indicate trends with significance level higher than 95%. For SE and SO, trends are referred to the periods 1875-2003 and 1866-2003 respectively.

	NW	NEN	NES	CE	SE	SW	ITA
Year	-	-	-	**-(10±3)**	-(8±5)	+	*-(5±3)*
Winter	-	+	+	-	-	+	-
Spring	-	-	-	**-(20±5)**	-	-	-(9±5)
Summer	-	-	+	-(13±8)	-	-	-
Autumn	-	-	-	-	-	+	-

The behaviour of precipitations has been analysed also by mean of the number of wet days (WD), defined as the number of day with a total precipitation higher then 1 mm, and the mean amount of precipitation for wet days (or precipitation intensity, PI). The results show an overall reduction trend of the number of low intensity events and towards a concentration of precipitations in events with higher mean intensity compared to the past. The total number of rainy days has decreased, especially in the last 50 years: the decrease is about of 6 days/century in the North and 14 days/century in the Central-South. The overall trend, for all the Italian regions, is in the direction of an increase of precipitation intensity and towards a decrease of their duration. Also the dry spells are on the increase and their persistence is higher in winter in the North and in summer in the South.
The detailed behaviour of cumulated precipitation, WD and PI over 5 Italian regions is reported on figure 4 (Brunetti et Al., 2006b).

Figure. 6.4: Yearly TP, WDs and PI series for the 5 regions. The data were smoothed with a 31-year width window and 5-year σ Gaussian filter



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Extreme events

Extreme events are, by definition, rare stochastic events. Extreme weather events, such as extremely hot or cold temperatures, directly affect human health. Other, such as rainfall in extreme quantity and frequency or strong wind, can cause or contribute to natural disasters: Flooding and sometimes landslides often follow positive extremes in rainfall; drought is a consequence of negative extremes in rainfall and often lead to fires. In this section, only the simple events like hot and cold days are tackled.

In Europe, Christensen and Christensen (2003), Giorgi et al. (2004) and Kjellström (2004) all found a substantial increase in the intensity of daily precipitation events. This holds even for areas with a decrease in mean precipitation, such as Central Europe and the Mediterranean region during summer. It is associated with both changes in the number of wet days (decreasing for Southern Europe) and changes in the amount of precipitation on wet days.

The combined effects of warmer temperatures and reduced mean summer precipitation would enhance the occurrence of heat waves and droughts. Schaer et al. (2004) concluded that the future European summer climate would experience a pronounced increase in year-to-year variability and thus a higher incidence of heat waves and droughts. Beniston et al. (2004) estimated that Mediterranean droughts would start earlier in the year and last longer. Although only the eastern Mediterranean currently has a regularly recurring dry period, the rest of the Mediterranean and even much of E. Europe may also experience such periods by the late 21st century.

For the assessment of the "frost days" and "hot days" events/phenomena over Italy, three indices among those defined by the CCl/CLIVAR Working Group on Climate Change Detection (Peterson et al., 2001) have been evaluated: the number of days in a year with daily minimum temperature lower or equal 0 °C (frost days); the number of days in a year with daily minimum temperature greater than 20 °C (Tropical nights); and the number of days in a year with daily maximum temperature greater than 25 °C (summer days).

These indices were obtained from data measured by 49 synoptic stations of the Air Force Meteorological Service well distributed over the Italian territory. These data series are quality checked and satisfy basic requirements of completeness and continuity (Toreti & Desiato, 2007b).

Figure 5 shows the mean number of tropical nights over Italy from 1961 to 2006. The dashed line represents the mean value in the period 1961-1990. Two trends may be distinguished. In the first, from 1961 till 1981, the number of tropical night's decreases, while from 1981 till 2006 it increases at a faster rate. In the whole period, a net increase of about 50% of tropical nights is estimated.

Figure 6.5: Annual number of tropical nights from 1961 to 2006. The dotted line indicates the mean value for the reference period 1961-1990

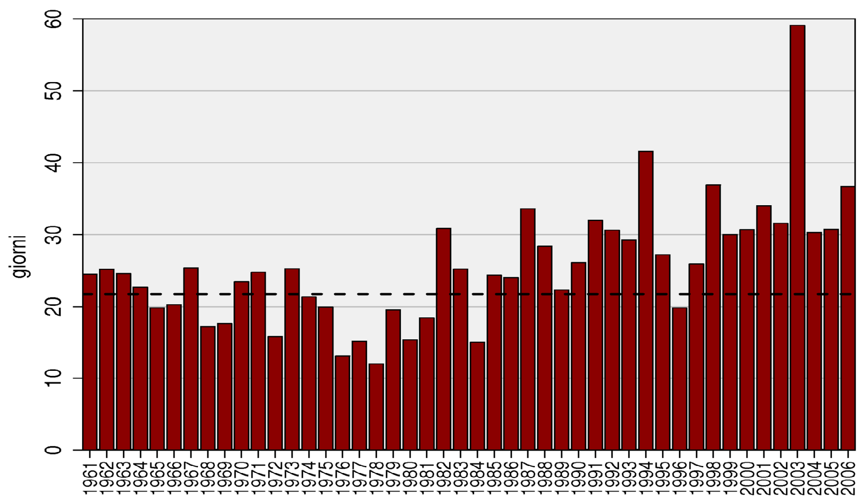

Figure 6 shows the mean number of summer days over Italy from 1961 to 2006. The dashed line represents the normal value in the period 1961-1990. Two trends may be distinguished. In the first, from 1961 till 1978, summer days decreased, while from 1978 till 2006 it is increased. In the whole period, a net increase of about 14% of summer days is estimated through a statistical trend model.

Figure 6.6: Annual number of summer days from 1961 to 2006. The dotted line indicates the mean value for the reference period 1961- 1990

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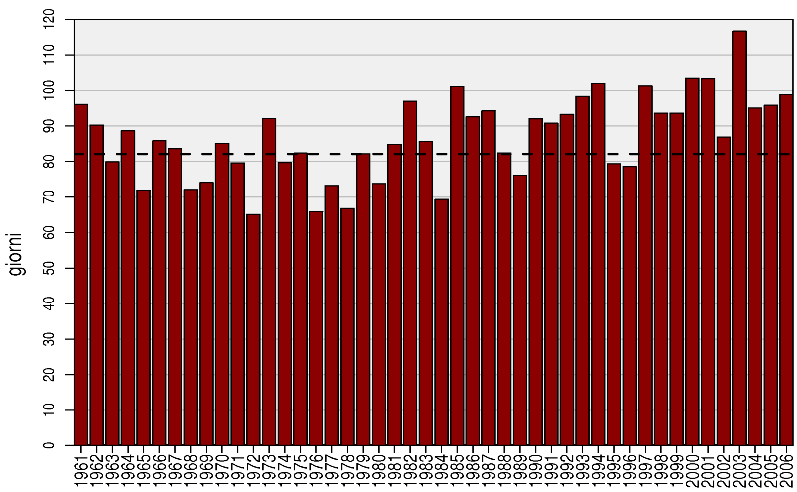
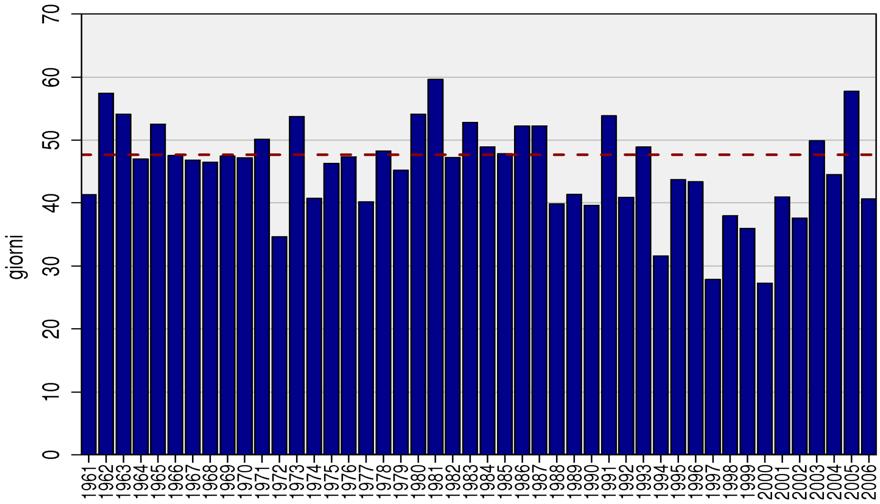


Figure 6.7 shows the mean number of frost days over Italy from 1961 to 2006. The dashed line represents the average in the period 1961-1990. Based on a trend recognition parametric statistical model, a decrease of about 0.2 frost days per year from 1961 to 2006 is estimated, corresponding to an average reduction of about 20%.

Figure 6.7: Annual number of frost days from 1961 to 2006. The dotted line indicates the mean value for the reference period 1961-1990



Sea Level Change

Present-day sea level change in response to global warming is a topic of considerable interest because of its potential impact on human populations living in coastal regions and on islands. Besides, because sea level change integrates non-linear coupled responses of several components of the Earth's system (i.e., oceans, atmosphere, ice sheets and glaciers, land water reservoirs, mantle and crust), measuring sea level variations and studying processes that cause them is highly interdisciplinary, involving research fields such as ocean and atmospheric sciences, hydrology, glaciology, geophysics, geodesy, and remote sensing.

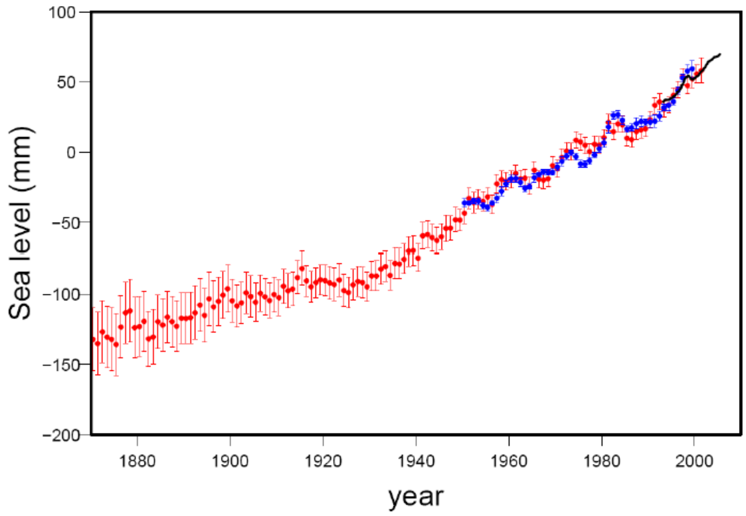
At a global scale, two classes of processes are responsible for sea level variations:

1. Temperature and salinity variations of ocean waters causing water density (specific volume) change.
2. Exchange of water between oceans and other reservoirs (e.g. ice sheets, mountain glaciers, and land water reservoirs), causing ocean mass change.

According to the last two IPCC reports (TAR and AR4), the largest positive contribution (0.3÷0.7 mm/yr of sea level rise) arises from thermal expansion due to warming of the oceans that mainly occurred since the 1950s. Melting of mountain glaciers produces 0.2÷0.4 mm/yr sea level rise. Estimated Greenland and Antarctica mass imbalance (accounting for a long-term readjustment since Last Glacial Maximum plus a climate-related response) contributes -0.2÷0.6 mm/yr. The most uncertain contribution reported in the IPCC reports were the change in terrestrial water storage that results from human activities, in the range of -1.1÷0.4 mm/yr with a median value of -0.35 mm/yr (i.e., corresponding to sea level drop). The sum of these contributions ranges from -0.8÷2.2 mm/yr, with a median value of 0.7 mm/yr. Concerning the 20th century sea level rise, Church et al. (2001) adopted a best estimate value of 1.5±0.5 mm/yr and noted that the sum of climate-related components (0.7 mm/yr) is low compared to observations. In effect, the observed value is more than twice as large as the TAR's estimate of the total climate contributions, although there is complete overlap between their respective uncertainties. It thus appeared that either the climate-related processes causing sea level rise had been underestimated or the rate of sea level rise observed with tide gauges was biased toward values too high. Recently new results have been reported in the recent literature. These may be summarized as follow:

1. Sea level rise measured during the 1990s by Topex/Poseidon satellite altimetry has approached 3 mm/yr, a value significantly larger than current estimates of the 20th century sea level rise that reopens the question of sea level rise acceleration (Church et al, 2004; Church and White, 2006 and see Figure 6.8).
2. Sea level change is highly non uniform spatially.
3. Near-global ocean temperature and salinity data have been recently made available for the last 50 years, allowing the first observations-based estimate of the steric contribution to past decades sea level rise.
4. Land water storage contribution due to change in the global water cycle can now be estimated.
5. Revised estimates of mountain glaciers and ice sheets melting are available for the past decade.
6. Trends in the occurrence of extreme sea level are found in the tide gauge data, mainly associated with regional climate change.

Figure 6.8 : Annual averages of the global mean sea level (mm). Red curve shows reconstructed sea level fields since 1870; Blue curve shows coastal tide gauge measurements since 1950; Black curve is based on satellite altimetry. The red and blue curves are deviation from averages 1961-1990, and the black curve is the deviation from the average of the red curve for the period 1993-2001. The error bars show 90% confidence interval (source: IPCC-AR4, WGI, Ch. 5, Figure 5.13, 2007)

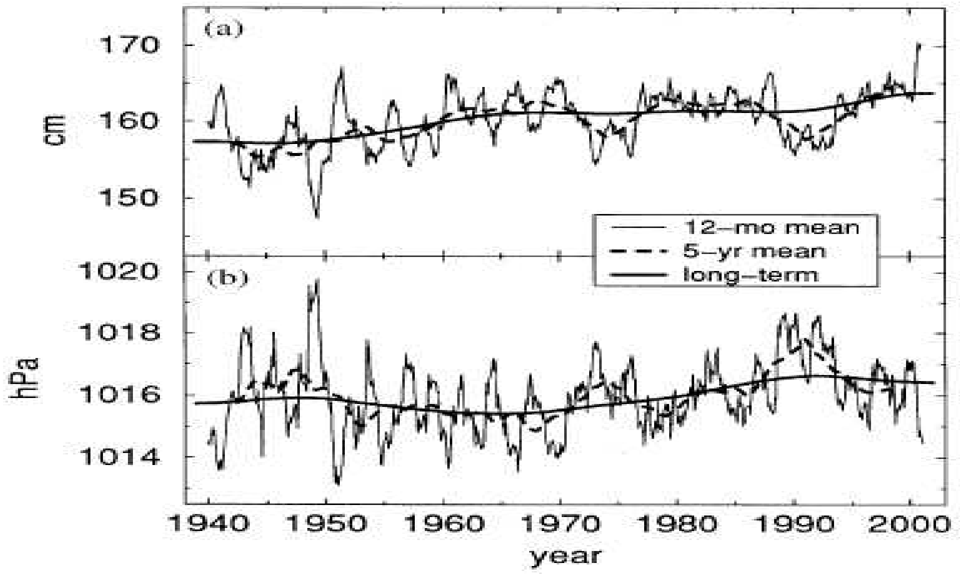


Sea level changes in the Mediterranean Sea

Sea level variability in marginal and semi-enclosed seas may well differ from the open sea variability. Bathymetry may enhance the impact of wind speed and direction changes, while the existence of Straits may control the exchange and contribute to sea level variability. The Mediterranean Sea is a semi-enclosed sea in which the cycle evaporation-precipitation-river runoff results in a net loss of water and is balanced by influx of water through the Gibraltar Strait. As a result, in addition to basin wide steric variations, and addition of water mass and oceanic circulation (inclusive of changes in intermediate and deep water formation), sea level depends on the hydraulic control of the water exchange at the Strait of Gibraltar.

Only a few long sea level records spanning to the beginning of the 1900s exist in the Mediterranean Sea and these are located at the Northern coasts of the Western Mediterranean (Marseille and Genoa) and at the northern coasts of the Adriatic Sea (Trieste and Venice) (Tsimplis and Baker, 2000; Raicich, 2003 and Figure 6.9). Venice has particularities due to variations in local subsidence and therefore it is not usable in the context of long term sea level trends (Woodworth, 2003). Nevertheless it is worth noting that sea level proxy data indicate that the trend has remained unaltered in Venice since the early 18th century (Camuffo and Sturaro, 2003).

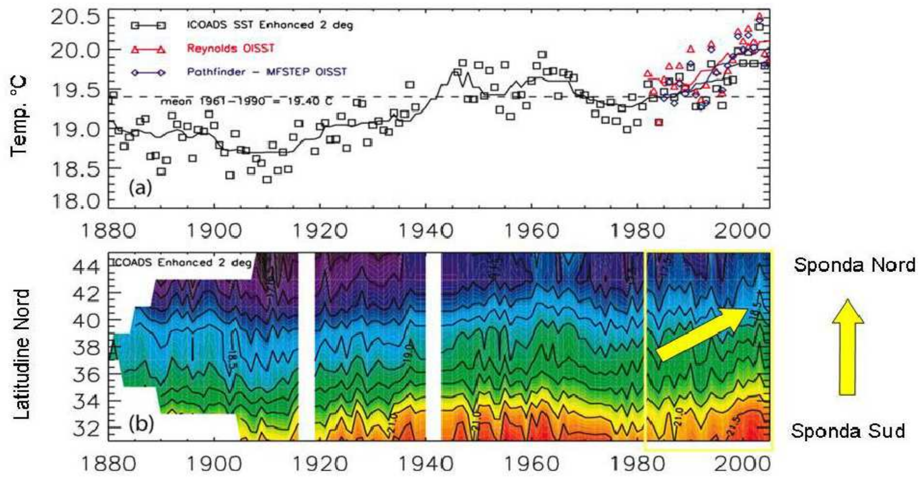
Figure 6.9: Time series of 12-month running means (thin solid lines), 5-years means (thick dashed) and long-term components (thick solid) of sea level (a) and atmospheric pressure (b). Sea level is referred to the gauge zero (from F. Raicich, 2003)



The sea level trends for the three longer stations are presently in the range 1.1÷1.3 mm/yr, thus lower than the estimated global value for sea level rise. New data for Trieste extending the record for this tide gauge fifteen years back to 1875 leave the above estimate unaffected. Two periods of sea level variability must be discussed further. Between 1960 and the beginning of the 1990s sea level in the Mediterranean Sea was either not changing or decreasing (Tsimplis and Baker, 2000) due to atmospheric pressure changes during the winter period (Tsimplis and Josey, 2001; Woolf et al., 2003) as well as temperature reduction and salinity changes linked to the North Atlantic Oscillation (NAO) (Tsimplis and Rixen 2002) or to the thermohaline Mediterranean circulation (Artale et al, 2006). Nevertheless, it appears that the temperature and salinity changes are constrained in the northern part of the basin while east-west gradients on atmospheric pressure as well as evaporation minus precipitation also exist. The second period concerns the era of satellite altimetry and in particular Topex/Poseidon during which fast sea level rise was observed at the Eastern Mediterranean Sea and was linked with changes in observed sea surface temperature (Cazenave et al., 2001) The observed sea level values and their temperature forcing has been confirmed by the use of climatological data of oceanic temperatures (Tsimplis and Rixen, 2002). During the same period of time a reduction in the sea level gradient across the Strait of Gibraltar has been observed and the change was suggested as caused by varied hydraulic conditions in the Strait or by changes in the density difference between the Mediterranean and the Atlantic (Brandt et al., 2004). The extent to which the Mediterranean Sea can have long-term sea level variability different from the global ocean remains an open question. The whole question turns around the gradients which can be sustained across the Strait of Gibraltar coupled with the density changes within the basin (Sannino et al.,2007).

The analysis of the Mediterranean surface temperature (figure 6.10) has allowed the quantitative evaluation of the positive trend of the temperature during the last 20-25 years and the validation of the *in situ* available measurements in order to evaluate its ability to depict the trend over the last 120-130 years starting from 1880 (Marullo et al., ENEA-Cnr-Isac, 2007).

Figure 6.10: Mediterranean surface temperature trend in the past 125 years (a) and latitude (b)



Among the la test results obtained thanks to the availability of this observation network, has to be mentioned the study carried out during the 2003 anomalous heating summer event recorded over most Europe and Mediterranean. Satellite observations detected a significant increase (in some areas higher then 4°C) of the sea surface temperature over wide Mediterranean regions. This fact caused concern both because the possible meteorological effect due to the delayed release in the atmosphere of the huge amount of heat cumulated by the water mass, and for the immediate consequences over the coastal ecosystems and the valuable biological communities, particularly sensitive to strong increase of temperature.

Such a thermal anomaly has actually had negative impacts with some marine organisms community, already stressed by the similar event occurred in 1999, but the feared meteorological effect did not happen.

Climate Change Scenarios

Introduction

Forecasts about future Italian climate can be carried out, recurring to the following categories of numeric models and methods: high resolution global climate models (GCM), able to manage processes and aspects on a global and regional scale; regional climate models (RGM), which are "inserted" on GCM in order to focus climate change in a particular area; and finally empiric/statistical or statistical/dynamic downscaling methods, where GCM or RCM forecasts are coupled with observed time series data, in order to make projections at a local scale.

High resolution GCM and RGM supply forecasts for the European continent and/or the Mediterranean, from which is possible to extrapolate specific estimations for Italy. Each approach has limits and advantages as shown in the IPCC reports.

All the climatic variables forecasts refers to different emissions scenarios, classified in subgroups marked with different acronyms. They represent different evolution models of GHG emissions until the end of the century, corresponding to different hypothesis of socio-economic development at a global scale. For example, A1B scenario refers to a fast global economic growth, the global population attain the top at the middle of the century than decrease, and a rapid introduction of new and more efficient technologies and a balanced energy source mix.

Therefore, numeric models supply a set of climatic variables forecasts for each scenario. To the intrinsic uncertainty of the model it has to be added uncertainties related to the probability that the scenario occur.

Briefly, for each climatic variable there is a range of values (rather wide) foreseen at a certain date. This range take into account the uncertainties of the model, the values foreseen by different models and the values foreseen in different scenarios.

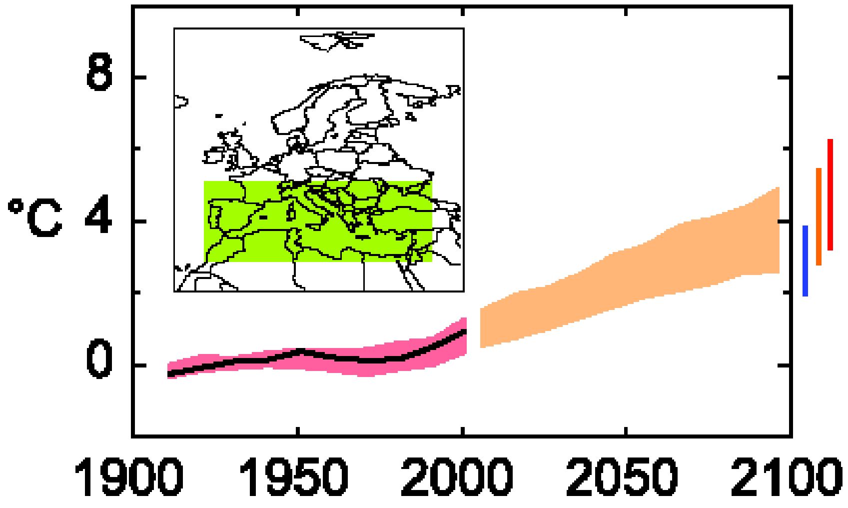
The most authoritative information source about climatic variables forecasts at a global and continental scale, is the IV IPCC Assessment Report, in particular the 11 Chapter of the Working Group I.

From there, it is possible to extrapolate forecasts concerning South Europe and the Mediterranean, then about Italy. Temperatures and rainfalls foreseen refer to A1B scenario, which represents an intermediate scenario of different global average emissions of CO_2 until the end of the century. A1B scenario refers to CO_2 average concentrations of 700 ppm at 2100.

Temperatures

In the A1B scenario, GCM models foreseen that the annual average temperature in South Europe in the period from 1980-1999 to 2080-2099 will increase in a range included between 2.0 and 5.1 °C (fig.11), with a median value of 3.5 °C.

Figure 6.11:Temperature anomalies with respect to 1901 to 1950 for South Europe and Mediterranean for 1906 to 2005 (black line) and as simulated (red envelope) by MMD models incorporating known forcing; and as projected for 2001 to 2100 by MMD models for the A1B scenario (orange envelope). The bars at the end of the orange envelope represent the range of projected changes for 2091 to 2100 for the B1 scenario (blue), the A1B scenario (orange) and the A2 scenario (red) (IPCC AR4 WG1, Ch.11, 2007).



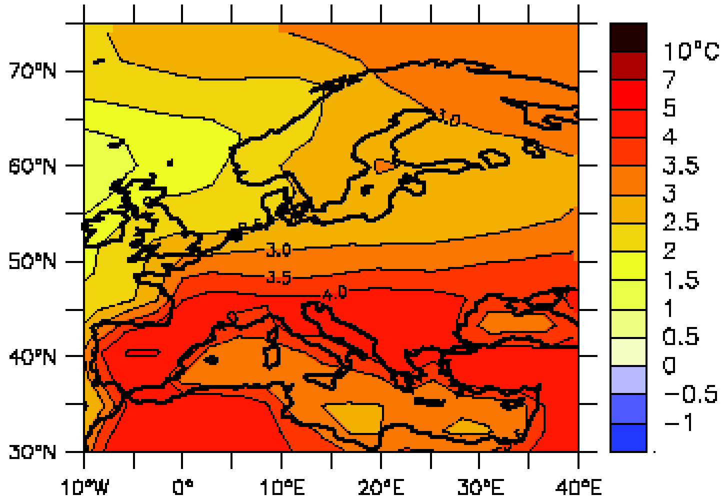
The estimations of average temperatures increase for South Europe are shown in the table 6.3, where are reported the minimum, the maximum, the median, the 25th and the 75th percentile of temperatures variations foreseen by 21 models in the A1B scenario, from 1980-1999 to 2080-2099.

Table 6.3: Average temperature variation (°C) foreseen in 21 models from 1980-1999 to 2080-2099 and probability of "extremely warm season" in the period 2080-2099. Scenario A1B, South Europe

Season	min	25° perc	Median	75° perc.	max	Probability of extremely warm season
Winter	1.7	2.5	2.6	3.3	4.6	93
Spring	2.0	3.0	3.2	3.5	4.5	99
Summer	2.7	3.7	4.1	5.0	6.5	100
Autumn	2.3	2.8	3.3	4.0	5.2	99
annual	2.2	3.0	3.5	4.0	5.1	100

In the regions bordering the Mediterranean, Italy included, the foreseen warming is greater in the summer (Fig. 12).

Figure 6.12: JJA temperature change between 1980 to 1999 and 2080 to 2099, averaged over 21 models (IPCC AR4 WG1, Ch.11, 2007).



In the table 3 is reported the probability of "extremely warm season" in the period 2080-2099. The probability is calculated starting from the simulations in the control period 1980-1999, from which is extracted and used as reference value, for each forecasting model, the warmest summer. Then, the fraction of summers in which the temperature overcome this reference value in the period 2080-2099, is calculated. This fraction mediate on 21 models, give the probability of "extremely warm season".

Following the table 3, all the models concur in foresee for the end of the century, in South Europe and in the scenario A1B, warmer summers then the warmest summer of the period 1980-1999.

Using different emissions scenarios, the range of the average temperatures increase, foreseen from different models may vary sensibly. For example, if it is considered B1 and A2 scenarios, which are those placed at the minimum and the maximum of CO_2 emission range foreseen at 2100, the width of the range of the average temperatures increase, foreseen by the models go from 3.8 °C (from 2,7 to 6.5 °C, see Tab. 3) to about 9÷10 °C. The average of the distribution remains included between +4 and +5 °C.

Concerning the variability of the average temperature, most models foresee an increase of the inter-annual standard deviation of summer temperature both in North Europe and in the Mediterranean. A signal of the trend to a more marked variability could be the heatwave that has invested Europe in the summer of 2003. In the winter months the models indicate, by contrast, a reduction of the variability of the average temperature.

The use of statistic downscaling models for the estimations of temperature variations at local scale, foreseen at the end of the century in Emilia-Romagna (Tomozeiu et al., 2007) show, in the A2 scenario, an increase of minimum temperatures included between 2 and 2,5 °C in every season and an increase of maximum temperatures included between 2 °C in autumn and in winter and 5 °C in summer.

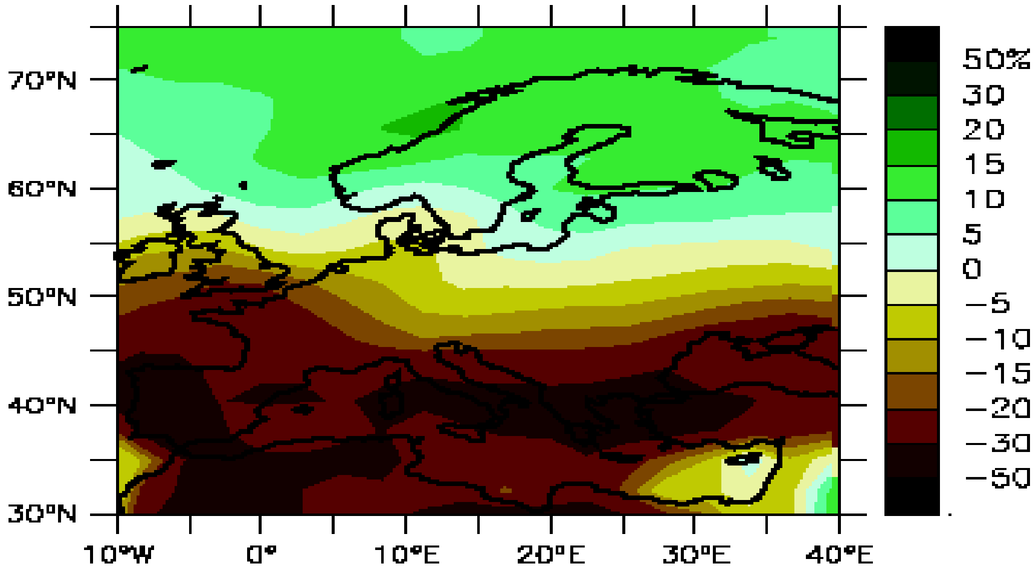
Other significant results concern the forecast of an important decrease of cold days and an increase of the heatwaves duration index, defined as the maximum number of consecutive days with maximum temperature more than 5 °C with the normal value.

Rainfalls

GCM models provide that in A1B scenario the annual precipitation cumulated in South Europe from 1980–1999 to 2080–2099 decrease in average of a percentage of between 4 and 27%. (table 4). The decrease more sensitive it is expected in the summer season (Fig. 13).

Unlike the changes in temperature, which are therefore rather uniform, the forecasts of precipitation may vary significantly on reduced scale, in particular on areas with a complex orography as our peninsula. Also, especially in southern Europe, almost all models provide variations in varying degrees and in some cases of different sign, moving from a few degrees in latitude.

Figure 6.13: Precipitation changes over Europe from the MMD-A1B simulations. JJA fractional change in precipitation between 1980 to 1999 and 2080 to 2099, averaged over 21 models. (IPCC AR4 WG1, 2007, ch. 11.)



As for the temperatures, using different emission scenarios, the range of variations of precipitation shown by the models increases but the median not differs considerably from that of the A1B scenario.

Table 6.4: percent variation of cumulated rainfalls foreseen by 21 models from 1980-1999 to 2080-2099 and probability of "extremely rainy season" and "extremely dry season" in the period 2080-2099. A1B Scenario, South Europe

Season	min	25° perc	median	75° perc.	Max.	probability of extremely rainy season	probability of extremely dry season
Winter	-16	-10	-6	-1	6	3	12
Spring	-24	-17	-16	-8	-2	1	28
Summer	-53	-35	-24	-14	-3	1	41
Autumn	-29	-15	-12	-9	-2	1	21
annual	-27	-16	-12	-9	-4	0	45

Also taking into account the considerable uncertainties and the spatial marked variability of the forecasts of rainfalls, models provide a very likely signal of reduction of the soil humidity in the Mediterranean area especially in spring and summer, due, in addition to the (possible) decrease of rainfalls, also to the

greater evapotranspiration linked to an increase in average temperatures. Another indication concern the decrease of the number of days with rain and greater duration of periods of drought in southern Europe.
Also on the Alps as in other parts of Europe is expected that the increase in temperature, with consequent reduction of the fraction of snowy precipitation, cause a reduction in the thickness of the mantle and the area covered by snow in winter.
An increase of the average temperature of 4 °C in the Alps, as expected on average by the models in A2 scenario, would reduce the duration of the snow of 50% to the altitude of 2000 m and 95% under 1000 m a.s.l.

Sea Level Rise

The recent detection of the complex movement's lifts of the sea on the Italian coast, together with the future evaluation for the next years of the acceleration of lifting of the sea due to global warming, it takes a considerable importance for the programming of human activities in the future.

ENEA has done the National map of the coastal areas with sea flood risk (figure 6.14).

Figure 6.14: National map of areas with sea flood risk, from DEM to 20 m (F. Antonioli, G. Leoni, 2007)

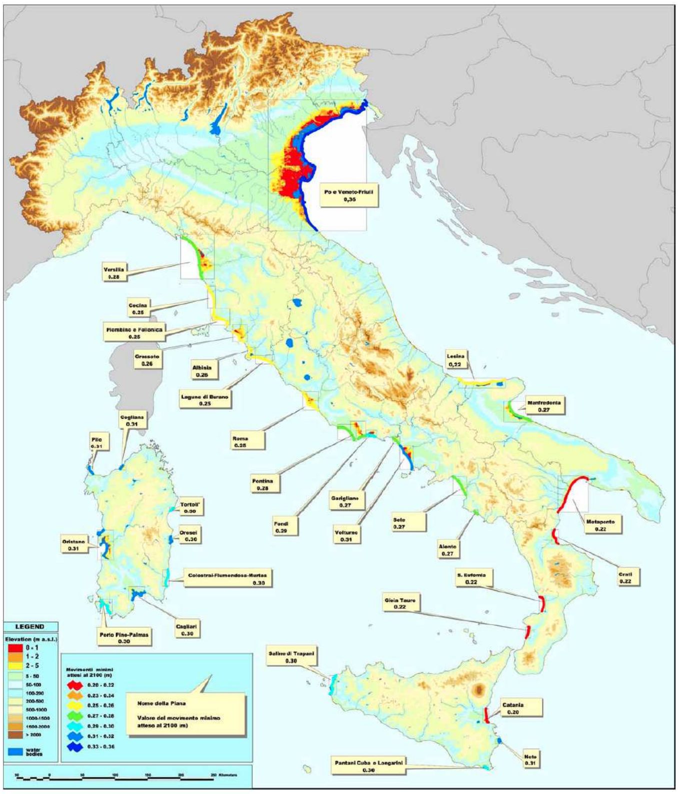


Table 5 show the minimum (0.22 m) and the maximum (0.96 m) values foreseen at the end of the 21st century, as reported in the EU report "Impact assessment" published on 10 January 2007.

The figures are rounded to the second decimal. The current movements (expressed in mm/year) are the sum of the isostatic values (Lambeck 2004a et al) + tectonic (Ferranti et al 2006) and eustatic 1.02 (Lambeck 2004b et al) for Italy.

In the Po river area has been considered an average value. To these figures should be added those concerning soil constipation and gas and water drainage. Red areas are those in which ENEA has made soundings and evaluate precise tectonic values.

Table 6.5:

Coastal sites	Actual movements	Expected movements at 2100 (yards)	
	Isostatic and tectonic + eustatic (1.02) mm/year	Minimum value 0.22 m	Maximum value 0.96 m
Po e Veneto-Friuli *	-1.25 +1.02	0.36	1.08
Lesina	-0.30 +1.02	0.22	0.99
Oristano	-0.88 +1.02	0.31	1.05
Versilia	-0.56 +1.02	0.28	1.02
Grosseto	-0.38 +1.02	0.26	0.99
Volturno	-0.95 +1.02	0.31	1.05
Manfredonia	-0.5 +1.02	0.27	1.01
Cagliari	-0.85 +1.02	0.30	1.04
Pontina	-0.6 +1.02	0.28	1.02
Albinia	-0.4 +1.02	0.26	1.0
Fondi	-0.65 +1.02	0.29	1.03
Roma	-0.35 +1.02	0.25	0.99
Porto Pino-Palmas	-0.8 +1.02	0.30	1.04
Pontina Laghi costieri	-0.5 +1.02	0.27	1.01
Sele	-0.5 +1.02	0.27	1.01
Metaponto	0 +1.02	0.22	0.96
Garigliano	-0.5 +1.02	0.27	1.01
Catania	+0.2 +1.02	0.19	0.94
S. Eufemia	0 +1.02	0.22	0.96
Piombino e Follonica	-0.35 +1.02	0.25	0.99
Lagune di Burano	-0.35 +1.02	0.25	0.99
Crati	0 +1.02	0.22	0.96
Colostrai-Flumendosa-Murtas	-0.8 +1.02	0.30	1.04
Saline di Trapani	-0.75 +1.02	0.30	1.03
Orosei	-0.80 +1.02	0.30	1.04
Gioia Tauro	0 +1.02	0.22	0.96
Pilo	-0.88 +1.02	0.31	1.05
Cecina	-0.25 +1.02	0.25	0.99
Tortoli'	0.82 +1.02	0.30	1.04
Pantani Cuba e Longarini	-0.75 +1.02	0.30	1.03
Alento	-0.5 +1.02	0.27	1.01
Coglians	-0.85 +1.02	0.31	1.04
Noto	-0.85 +1.02	0.31	1.04

Evaluations and figures contained in this map have to be considered as a preliminary stage of a more detailed study.

Impacts of Expected Climate Change and Vulnerability Assessment

Energy sector

According to the Fourth IPCC Evaluation Report, climate change impacts on the energy sector will be particularly critical in the Mediterranean region. The table 8, extracted from the Working Group 2 contribution, summarizes the climate change main impacts on the energy sector expected in Europe during the 21st century in absence of any adaptation policy. Severity of each impact has been determined taking into account (1) impact extension and number of people involved, and (2) impact intensity. The severity measure is expressed in terms of number of arrows (from one to three), their direction and colour (upward blue arrow = positive impact, downward red arrow = negative impact).

Table 6.8: Summary of main climate change impacts on the energy sector expected in Europe during the 21st century (source: IPCC - 4AR - WG2)

Impact	**Area**				
	Northern	*Atlantic*	*Central*	*Mediterranean*	*Eastern*
Energy supply and distribution	↑	↑↑	↑	↓	↑
Energy demand in winter	↑↑	↑↑	↑	↑↑	↑
Energy demand in summer	↓	↓	↓↓	↓↓↓	↓↓

As far as energy supply is concerned, it is foreseen a reduction of electricity generation from hydropower which, in 2005, has been more than 70% higher than electricity generation from renewable sources and equal to about 10% of the gross domestic consumption in Italy. Between 2001 and 2005, the hydropower gross generation has already decreased by about 23%. The generation reduction trend is particularly evident for plants with gross efficient power above 10 MW, whose average capacity factor has been reduced from 36% in 1992 to 22% in 2005 as a consequence of the meteorological trend. According to some of the scenarios considered in the Fourth IPCC Evaluation Report, the gross hydropower potential in Europe would experience an average 6% decline by the 2070s, with a reduction up to 20-50% in the Mediterranean area (Lehner *et al.*, 2005).

In some Italian areas, and especially in the Po valley, reduced availability of water resources affects, apart from hydropower generation, supplying of drinking water and water for irrigation. Moreover, water abstractions from the main basins could jeopardize river navigability and thermoelectric power plants cooling. Increased demand on water resources from new and diversified users is probably the main cause of reduced water availability in the Northern Italy main basins. This reduction cannot be justified only on the basis of precipitation data that, especially in Northern Italy, show a scarcely significant trend.

During the summer season this situation gives rise to recurrent water resource allocation problems; for this reason, it is closely watched by the Dipartimento della Protezione Civile which, in collaboration with regional and water basin authorities, monitors hydropluviometric data and water availability at least once per month in order to foresee as soon as possible future water critical situations. As from January 2007 the Dipartimento della Protezione Civile has created a technical-scientific group formed by the most important experts in seasonal weather forecasting and climatology with the aim to update monthly the scenarios for the next three-month period.

All studies on this subject agree on the fact that energy consumption for heating will decrease whilst energy consumption for cooling will increase as compared to the 1961-1990 reference period levels (Santos, 2002; Livermore, 2005; López Zafra, 2005; Hanson, 2006). Demand for domestic cooling in the summer season will affect significantly electricity consumption (Valor, 2001; Giannakopoulos, 2006) with increases up to 50% in Italy and Spain by 2080 (Livermore, 2005).
In Italy, sales of air conditioners have raised to about 11,6 million units, of which about 8 millions as from the beginning of 2000; sales of conditioners in the range of up to 7 kW of cooling power, which specifically characterize domestic utilization, have been of 10 and 6.6 million units, respectively (Ghielmi, 2006). By taking into account just systems of power lower than 7 kW one can estimate a consumption of 11 TWh/year corresponding to an emission of 6 Mt CO_2/year equal to 10% of the increase in CO_2 production in Italy after 1990 (Ghielmi, 2006). Consumption increase for air-conditioning is the cause of the increase in maximum summer energy consumption that in 2006 with 55619 MW has been for the first time higher than the maximum winter energy consumption (Silvestrini, 2006). At the present sale rate, the amount of operative air conditioners could grow up to 14 million units by 2011. Under business-as-usual conditions, even considering a growing attention for energy-saving products, consumption would raise to 16,400 million kWh/year, equivalent to a CO_2 emission of about 9,85 Mt/year (Ghielmi,2006).
The massive consumption shift from winter heating to summer cooling involves also a relevant change in the type of energetic devices which are utilized. Indeed, while heating is mainly accomplished by directly burning-up a fuel, cooling requests the use of electrically powered devices. In this way the energy system entropic balance is bound to get worse, at least until electricity generation will be essentially based on the use of fossil fuels. This change is likely to have a decisive impact on the overall greenhouse gas emission balance.

Agriculture

In the Mediterranean region increases in the frequency of extreme climate events during specific crop development stages (e.g. heat stress during flowering period, rainy days during sowing dates), together with higher rainfall intensity and longer dry spells, is likely to reduce the yield of summer crops. Climate change will modify other processes on agricultural land.

Lengthening of the growing period of about 10-15 days per each °C of rise in yearly average temperature and consequent shortening of cold winter periods are expected. 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; all ecosystems are expected to shift 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.

As concerns crop yields, in the past decades weather extremes have adversely influenced yield results. One of the most remarkable was the heat-wave in 2003. High temperatures and long period with low or no precipitation led to droughts in large parts of Italy with consequent drop in crop yields (for example wheat yield in 2003 dropped between -3.5% and -10% compared to 2002. JRC, 2003)

Crop yields will not change significantly in a climate warming scenario up to 2°C: in fact under these conditions associated with an increase of atmospheric CO_2, growth of several species will be favoured (provided that sufficient water and soil nutrients are available). Problems will arise for those regions where climate change is causing processes of aridity and soil degradation, and for those regions where frequency and intensity of extreme meteorological events are increasing.

In terms of crop production, outcomes of the PESETA (JRC, 2007) project show that the change foreseen for 2020 and 2080 would result in a yield decrease from 1.9% to about 22.4% in the Southern Europe regions, caused primarily by probable reduction of the growing season, by extreme events more frequent during the production cycle phases, as for example strong precipitations during sowing dates, heat waves during the flowering period and longer dry spells.

Coastal zones

Coastal areas are highly susceptible to sea level rise that is expected to constitute an increasing threat in the future. Specific studies related to the Mediterranean sea show that a sea level rise could be slightly above 1 mm/year. A sea level rise of 0.20-0.70 metres has been projected to 2100.

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.

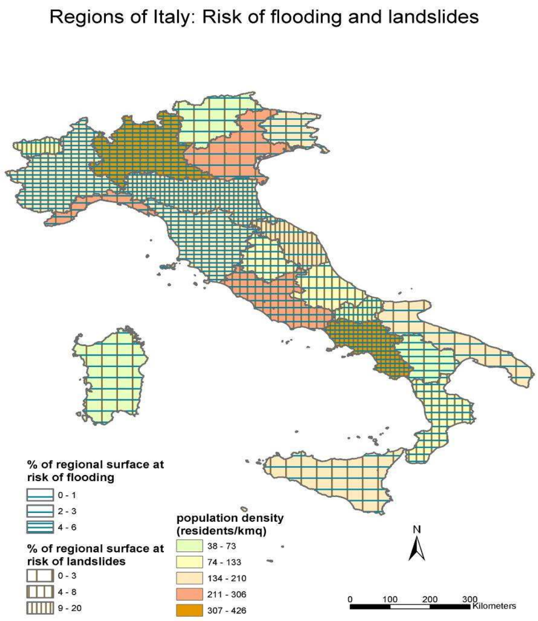
Other concerns for Italy in relation to projected climate changes have been identified as follows:

- loss of humid zones nearby rivers estuaries;
- salt water intrusion into coastal fresh-water beds, with adverse impacts on agriculture and fresh-water supply;
- coastal erosion.

Sea level rise will imply higher risks for the Italian coastal areas. 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.
- Low-lying coastlines with high population densities and small tidal ranges will be most vulnerable to sea level rise. Coastal flooding related to sea level rise could affect large populations.

Figure 6.15: Risks of flooding and landslides in Italy (Legambiente 2006)



The flooding risk in Italy is high and widespread (figure 6.15) especially because of its peculiar geological and geomorphologic conformation characterised by a young orography. Some areas in Italy are interested by the phenomenon of subsidence, which further increases this risk. Subsidence in Italy is increased in the last years as a consequence of human activities, especially excessive groundwater withdrawal. In the eastern Po plain in north Italy, the recent effects of human activities on subsidence has been evaluated to be at least an order of magnitude higher than that due only to long-term natural processes. A clear-cut correlation between flood frequency and rapid subsidence can be also demonstrated (Carminati & Martinelli, 2002).
A technical report of the Ministry for the Environment, Land and Sea (Ministero dell'Ambiente, 2000) quantifies the areas with high risk of flooding: they cover an area of 7.774 sq km, corresponding to 2,6% of the national territory. Floods can cause several consequences to human health, infrastructures and the environment. The most dramatic floods in Italy occurred in the Po (1951, 1994, and 2000) and Arno river basin (1966).

Soil degradation and water resources

Climate change might cause general soil quality 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, salinization, and nutrients loss as a consequence of precipitations decrease and increase of droughts. To this regard a particularly negative effect is anticipated at local scale in Southern Italy, where both vegetation and territory are already experiencing a marginal water supply regime.

Both underground and surface water are vulnerable to projected climate changes, because water uses are steadily increasing whereas meteorological contributions are either stable or decreasing. In Italy, the total meteoric inflow is of about 300 billion mc/year (data of Regione Emilia Romagna). The highest percentage of these precipitations, a little more than 40%, is concentrated in the northern regions, 22% in the central ones, 24% in the southern regions and just 12% in the two largest islands, i.e. Sicily and Sardinia. Nevertheless, the precipitation percentage not evaporating and not dispersed in the subsurface, and as such liable to be utilised, is estimated by the Ministero dell’Ambiente to correspond to no more that 110 billion mc/year. This results in a water resource availability, today actually utilizable, estimated to be of only 58 billion mc/year, 72% of which derivable from surface resources (springs, rivers, lakes), while 28% from underground resources (water tables close to the surface). Almost 53% of the utilizable surface resources are localized in Northern Italy, 19% in Central Italy, 21% in Sothern Italy, and 7% in the two largest islands.
Moreover, about 70% of the underground resources is localized in the large flood plains of Northern Italy, while not many are the water tables utilizable in Southern Italy, all of them confined in the short stretches of coastal plains and in a few inner areas.

These data confirm the uneven distribution between northern and southern parts of the country and the reduction trend caused by the concurrent decrease in precipitation and increase in evapotranspiration and water utilization.

As for the potential climate change scenarios for Italy, one can expect:

- an increase of mud/debris slides, these phenomena being considered as those with the highest component of induced risk (f.e. Sarno 1998) linked to the expected increase in extreme meteorological events;
- a general decrease in deep slide phenomena as a consequence of the precipitation decrease, both on an annual and a seasonal scale;
- a general decrease in the mean river flow rates, especially in the plains, with a consequent decrease in hydraulic dangerousness;
- an increase in rock falls next to outcrops of medium-high rocks, especially in wintertime, caused by progressive deglaciation of alpine areas and increase in sudden changes in temperature;
- an increase in flash floods in the alpine and Apennine mountainous and piedmont zones. Effects of these phenomena spread widely over the territory, with a high induced risk for the population.

As far as alpine and mountain environments are concerned, on the basis of data collected at altitude by weather stations located on the Italian, Swiss, and Austrian sides of the Alps, the average temperature increase rate over the alpine chain during the last century has been between 1.5 and 2°C, the largest part of this increase dating from after 1980. Changes have also been observed in snowfalls, in frequency of snow slides and avalanches, and even in anemologic regimes, according to studies ongoing at the World Glacier Monitoring Service in Zurich.

Scientists consider glaciers to be among the best natural indicators of climate change and, therefore, monitor them closely. Rapidly shrinking glacier areas, spectacular tongue retreats, and increasing mass losses are clear signs of the atmospheric warming observed in the Alps during the last 150 years.
The Alps could lose up to 80% of their glacier cover by the end of this century, if summer air temperatures rise by 3°C. And if temperatures increase by 5° C, the Alps would become almost completely ice-free by 2100. (M. Zemp, 2006)

In the 1970s, about 5,150 Alpine glaciers covered a total area of 2,909 square kilometres. This represented a loss of about 35 percent of glacial area from 1850 to that time. Accelerated loss of ice cover since then has resulted, today, in a total loss of 50% of the 1850 area, culminating in a volume loss of 5 to 10 percent of the remaining ice during the extraordinary warm year of 2003.

Observation of long historical series regarding the glaciers lengths provides the most interesting information (Regione Lombardia, 2006). Historical series longer than 50 years confirm a clear and strong icefront regression for all the most important glaciers. In particular, the most extended or the longest glaciers present higher average annual variations, while glaciers of lower surface or shorter length have undergone more limited frontal changes.

Among them, for example, the time series recorded at Forni (Ortles-Cevedale), the largest glacier in Lombardy, which has been monitored for almost a century, presents a total regression of 1.7 km, rising to 2.6 km if one takes into account sparse data recorded during the second half of the nineteenth century.

A confirm comes from mass balance data indicating a progressive reduction in volumes and thicknesses (up to 1 m/year) of a number of sampled glaciers. As the average thickness of Lombard glaciers seldom exceeds a few tens of meters, it is presumable that they will not survive for more than half a century.

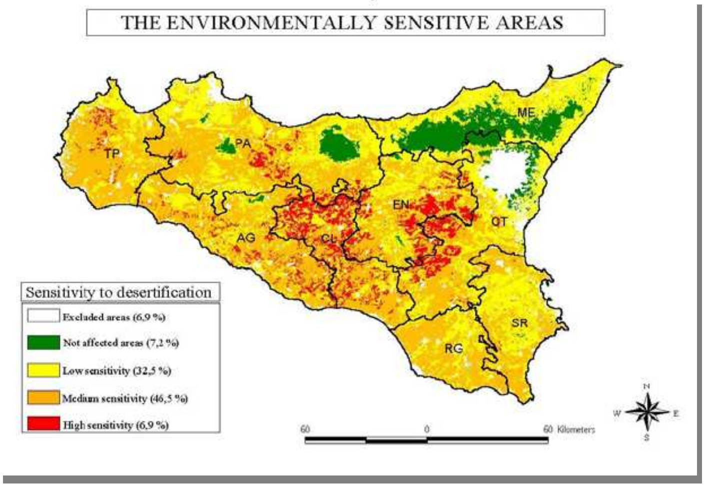
Desertification

Desertification is a phenomenon producing a decrease in economic and biological productivity of climatic zones which are defined arid, as a consequence of several processes caused also by human activities.
Soil quality tends to degrade especially in Southern Italy, even though not only for climatic reasons. Arid, semi-arid and sub-humid areas changing into degraded areas cover today 47% of Sicily, 32% of Sardinia, 60% of Apulia, 54% of Basilicata and other regions although less severely. Degradation is also caused by changes in soil utilization, or by its inadequate utilization, besides from an increase in forest fires. Degradation is also worsened by factors of anthropic origin such as erosion, salinization, loss of organic substances, waterproofing and, in some cases, also phenomena of large run-off caused by floods.
The European Environmental Agency has made a map of sensibility to desertification for all countries of the Mediterranean basin as part of a project in which also ENEA has been involved. Extracted from this map, fig.16 shows the situation over the Italian territory. As can be seen 37% of the territory is very vulnerable, whilst 32.15% is mildly vulnerable and 64.11% not very vulnerable under the present climate conditions and utilization of the territory. Mildly and not very vulnerable areas are prone to become more vulnerable under some of the climate change conditions foreseen by future scenarios.

Figure 6.16: Map of sensitivity to desertification (EEA, 2001)

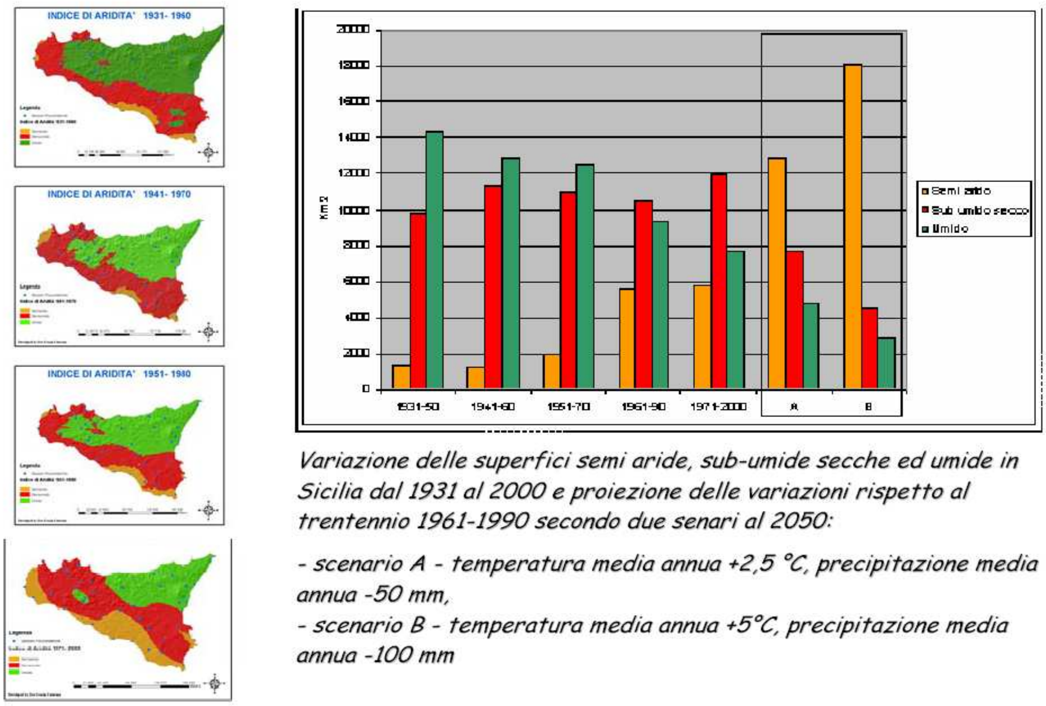
The most critical situation can be found in southern and insular regions where environmental conditions are more unfavourable and where agriculture and sheep-farming affect the territory conditions. ENEA has deepened the study of desertification both at regional level, making a sensitivity map of Sicily (fig.17), and at sub-regional level, analysing areas suffering from particular degradation processes.

Figure 6.17: Map of sensitivity to desertification of Sicily (Sciortino, Iannetta, 2002)



Changes in the values of climate aridity caused by simultaneous changes in precipitations and temperatures are proved by the results of the analysis carried out by ENEA on the Sicilian territory using climatic data provided by the Ufficio Idrografico Regionale. From fig.18 one can see that the semi-arid territory extension had been gradually increasing in the period from 1931 to 2000 up to 20% of the regional territory. Parallel to this, territories classified as humid decreased by 30%.

Figure 6.18:Variation of the percentage of Sicilian territory affected by aridity conditions (Sciortino, 2007)



The aridity variation can be essentially attributed to the effect of temperature, significantly increased over all the regional territory. Changes in precipitations are less indicative, even though Ufficio Idrografico has estimated an average decrease of 30mm/year over the regional territory during the last two thirty-year periods.

Biodiversity and ecosystems

In general, climate change might cause an overall migration of ecosystems northwards and upwards for the mountainous areas: for example a 3°C increase in temperature, within the range projected for 2100, corresponds to a shift in species distribution of 300-400 Km to the north (in the temperate zones) or 500 m in elevation. Many species will have difficulties in responding to such rapid change by migration or adaptation and are likely to become more restricted in distribution or even extinct.
Keeping into account the Italian orographic and geomorphologic complexity, the whole balance of the natural landscape will tend to change in relation to the different local adaptation capabilities.
Under the above scenario, the share of stable plant species in 2100, compared with 1990, might range between 60÷80% in Northern Italy and Apennines, 20÷40% in the Mediterranean area, 40÷60% in Southern Italy.
Current plant species richness in the Mediterranean area might be reduced over the 21st century because of the projected decrease in precipitation, more frequent forest fires, increased soil erosion and the lack of species that could replace those that are lost.
As far as concern alpine and mountain environments, a shift of the ecosystems towards higher altitudes and the melting of glaciers induced by higher temperatures may also alter the hydro geological cycle in the mountains, with repercussions on both the water balance of rain collecting basins and the stability of mountain slopes.
In addition, it is virtually certain that European mountain flora will undergo major changes due to climate change. Overall trends are towards increased growing season, earlier phenology and shifts of species distributions towards higher elevations. Similar shifts in elevation are also documented for animal species. The tree line is predicted to shift upward by several hundred meters. These changes, together with the effect of abandonment of traditional alpine pastures, will restrict the alpine zone to higher elevations, severely threatening nival flora.
The Italian forests are very important for the landscape, the biodiversity, the balance of the environment, and for the economy. It occupies about 10 millions of hectares (30% of national area) and represents 5% of total European forested area. This forested area was gradually increased, at a rate of about 100000 hectares per year, in the period 2000-2005 through a progressive change from agriculture land use form.
Positive trends in maximum number of consecutive dry days, as observed in south and central Italy, and associated increases in heavy precipitation events determine responses of the Italian forest that go 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, an 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 is more or less seriously damaged by fires every year. 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 (Italian Ministry of Environment, 2003).

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.

Forestry ecosystems sequester C throughout its fixation in wood biomass, in the litter and in the soil and in particular, in soil organic matter (SOM). This latter, due to its stability, is able to sequester the greatest amount of C and for the longest time period reducing the increase of the concentration of C component in the atmosphere (Del Galdo et al., 2003). Due to the strength and longevity of terrestrial biosphere and soil as a carbon sink, forest areas, forests are increasing their importance on carbon sequestration. This can be a result of afforestation projects and abandonment of agricultural fields.

Every year thousands of hectares are destroyed or damaged by forest fires. Fires at any given location are the result of complex interactions between forest biomass, topography, ignitions, uncontrolled land use and weather.

In the past 20 years 1,100,000 hectares of forest have been burnt. Every year an average of 11,000 fires occurs, destroying more than 50,000 hectare of wood each year. The cause of this phenomenon is by a third related to arson, wrong behaviour and inattention. The consequences for the natural balance are grave and the time for recovering is long. Today, as a result of a strong sensibilisation campaign and thanks to an improved organisation of the regional and national fire prevention system, the risk, though remaining high, has decreased. The surface burnt decreased from 190,640 in 1985 to 76,427 in 2001. Half of the total of about 10,000 fires every year occurs during July and August. During the hot year of 2003, a total of 9,697 fires have been registered, affecting more than 91,000 ha of land. The regions most severely affected are Calabria and Campania in the south-west of Italy when referring to the number of fires in 2003. The largest surfaces affected by the fires are in Sicily and Sardinia. Dry weather and damaged ecosystem with accumulation of dead biomass increase the risk of forest fires and therefore increased climate variability will augment the risk of forest fires.

Marine ecosystems

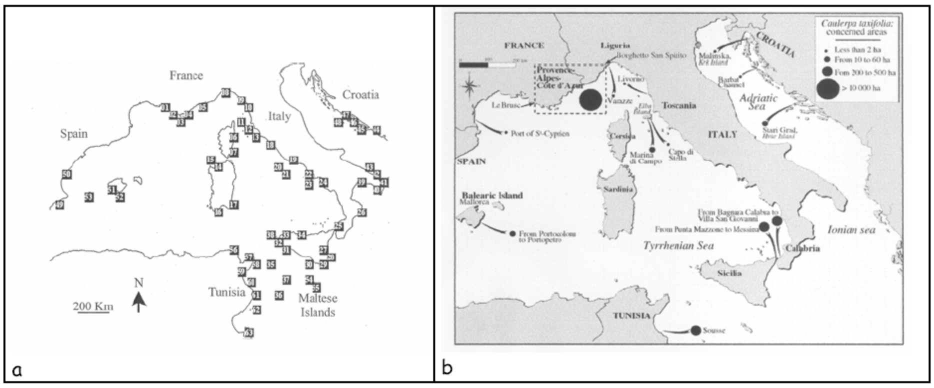
The scientific community strongly agrees that marine ecosystems and the benefits associated with them are jeopardized by the climate change which is taking place. Effects can be detected at level of single organisms, populations, communities and ecosystems and manifest themselves through changes in population size and distribution, in the habitat and ecosystem specific composition and geographic extension, and through increasing species extinction rates.

During the last 20 years studies have been carried out on benthic communities with high diversity levels, paying particular attention to costal areas having high naturalistic and socioeconomic value.

In the case of prairies of Posidonia Oceanica, a species included in the UNCED Action Paper (Agenda 21), results show how the combined action of anthropic effects and climate change negatively affects the entire ecosystem, causing seashore regression and decrease of marine life. In the Liguria sea, for example, about 30% of the original alga extension was lost in the thirty-year period between 1960 and 1990. Analysis of the decadal series regarding the growth of Posidonia shows a positive trend related to the climatic parameters for the Liguria area, representing one of the coldest parts of the Mediterranean sea.

ENEA has monitored the effects of thermal abnormalities recorded at the end of summer in 1999 and 2003 over a valuable benthic community in the Eastern Liguria sea. Events of mass mortality regarding a large number of marine invertebrates have affected a broad geographic area, from the Tuscan archipelago to the Southern France coast, causing on the whole losses higher than 50% in terms of density and biomass of several benthic species.
An additional climate change effect can be found at organism physiology level, as evidenced by repeated and increasingly frequent flowering of oceanic Posidonia in the Mediterranean sea, attributed by several authors to thermal abnormalities during the summer periods. This phenomenon is monitored since 1990.
One of the effects of water warming has been the spreading of "invasive" species never found before in the Mediterranean sea, being confined to geographic areas considered as warmer. Among the invasive species of tropical origin, those known at benthic level are the green Caulerpa Algae (Caulerpa Taxifolia and Caulerpa Racemosa) which have been monitored by ENEA, together with other National and International Research Institutes, since their first findings (fig.20). This effect, affecting above all Caulerpa Racemosa, represents an evident indication of the changes which are taking place within the basin (Piazzi et Al, 2005; Meinesz et Al, 2000).

Figure 6.20: a) Distribution of tropical alga Caulerpa Racemosa var. Cylindracea in the Western Mediterranean sea in 2003 (Piazzi, 2005) b) Status of the invasion of the tropical alga Caulerpa Taxifolia in the Mediterranean sea in 2000 (Meinesz, 2000)



In the last years, several Italian coastal stretches have been interested by the occurrence of Ostreopsis ovata, a marine dinoflagellate species (Gallitelli et al., 2005, Sansoni et al., 2003).
Some tropical species have colonized the Mediterranean Sea coming from other seas through the Suez Canal, the Strait of Gibraltar and ships' ballast water. Several toxic algal species live in the Mediterranean Sea. Recently, some tropical ichthyotoxic species have also been found in Italian seas.
Optimal climatic conditions have permitted the expansion in the Mediterranean sea of the Ostreopsis ovata microalga, commonly found in tropical seas. The first Ostreopsis flowering in the Ligurian sea was observed by ENEA in 1989 in the La Spezia gulf. Since then its presence and flowering has been detected in several other places of the Ligurian coast, especially during the summers of 1999, 2003 and 2006.

Tourism

Mediterranean area is one of the most popular tourist destinations because its climate is generally quite, benign and delightful. The annual migration of northern Europeans to the countries of the Mediterranean coast in search of the traditional summer 'sun, sand and sea' holiday is the single largest flow of tourists across the globe, accounting for one-sixth of all tourist trips in 2000. This large group of tourists, totalling around 100 million per annum, spends an estimated € 100bn per year.

Any climate-induced change in these flows of tourists and money would have very large implications for the destinations involved. The PESETA tourism case study focuses on the tourism segments most climate-dependent and sensitive to climate change; initial results are based on thermal comfort for beach tourism.

The fact that in the last years heatwaves are more frequent and persistent, often associated with low water availability, and that winter precipitation has undergone modification related to the rising altitude of the thermal zero, highlights concerns that such change could have an increasing impact on tourism. Although weather and climate are widely recognised as vitally important for tourism, relative little is known about their effects. For many regions, such as Italy, tourism is a very important source of income. Since about 40% of tourists come to Italy during summer, the hot weather can play a very important role in determining the quality of a vacation. Furthermore, the extreme hot conditions may represent a risk factor to tourists, increasing emergency room visits, especially among the elderly and those who are affected by chronic diseases.

The pattern of summer conditions may well change dramatically in the course of this century as a result of climate change. The zone with excellent conditions, which is currently located around the Mediterranean (in particular for beach tourism), will shift towards the north, perhaps as far as the North Sea or the Baltic Sea. The same holds probably for the interlinkages between tourism development and water availability.

However, conditions in spring and autumn will improve. Much will therefore depend on the tourists' response to these changes. The more tourists stay home, or switch to different destinations, the larger the distributional impact in Europe will be. How large these distributional effects will be, depends on the adaptation of tourists, tourist businesses and entire societies. The largest impact will probably be realised if the dominant form of adaptation for tourists is travelling to other destinations. In this case, many destinations (in particular in southern Europe) will suffer, although others will gain.

Many Italian cities are characterised by a mild climate, generally without temperature extremes. Together with other attractive attributes, such as history, architecture and favourable geographical position, climate helps to make Italy an important destination for tourists. Tourism activity peaks in summer, coinciding with the time when natural water availability (strongly dependent on climatic conditions) is at its lowest and creates significant pressures on existing natural water resources that lead to an increasing seasonal water deficit.

In small islands of the Mediterranean basin the groundwater is, in most cases, adequate to cover the household demand, but this is only a small fraction of the peak summer demand. The timing of Mediterranean rainfall does not usually coincide with the time of major water demand. In this way tourism will make a major contribution to the degradation and destruction of water ecosystems.

The availability of water supply could become a major constraint and the quantity and quality of water available may not be sufficient to satisfy future tourist demands. Large scale expenditure on desalinization plants will be needed, especially in some island resorts if water supplies are to be guaranteed.

There are evidence that drought of the early 1990's could make Mediterranean islands dependent on water being transported from the mainland with attendant political tensions. Small Mediterranean islands could be particular affected if tourism is allowed to continue to grow.

Climatic change due to the enhanced greenhouse effect is likely to have substantial impacts on tourism, especially regarding the choice of destination for seasonal activities. For example traditional beach resorts may become too hot for summer holidays with a much higher frequency of severe climatic stress on tourists. On the other hand, insufficient snow precipitation on mountain sites may severely affect winter sport resorts.

Summer will show more frequent extreme discomfort conditions, especially in urban environments, with strong impact on summer tourist activities.

Human health

Health effects are one of the key impacts of climate change. The most important, likely health effects of future climate change include:

• Increases in summer heat related mortality (deaths) and morbidity (illness);
• Decreases in winter cold related mortality and morbidity;
• Changes in the disease burden e.g. from vector-, water- or food-borne disease;
• Increases in the risk of accidents from extreme weather events (storms and floods).
• Impact on mortality, morbidity, disability, health systems, and health economics of extreme events (storms and floods)

Preliminary investigations on the most significant health impacts for Italy indicate the following findings:

Heatwaves

Italian populations have been affected by heatwaves. An average of 5% increase in excess deaths per degree increase of temperature has been observed. Excess mortality increased dramatically with age, with the greatest impact in the over 85 years old and in the 75-84 years old. The analyses of cause-specific mortality illustrated that the greatest excess in mortality was observed for the central nervous system, cardiovascular, respiratory diseases and metabolic\endocrine gland and psychological illnesses. Results show that the low socio-economic levels are an important risk factor. Assuming no further planned adaptation or effective adaptation, these rates could be increasing in the years to come.

The heat wave in 2003 caused more than 35,000 excess deaths across Europe. Europe was not prepared to predict, detect and prevent the health impacts of heat waves, nor did it expect a heat wave of such extend to occur. Since the dramatic death toll of the 2003 heat wave in Europe some effort has been directed towards the prevention of health impacts and the research of health impacts of heat.

Heat–related mortality does not affect the entire population but there are a series of individual factors that make specific subgroups more susceptible to the effect of heat. Descriptive analyses of individual heat wave events have suggested that hot weather predominantly affects people with limited adaptive responses living in urban areas. The elderly, small children, people who live in deprived areas and socially isolated. Furthermore, people with chronic diseases, such as cardiovascular, respiratory and cerebrovascular diseases. A recent case-crossover analysis carried out in Italy showed a higher risk of dying during hot days also for people suffering from psychiatric disorders and depression. A more controversial aspect is the role of gender in influencing the risk of dying during heat waves.

Although heat wave related mortality is present during all years in numerous locations, the number of excess deaths is strongly correlated with the type of heat wave and its meteorological characteristics. Major heat waves have been documented (table 6.6) In terms of human health the summer of 2003 was an outstanding example of increased levels of human mortality during the periods of heat waves and exceptional for the extensive loss of life, results from different studies are summarised in table 6.6 (APAT, 2007).

Following the unusually hot summer 2003, the Italian Minister of Health requested the Istituto Superiore di Sanità's Office of Statistics to undertake an epidemiologic study of mortality in Italy during summer 2003, to investigate whether there had been an excess of deaths, with a particular focus on the elderly population. Excess mortality for the summer period (June 1-August 31, 2003) was estimated comparing observed mortality in 2003 with observed counts from the previous year for all residents dying in the city of residence.

Compared to 2002 there was an overall increase in mortality of 3,134 (from 20,564 in 2002 to 23,698 in 2003) during the three summer months, with the greatest increase was among people aged 75 years and older (+92%). The increase in mortality was not homogeneous. In terms of the spatial distribution, the highest increase were observed in the North-West; again especially for the elderly in Turin (44.9%), Trento (35.2%), Milan (30.6%) and Genoa (22.2%).Worth noticing are also the apparent increases observed in two southern cities, where the weather is usually cool, such as L'Aquila (24.7%) and Potenza (25.4%). For what concerns Bari, its value of 33.8% was extremely influenced by the high mortality increase recorded during august.

Finally, in order to give the magnitude of the excess mortality occurred among the elderly population in Italy, on the basis of the mortality data recorded in the 21 Capitals of Regions as well as of the Italian demographic figures, an empiric estimate of more than 7000 deaths (7.659) exceeding was calculated. These deaths occurred within 45 days from 16 July up to the end of August 2003, compared to the year 2002, among individuals of 65 years of age and older; the mean percentage of increase was 19.1. The percentage values were higher for what concerns more populated cities (39.8% for those cities with more than 500.000 inhabitants) and lower for the smaller towns (13.8% for towns with a population equal or less than 100.000 inhabitants and 29.2% for towns with a population of 100.001 up to 500.000 inhabitants).

Table 6.6: Total and excess mortality by age group and sex in Rome, Milan and Turin during summer 2003.

Mortality *Reference period*	Rome 1995-02				Milan 1995-02				Turin 1998-02			
	Observed	Expected	Excess	%	Observed	Expected	Excess	%	Observed	Expected	Excess	%
All ages	6009	5065	944	19	2968	2409	559	23	2332	1755	577	33
0-64	915	973	-58	-6	372	407	-35	-9	307	286	21	7
65-74	1163	1112	51	5	480	503	-23	-5	416	358	58	16
75-84	1938	1541	397	26	1020	715	305	43	752	539	213	40
85	1993	1439	554	38	1096	784	312	40	857	572	285	50
GENDER												
Male	2768	2522	246	10	1299	1158	141	12	1074	859	215	25
Female	3241	2543	698	27	1669	1251	418	33	1258	896	362	40

The PESETA health project has attempted to quantify all the above effects under changed climate conditions in 2020 and 2080, but has initially concentrated on cold and heat related mortality. The preliminary results indicate that at an overall European level, the increase in the number of heat related deaths could be larger than the reduction in cold related deaths for the 2080s. The analysis shows almost 86,000 net extra deaths per year under a scenario A2 with a global mean temperature increase of 3°C in 2071-2100 relative to 1961-1990. Under scenario B2 with a global mean temperature increase of 2.2°C in 2071-2100 relative to 1961-1990, this number of net extra deaths per year halves to 36,000 (Table 6.7).

These results are preliminary and do not assume acclimatisation and do not yet separate out the impact of non-climate changes (socio-economic changes in age structure or population movements). Nonetheless, assuming a range of values of statistical life of from € 1-2m, they do show that potential economic costs of climate change are large – measured in € billions as an annual cost already in the second half of the 21st century.

Table 6.7: Preliminary Annual Average Changes in Heat and Cold Related Mortality in Europe. (2020-2080, for A2 and B2 scenarios, no acclimatisation):

A- Annual Average Mortality – Temperate Countries – no acclimatisation			
	Increase in heat related mortality	Reduction in cold related mortality	Net change in mortality
Increase in 2011-2040	13.543	-20.704	-7.161
Increase in 2071-2100 A2	58.310	-29.627	28.683
Increase in 2071-2100 B2	27.445	-20.220	7.225

B- Annual Average Mortality – Hot Countries – no acclimatisation			
	Increase in heat related mortality	Reduction in cold related mortality	Net change in mortality
Increase in 2011-2040	13.924	-3.062	10.862
Increase in 2071-2100 A2	64.122	-5.468	58.654
Increase in 2071-2100 B2	32.738	-4.061	28.677

Flooding

Floods have caused deaths, disability and disease in the past decades. Very little quantitative information is available. From other European studies it can be assumed that Italy might have faced increased cases of injuries, enteric infections, mental health such as post-traumatic stress disorder, rodent-borne disease, poisoning caused by toxic substances; the growths of moulds and spores in the aftermaths of floods; and other negative health outcomes, such as disruption of healthcare services and population displacement. Italians populations are both at risk of sea and inland floods.

There is a paucity of information available on how many people died or were injured in natural disasters in Italy. From the EmDAT database almost 140.000 people died in natural disasters since 1905. In order for a disaster to be entered into the database at least one of the following criteria has to be fulfilled: 10 or more people reported killed, 100 people reported affected, a call for international assistance, declaration of a state of emergency. The entry criteria for the EM-DAT database are good to give a global overview over disasters. For national analysis the criteria are far too high. Alternative sources reveal that from 1991 to 2001 about 12.000 landslides and more than 1000 floods in Italy have been occurred. Only the major flooding events in 2003 have affected more than 300.000 people and caused an economic damage of more than 2 million Euros. Beside this, there are many smaller flooding events which damage agricultural areas and urban areas, causing significant damage but no human victims.

Ozone

Climate change may increase the frequency and duration of extreme ozone events in particular during the warm season. The potential synergism between air pollution exposure and extreme weather events should be examined in more details. Long term studies on air pollution and respiratory diseases in various climate areas should be designed.

The delayed recovery of the ozone layer could contribute to additional numbers of melanoma in Italy.

Vector borne diseases

Italy is at risk of changes in spatial and temporal distribution of vector borne diseases. There is a high potential risk of West Nile fever cases, and an increase risk of Leishmania and of bottonneuse fever moving northward.

The importance of the mosquitoes as disease vectors it is tied up above all to the transmission of malaria, an illness that causes today still million of deaths every year in the world (WHO, 2005). In Italy malaria has been eradicated at the end of the '40. The mosquito species, that were responsible of the transmission, are still present in remarkable density in Southern regions of the country, like Sicily and Sardinia. Today, the cases of malaria annually notified in Italy are imported for the almost totality; only very few cases are locally contracted, usually following accidental events. A recent study carried out in Tuscany has appraised the parameters that define the so-called "malariogenic potential" of a country: the receptivity and the vulnerability. The three factors which determine the level of malariogenic potential are receptivity, infectability, and vulnerability. The first refers to the presence of potential vectors, the second to the possibility that the native vectors become infected with the plasmodia species, and the third one is the number of subjects carrying the gametocytes. The malariogenic potential for Italy is not very high, but it doesn't exclude nevertheless the possibility that malaria autochthonous malaria cases could occur in areas "at risk", especially in the south and in the islands.

In next decade, the constant increase of the mean temperature could widen the area of distribution of the vectors, although these are dependent from the presence of larval breeding sites during the seasonal activity of the vectors between July and September. Also the accidental importation of infected vectors from zones of endemic it is an event already happened in Italy and that would possibly cause only isolated cases of malaria. The possibility, instead, that a tropical vector can settle in our country, it appears highly unlikely because of the complexity of ecological factors linked to the different anopheline species.

Food pests

Climate change can greatly influence timing and typology of food pests and food borne diseases. For example weather determines the attack of insects on plants by influencing their capacity of over wintering, their distribution over cultivated lands, and the ranges of insects. As of food borne diseases there is a risk of fungi growths, depending however on the climate situation and how the climate will evolve.

Water borne diseases

Water borne disease outbreaks could increase, because of extreme rainfall (intense rainfall or drought) and changes in water runoff that can influence the microbiological contamination of coastal, recreational, or surface waters. There is also a direct relationship between some diarrhoeal diseases in spring and summer time.

Water-related diseases can be classified by route of transmission, thus distinguishing water-food borne (ingested) and water-washed (lack of hygiene) diseases. Climate variability can affect both water availability and water quality. There are four main considerations when evaluating current climate and health outcomes (primarily diarrhoeal disease):

- The role of extreme rainfall (intense rainfall or drought) in facilitating water-borne outbreaks of diseases through either the piped water supplies or surface water;

- Effects of temperature and runoff on microbiological contamination of coastal, recreational, or surface waters;
- Direct effects of temperature on diarrhoeal diseases
- Water stress and measures to reuse waste waters

Economic impacts

In order to evaluate the damage caused by climate change, it is necessary to know its physical impacts and to assign an economic value to these impacts.

This process turns out quite often difficult because of two reasons: the projections of the climate change impacts very often do not exist, particularly on national or regional scale (at which level usually adaptation measures are taken); it does not exist neither a monetary value for all the possible damages caused by climate change.

Scientists should compensate for the first question, by means of models allowing the downscaling of the global scenarios of climate change impacts. Up today this has been done only at limited level (particularly for Italy) and subject to great uncertainties.

The second question should be compensated by the economists, with evaluation techniques which would allow assigning a monetary value also to those items, such as biodiversity, the historical/artistic heritage or a landscape, without any market value.

Alpine Zones

Up today there are not monetary estimates which consider the impacts of climate change over the Italian alpine zones. However, there are, some estimates for the tourism, aver though an economic evaluation of all the various aspects is very complex, in particular when we want to consider the possibilities that the tourists and the tourist operators have.

The possibility to practise sport and leisure activities is directly connected to the availability and reliability of the snow cover in winter as well as to the duration itself of the summer and winter seasons.

As the "reliability line" (LAN) of the snow, which actually is located between 1200 and 1300 meters above sea level is subjected to raise at the rate of about 150m for each °C of temperature increase (Föhn 1990, and Haeberli and Beniston, 1998, the following money loss will be very likely (Table 6.8).

Table 6.8: Money loss (M€) from the skiing station deprived of reliable snow cover

	> 1.650 (+1°C)	> 1.800 (+2°C)	> 2.100 (+4°C)
Valle d'Aosta	4.706	13.977	39.861
Piemonte	10.666	18.667	32.000
Lombardia	Na	Na	Na
Veneto	Na	Na	Na
Trentino	Na	Na	Na
Alto Adige	23.762	92.081	139.607
Friuli Venezia Giulia	13.625	13.625	13.625

Source: EURAC (2007) and HERMES (2005)

Water resources

At present, there are not available estimates for Italy regarding the inaction and the adaptation costs to the impacts of climate change over the water resources.

The only available information apply to the past. In Italy, for example, the 28 great flooding which occurred between 1939 and 2004 caused 694 casualties, leaving 1.5 million people homeless, hitting 2.85 million people and producing 23.7 billion US$ damages. Between 1991 and 2003 more than 12 thousand landslides occurred: the 13 most devastating landslides caused 2584 casualties, 3.7 times the number of casualties of the main flooding. According to the EM-DAT database, damages caused by the main landslides in Italy amount to about 1.2 billion US$, even though damages in terms of casualties are obviously higher. According to APAT (2006) urgent preventive measures which had been funded up to 2006 amounted to 447,36 million Euro for flooding risks and 667,88 million Euro for landslide risks. As far as the impact on agricultural land is concerned, table 6.9 shows a preliminary evaluation of the value of lands currently at risk in Lombardy, Latium and Calabrian.

Table 6.9: Value of farmland exposed to hydrological risk in Lombardy, Latium and Calabria

		LANDSLIDES	
Value of land at risk (thousand Euro)	LOMBARDY	LATIUM	CALABRIA
sowable ground	9.805,7	14.278,1	4.256,2
stable meadows	4.762,6	195	197,6
orchards	51.121,7	2.445,5	642,8
natural grazing lands and high altitude grassland	3.193,3	5.911,5	583,2
complex crop and particle (?) systems	11.237,6	8.413,8	5.460,9
crops (25<S<75%) + major natural areas	9.048,6	12.377,1	4.972,7
vineyards	9.151,6	1.072,5	23,9
olive groves	97	7.614,2	20.148,5
TOTALS	**98.418,1**	**52.307,6**	**36.285,9**
		FLOODINGS	
	LOMBARDY	LATIUM	CALABRIAN
sowable ground	12.848,2	36.850,8	5.914,4
stable meadows	205,2		
orchards	14,4	766,4	22.067,1
natural grazing lands and high altitude grassland	1.195,5	340	37,5
complex crop and particle (?) systems	30,1	137,3	176,6
crops (25<S<75%) + major natural areas	998,4	1.617,6	1.809,9
vineyards	983	2.093,9	1.942,6
olive groves		265,8	202,7
sowable ground		244,5	12.386,7
TOTALS	**16.274,8**	**42.316,1**	**44.537,6**

Elaboration of CORINE, APAT, INEA and EU-FEDN data.

Coasts and marine environment

Over the last years studies have been performed to evaluate the impact of rising water level in some specific areas. For example, a study carried out by Fondazione Eni Enrico Mattei together with ENEA as from 2002 assesses the economic cost of direct climate change impacts for two Italian coastal areas, the Fondi plain (Latium) and the river Sangro plain (Abruzzo). This study provides an assessment of the damage caused by climate change for the 2100 reference scenario equal to about 14 million Euro (Breil

et al., 2007). Nevertheless, by adding to rising water level the hydro geological risk, damage due to soil losses would amount to about 73 million Euro.
There is also a number of studies which evaluate the financial impact of climate change on the seaside tourist business in Italy. Results of the WISE project (Galeotti, Goria et al., 2004), based on data relative to the overnight stay/night ratio and to arrivals in Italy from 1986 to 1995, show that extremely hot summers reduce tourist streams by 1.22% over the regional average, except in coastal areas where a slight increase has been observed (Gambarellli and Goria 2004).

Desertification

During the UNCCD meeting held in Rome in the month of June 2006, it was stressed the lack of economic studies concerning desertification costs. This situation is at least partially justified by the difficulty of developing an integrated methodology for analysing direct and indirect costs of this phenomenon on regional and also global scale. In absence of specific studies in the Italian context, an approximate appraisal of desertification costs in Italy could be obtained by considering the appraisal available at global level, or those made for other countries. For example, Dregne's and Nan-Ting Choud's study (1992), based on a geographical approach, valued a desertification annual cost on a worldwide scale in reference to 1990 equal to about 42 billion US$ (11 billion due to loss of irrigated land, 8 of non-irrigated land, and 23 of grazing land). By applying this estimate to Italy one would get a total annual cost (relating to the 16.500 km2 vulnerable soil surface) between 60 and 412 billion US$.

Adaptation measures

In order to reduce the economic and environmental costs of climate change, mitigation policies and measures must be accompanied by sound adaptation strategies.

The world is facing a double challenge: we will have to reduce our greenhouse gas emissions while adapting to the changing climate conditions (UE, Green Paper, SEC(2007) 849). Adaptation strategies not only involve straightforward passive defence actions, to be realised by means of the implementation on the territory of public works, but instead a new way of smart planning the human activities interacting with the environment and the natural resources, in the light of the climate changes taking place.

Adaptation measures and activities are taking place in many countries, often in the contexts of natural hazard prevention, environment protection, and sustainable resource management. These measures are often initiated on an ad-hoc basis. These measures are usually initiated with a sectorial view (e.g. water resource management) and implementation by different sectors and organizations (e.g. local authorities), and often prompted by the impacts of recent extreme weather events.

A very strong international commitment to cut greenhouse gas emissions is needed to reduce the risks related to climate change. Mitigation efforts are likely to reduce the hardest consequences of climate change and in doing so, they will also reduce the need to implement adaptation measures.

The national conference on climate change 2007

Mitigation strategies aim at slowing down the pace and limiting the adverse impacts of climate change, while the adoption of adaptation plans, programmes and actions aims at reducing land vulnerability and limiting the exposure to socio economic adverse consequences. Adaptation strategies might also be a means to exploit new development opportunities eventually brought about by climate change.

Adaptation is an "anticipatory" choice to prevent negative consequences and minimise the potential damages and, for this reason, it depends strongly on a accurate risks and costs assessment. Adaptation strategies have to be developed at national level because they imply strategic decisions regarding the management of the peculiarities and vulnerabilities of the territory, economic activities and resources.

The Ministry for the Environment, Land and Sea has organised the National Conference on Climate Change (MATTM 2007a). Several preparatory workshops were organised in collaboration with the National System of Environmental Agencies to prepare documents and studies to present and discuss at the same Conference.

These workshops focused on the most critical national situations, such as desertification (Alghero, June, 21-22, 2007), erosion and coastal areas flooding (Palermo, June 27-28, 2007), glaciers and snow covers lost (Saint Vincent, July 2-3, 2007), hydro-geological risk (Naples, July 9-10, 2007) and hydrographic area of the river Po (Parma, July 16, 2007).

The environmental analysis has been integrated by socio-economic considerations in order to identify and evaluate those adaptation options that best suit the new risk potential. This evaluation necessarily requires the participation of the main stakeholders, such as central and local authorities, companies, non governmental organisations and citizens.

To complete the preparatory works for the National Conference on Climate Change, two other conferences have been held during the summer. The first one (Roma, June 25, 2007) focused on the effects of climate change on health, while the second one was dedicated to the updating of the national greenhouse gas emissions inventory (Brindisi, July 20, 2007).

The Conference (Roma, September 12-13, 2007) has analysed the problems concerning the changes in the level of vulnerability brought about by climate change and the applicable adaptation options (i.e. passive defence, active defence, insurance defence, no action) and has proposed concrete actions on the basis of the preparatory workshops and conferences.

Implemented and projected measures

The focus of climate change adaptation is on mainstreaming actions into sectoral policies rather than developing a stand alone adaptation strategy. In such respect, relevant ministries, local government and specific authorities work in parallel in their respective areas.
Adaptation measures range from the legal frameworks and monitoring to surveillance of early impacts and early warning. A wide range of activities have been initiated, and progress has been made in building and enhancing adaptive capacity across Europe.
Adaptation is developed in particular in the fields of coastal protection, agriculture, and desertification. MATTM is responsible for adaptation measures of national importance such as biodiversity, natural reserves, marine environment and assessment of environmental impact.
Only a few and site-specific economic assessments on adaptation exist in Italy.
Several studies on the implementation of adaptation measures have been carried out for the agricultural sector, focussing on management of seeding and harvesting methods and on allocation of water resources. The results indicate that even moderate adaptation policies may considerably reduce agricultural damage caused by climate change. Correct market signals are cited as being important in modifying human behaviour for implementing appropriate adaptation strategies.
In 2003, a network has been established for the prevention of the health effects of heat-waves, coordinated and financed by the National Department of Civil Protection at the national level. In collaboration with a centralized data centre, the Department coordinates a network of experts from epidemiological departments, local health authorities and regional agencies of the environment and civil protection. At the municipal level, local centres coordinate the work. The implementation of this plan includes development of a forecasting model; identification of intervention plans for each city; identification of the network of organizations/services to be involved; and evaluation of the effectiveness of the system in preventing excess mortality. The heat/health watch/warning system (HHWWS) is to be improved and its operation to be expanded to other Italian cities.

Coastal zones

It is not economically sustainable to implement adaptation measures for all the national coastal lowlands (about 4,000 km); protective measures only for those coasts already subject to erosion implies enormous investments (about 2 billions euros) that need to be repeated over time.
Since the ’70 different protective measures have been experimented to face coastal zones’ erosion and flooding and their results have been continuously monitored. The analysis has suggested the need to adopt national guidelines for their planning, construction, maintenance and monitoring.
Adaptation strategies in coastal zones vary from abandoning the coasts to their natural evolution to adopting proactive measures to manage and react to the main climate change impacts. Several measures may be taken into consideration, such as creating soft natural zones between land and sea, restoring dunes ecosystems and sediment input exchange systems between dunes and beaches defending the coastline with soft measures instead of hard ones. In some cases these options involve the reach of a new equilibrium point between man and nature.
The choice of the most suitable adaptation option must be based on an economic assessment of the area concerned: an example of such a study can be the pilot research conducted on the Piana di Fondi

(Gambarelli, 2004). In order to develop a methodological approach that can be used for all the coasts, it is necessary to build on the existing adaptation measures already adopted in some areas, trying to improve the capacity to manage the coast at short, medium and long time scales (MATTM, 2007b).

Water and health

National and local governments across Europe have developed and implemented early warning systems, however, warning systems are ineffective if not integrated with response plans. Comprehensive heat-wave plans include rapid health system preparedness and response, urban planning and indoor house improvements. To date, few countries have such plans, and different European and national projects aim to review and evaluated these systems in order to provided valuable information to support policymakers.

In 2004, the Italian Department for Civil Protection implemented a three-year national project for the prevention of heat-health effects during summer. The main objectives of the project are: the implementation of city-specific heat/health watch/warning systems (HHWWS), the development of "real time" surveillance systems for monitoring the impact of heat on mortality and evaluating the performance of warning systems and the introduction of national and local prevention programs.

The project aims to include all cities with a population greater then 200,000 inhabitants, and successively extended HHWWS to smaller cities and regional capitals; thus having a national network (De' Donato F, 2005). In 2006 warning systems will be operational in 13 cities and experimental in 11 cities. At a national level, the National Centre for Prevention of Heat Health Effects (NCC) coordinates the project and is responsible for data collection, the running of surveillance systems, as well as the development and the production of daily warning bulletins. Warnings are distributed throughout the network to all the local centres, where the local centre in charge (Civil protection, municipality etc) coordinates the local information network and activates prevention programs. Alongside the national project and warning systems each city is free to develop and adopt local warning systems as has been done in Turin and the Piedmont region, Florence and the hinterland of Bologna and Reggio Emilia Region as well as other cities in which the warning system is run experimentally.

Furthermore, in 2006 the National Centre for prevention and monitoring of disease (CCM) of the Italian Ministry of Health defined a national prevention program for the definition of heat health effects. The project includes the definition and identification of susceptible populations, the definition of the local network for the distribution of warning bulletin and review of local heat-health guide lines and definition on national guide lines. The prevention program will include all the cities which have a warning system.

Waterborne diseases constitute a significant health burden in all countries of the European region. Surveillance of the endemic burden of water-related disease is important to set overall targets and monitor progress towards these targets. The Protocol on Water and Health of the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes sets its objectives at protecting human health through improving water management and preventing, controlling and reducing water-related diseases. Articles 6 and 7 of the Protocol oblige Parties to establish national and/or local targets, and to periodically review and assess progress made towards the targets including the reduction of the scale of outbreaks and incidents of water-related diseases. Article 8 obliges the Parties to ensure establishment, improvement, and maintenance of comprehensive national and/or local surveillance and early-warning systems.

The diseases of importance for the Protocol that are notifiable and monitored by national surveillance schemes should be taken up first for the Protocol reporting purpose, while diseases of importance that are not notifiable but monitored by national systems should be introduced for reporting at a later stage.
Surveillance systems may vary from country to country. The responsibility for coordinating water-borne surveillance varies among the EU countries. In most of the countries waterborne disease surveillance is governed by national laws as part of the National Health Service.
The following are aspects for success surveillance systems:

- Information source: reporting from multidisciplinary sources; typically from physicians and clinical laboratories.
- Data quality: application of appropriate case definition and use of methods that allow accurate confirmation.
- Data consistency: information that is comparable nationally.
- Data transmission speed: possible use of electronic system to ensure timely reporting for effective detection of diseases and response.

Agriculture and water resources

The agricultural sector needs to develop its own adaptation strategies to counteract the agronomic and economic adverse effects of climate change. New measures are needed to reduce the risk of losses and, with reference to some specific cultures, even try to take advantage of climate change.
The economic measures will be aimed at avoiding the adverse effects of new production patterns on prices, while the agronomic measures will be aimed at reducing production losses. Some adjustments will probably be needed in any case; in the short term there will be a need to adapt and optimize the agronomic production to the different climatic conditions without radically changing the production system, such as:

- employment of cultivar with different characteristics;
- substitution of the existing species;
- agronomic practices change and fertilizers e anti-parasites switch;
- introduction of new techniques to keep the soil moisture and improve plant watering management;

In the long term there will be a need to adopt more radical measures involving structural changes that need to be planned at a high level, such as:

- land use change;
- development of new cultivars, especially those that better adapt to heat and water scarcity;
- substitution of the existing species;
- changing the agricultural species micro-climate

The analysis of the causes of vulnerability for the agricultural systems highlighted that water stress is by far the decisive factor determining the vulnerability of the main regional cultures. As regards adaptation policies and measures that could be adopted in the short and medium term, the most urgent are those concerning the improvement of the irrigation water management, including the adoption of the most efficient irrigation technologies.

When choosing the agricultural species to grow in a specific area, the most important circumstances to be taken into consideration are drought resistance, salinity tolerance, early ripening. As regards water scarcity resistance the following considerations may be noted:
a) wheat: the hard species are more resistant than the soft ones; the early ripening species more resistant than the late ripening ones;
b) barley: it is generally more resistant than wheat;
c) oat: the early ripening species more resistant than the late ripening ones;
d) legumes: the following legumes are sorted in descending order: broad beans, white lupines, lentils, chick peas, green peas;
e) vetches and Greek hay are more resistant than the crimson clover;
f) lawns: the following lawns are sorted in descending order: sulla, medica, lupinella, red clover.
A better understanding of water scarcity impacts on plants is of vital importance to improve both the agricultural practices concerning an optimum water use and the breeding and selection efforts aimed at obtaining new species that easily adapt to the changed climate conditions.
In order to breed and select those varieties that best adapt to climate change, the RIADE Project run by ENEA studied many varieties of wheat and of other species, such as: Lenticchia Lens esculentum (culinaria), various types of broad beans (Vicia faba major, Vicia faba minor), Lupines (Lupinus albus e Lupinus angustifolius), barley (Hordeum vulgare), chick peas (Cicer arietinum), artichoke (Cynara scolymus)**,** Brassica (Brassica carinata) and Carthamus (Carthamus tinctorius).

Ecosystems and biodiversity

The adaptation capacity of natural systems to climate change will have to be strenghten through the adoption of adaptation measures promoting:

- The development of efficient ecological corridors that allow species migration in fragmented landscapes;
- The integration of climate change considerations into all land-use planning and management processes;
- The surveillance of the most competitive species;
- Widespread protection projects for endangered species.

Desertification

The National Action Programme to Combat Drought and Desertification, approved by the Inter-Ministerial Committee for economic Planning in 1999, provides for a set of actions to reduce the vulnerability to desertification and to adapt to climate change. The Plan entrusted the Regions and Watershed Authorities with the responsibility to implement specific agronomic, civil and social measures and to adopt supporting information, training and research programmes in the following overriding sectors:
- Soil protection
- Sustainable management of water resources
- Reduction of environmental impact from productive activities
- Land restoration

The National Committee to Combat Drought and/or Desertification, created by the Council of Ministers Decree of 26 September 1997, in 2005 and 2006 started some pilot project in the five most affected regions.

The proposal for a framework directive for soil protection (COM (2006) 232) sets out common principles for protecting soils across the EU. It represent a valuable opportunity to start new soil protection and monitoring activities to prevent desertification (activities for the protection and rational use of soil, water resources, vegetation, land and ecosystems) mitigate its effects (land use integrated planning and application of sustainable ways of exploitation) and restore the ecosystem's functionality.

Adaptation strategies against desertification also involve water and groundwater protection. The European Commission regards water scarcity and droughts as a key challenge and has thus identified an initial set of policy options to be taken at European, national and regional levels to address the problem. Amongst the measures proposed are: a sound water pricing policy; an efficient resource allocation; a better drought risk management; water saving promotion; better information. Water protection plans will have to take into consideration different climate change scenarios.

Tourism

There are different strategies that the tourism sector can adopt to cope with the demand oscillations induced by climate change. As regards coastal tourism, adaptation strategies will focus on coastline protection that will, in turn, help protect the coastal tourism industry against erosion and flooding risks. The main available adaptation options have already been described previously. The tourism industry will also have to cope with the climate-induced change in the seasonal flow of tourists. To face this challenge it will be necessary to differentiate the tourism offer and to strengthen the seasonal diversification.

Also the winter tourism industry will have to adopt climate change adaptation strategies to cope with the decrease in the naturally snow-reliable ski areas. Adaptation strategies include technological solutions and the development of new business models. The main available technological solutions are: developing north facing slopes; extending and improving existing ski areas to higher elevations; slope development; tree planting to protect the slopes and artificial snowmaking. Snowmaking is surely the most common and widespread adaptation strategy in Italy (about 77% of the Italian ski areas are already covered by snowmaking systems).

Apart from the adoption of technical adaptation measures, adaptation to climate change also include the development of new business models that can lead to winter revenue diversification, including both snow related and non snow related offers (health tourism, congress tourism, other sports and popular activities, etc).

Energy Sector

Climate change has already caused the switching from a winter peaking regime to a summer peaking regime, thus increasing the vulnerability of the Italian electrical system. This trend is likely to continue and even worsen in the future and it might require an increase in the power reserve margin to guarantee a sound demand balancing during the summer season.

During the summer season, the hydroelectric production is usually lower, while the thermoelectric production could be affected by water scarcity for cooling needs and by the reduced efficiency of the combined cycles due to a reduction in air density. Amongst renewable energy sources, only photovoltaic plants can benefit from a stronger insulation, while wind production would probably be affected in case of increased air stillness (Zorzoli, 2007). The electric grid vulnerability can be reduced by improving its

interconnection capacity and by developing decentralized electric power generation systems and local micro grids (Arnell, 2005).
The decreasing hydroelectric production can be particularly critical for the electric system. The hydroelectric production not only contributes to satisfy the base load of the system but it also contributes to manage peak-load periods by using water previously pumped into an elevated storage reservoir during off-peak periods when excess generating capacity is available to do so. Given the likely adverse effects of climate change on the reliability of the hydroelectric production, it is necessary to start to adopt all the available energy storage solutions (pump-storage installations, hydrogen production).
Even the thermoelectric production will be affected by water scarcity because of its cooling needs. It is therefore necessary to avoid the construction of big thermoelectric plants that usually use a large amount of cooling water, and invest instead on small tri-generation plants with lower cooling needs and particularly on highly efficient micro generators.
It is also important to promote the diffusion of highly efficient technologies such as heat pumps, combined photovoltaic/thermal powered conditioners.
In the medium-long term, the replacement of fossil fuels with renewable energy sources can be considered as an efficient adaptation measure (Hanson, 2006). Given Italy's geographical and climatic peculiarities, it would be reasonable to develop those renewable energy sources that are not negatively affected by climate change, such as solar and geothermal energy with a low heat content that can be used for heating and cooling purposes. Biomass energy exploitation could be negatively affected by water scarcity, desertification and net agricultural land loss; it would therefore be wise to avoid the construction of oversized infrastructures and national grids and developing instead a local production system. As for wind energy, the possible relation between climate change and wind patterns change and its implications for Italy still needs to be studied.
As regards energy supply, the vulnerability of the electric system can be reduced through mitigation efforts aimed at the reduction of energy consumption and of the related greenhouse gas emissions. This result can be achieved through the adoption of energy saving policies and measures, such as more stringent building regulations, energy standards for new appliances, increased energy prices, education and training on energy saving issues. In order to reduce the summer peak, it is of great importance to adopt measures aimed at improving the efficiency of air conditioning systems. The legislation introduced at European level (i.e. directive 2005/32/CE on eco-design requirements applicable to energy consuming products) will help improve the efficiency of air conditioners newly put on the market, but specific measures are still needed to speed up the replacement of the old and inefficient ones. It is also necessary to reduce air conditioning demand through the diffusion of passive cooling techniques and the improvement of the energy performance of buildings.

Conclusions of the Italian national conference on climate change

Climate change is a national problem. Strategies to counteract its effects should be high on the Government's agenda. As should be the integration of adaptation measures and actions aimed at reducing greenhouse gas emissions into social, economic, financial, and agricultural and land policies. These actions can and should also produce new job opportunities. The protection, well-being and quality of life of present and future Italian citizens depend on the health of the Planet and on its climate. By 2008, the Italian Ministry for the Environment, Land and Sea commits to drafting a national sustainable adaptation and land protection strategy.

1. Based on the outcome of the National Conference, and consistently with the strategies outlined by the United Nations (in particular the UN Framework Convention on Climate Change - UNFCCC) and by the European Union, effective climate change mitigation policies need to be developed, thus fulfilling our commitment to work with the appropriate international bodies to significantly reduce greenhouse gas emissions responsible for climate change. At the same time, effective measures in favour of energy savings, energy efficiency and the sustainable use of renewable energy sources need to be implemented. The first step is the implementation of the Kyoto Protocol by 2012 and - during the forthcoming re-negotiation of the emission reduction targets - proceed to the further reduction of greenhouse gas emissions as indicated by the European Union, equivalent to at least 20% by 2020 (which we hope will reach EU expectations of 30% in the framework of a global treaty) and to 60% by 2050, consistently with the recommendations set by the Intergovernmental Panel on Climate Change (IPCC).

2. Mitigation measures to climate change need to be coordinated with adaptation measures, integrating the latter from the very onset into sectorial economic policies, into legislation and funding programmes for large public works. Adaptation measures that can be implemented immediately need to be defined, starting from policies concerning:

- ecosystem and biodiversity protection (marine and terrestrial)
- soil and coastal management
- water resource management
- population health protection
- agriculture and rural development
- industry and energy
- tourism

In this context, top priority must be given to the implementation of the following legal frameworks:
a) The Water Framework Directive 2000/60 (Water resources)
b) The Habitat Directive 92/43/EEC and the Birds Directive 79/409/EEC (Biodiversity)
c) The International Convention for the Protection of the Alps
d) The national accounts system on the Environment (Proxy Law)

Another top priority is the completion of the environmental assessment policy reforms, particularly concerning the integration of Strategic Environmental Assessments in the new programmes.

3. The immediate definition of a National Adaptation Plan to Climate Change is also urgently required. The Plan should engage the Government as a whole, local and regional institutions and social parts. Furthermore, it should be linked to the inception and integrated with the implementation of the two plans foreseen by the Convention on Biodiversity (CBD) and by the UN Convention to Combat Desertification (UNCDD), and namely:

- The National Plan for Biodiversity, particularly focusing on restoration ecology and defragmentation and,
- The National Action Plan to Combat Desertification and Drought.

Furthermore, in the spirit of true environmental sustainability, the Plan will have to include the best strategic actions aiming at:

- soil protection
- integrated coastal zone management
- tourism adaptation in Italy
- water resource management
- a national participation, information and awareness-raising programme devoted to climate change

The complexity of the issue of climate change and of its links to national socio-economic development and international issues (related to European policies and to Community Directives, as well as to extra-European and international relations), demands that the National Adaptation Plan to Climate Change be in line with the mitigation strategies and the research programmes focusing on climate change and training.

The need to develop strategies and adaptation plans at different territorial levels demands that administrations dealing with these issues have access to data, information and documentation, and that they prepare periodical reports on the state of project implementation. To achieve these goals, and following the German example, it is essential that the Agency for Environmental Protection and Technical Services (APAT) be appointed as the Central Authority on the impacts and adaptation measures to climate change.

4. Measures to assist developing countries in planning and implementing sustainable adaptation plans need to be promoted, particularly with a view to preventing social disparities. The institution of a European Fund for Adaptation in support of the integration of the sustainability concept in adaptation policies will be proposed. The aim of the Fund is to offer assistance to adaptation initiatives being carried out in developing countries, particularly in those within the Mediterranean Basin.

5. It is hoped that the commitment of the Italian Government to integrate the adaptation logic within its general and sectorial policies can be achieved within the next three years. To monitor progress, and to conform policies to the pressing rate at which climate is changing, it is hoped that the National Conference on Climate Change may be repeated at regular intervals, corresponding at any rate to the output of IPCC reports, and that it may include updating.

The first 13 actions for sustainable adaptation

From the Italian National Conference on Climate Change and from preparatory works several indications emerge for the priority action of the Ministry of Environment. The Ministry commits to become promoter of a large policy, coordinated with the other competent Ministries.

1) Start a wide research and knowledge work about major critical issues linked to the effects of climate change; engage in the preparation of a yearly report on the monitoring of climate change and its effects on the environment, on citizens' health, on the economy; imply in a widely way the world of research and university.

2) Confirm and expand the incentives system for energy savings in the residential sector; start a programme for supporting bio-architecture (bio-building), defining the regulations which may help its development, with the aim to integrate actions of greenhouse gases reduction with those of adaptation to changing climate.

3) Engage in the incitation of new forms of consumption compatible with the needs of adaptation to climate, starting by the promotion of water labelling of goods and products.

4) Adjust water resources management to climate change. Start voluntary actions for water economies in agriculture through a pact with agriculture organisations; avoid the exploitation of waterbeds in the neighbourhood of wetlands of high natural value; conserve water and distribute it avoiding wastes.

5) Respond to the impact of climate change on agriculture. Defend Italian typical products, supporting quality agriculture and organic agriculture, promoting traditional cultivations resistant to the minor availability of water, supporting the cultivation of forests as maintenance of territory.

6) Set in security Italian coasts. Adjust urban areas regulations for the coastline, rethink port infrastructures, transport networks, energy plants localisation in relation to the modification of the coastline; restore the coastal dunes and wetlands.

7) Respond to the expected increase in the frequency and gravity of extreme events restoring and setting back in security major hydro-geological risk areas. Apply security regulations for buildings in rivers' expansion areas and in areas at risk of landslides and avalanches, reforest low vegetal cover areas with the aim of mitigating the climate warming effects and adapting the territory to induced risks (soil defence, desertification).

8) Provide action for a sustainable management of marine resources; start mechanisms for the development of sustainable fishing; put in place a recovery plan for the river resource, coordinating actions of ecosystem safeguard and water resources management.

9) Think to the mountain: encourage a tourism less linked to skiing needs, more aware of the natural heritage. Aim to the requalification of skiing areas, submit the realisation of new infrastructures to the verification of economic convenience and feasibility.

10) Insert in health strategies the variable of the new risks connected to climate for what concerns both localisation and functioning of health structures.

11) Set an even more efficient system of meteorological early warning in the higher risk areas for floods and landslides, in order to intervene in a preventive way where it is already known that emergencies will happen.

12) Increase the level of citizens participation and involvement in policies for mitigation and adaptation to climate change; launch initiatives for raising public awareness and democratic participation with the realisation of the Climate Day, to be held the day of the ratification of the Kyoto Protocol (16th February).
13) Realize forms of environmental incentives for labour and enterprises also in relation to the new regulation for on environmental accountability.

CHAPTER 7
FINANCIAL RESOURCES AND TECHNOLOGY TRANSFER

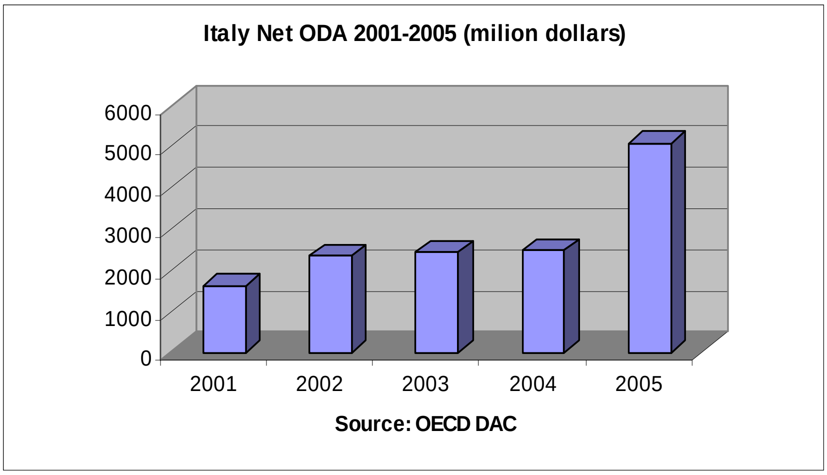
Introduction

This chapter provides an overview of the measures adopted by Italy between 2001 and 2005 in undertaking the commitments of the United Nations framework Convention on Climate Change , articles 4.3, 4.4 and 4.5. As set forth in these articles, the industrialized 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 programmes and projects, promote the transfer of technologies aimed at reducing the impacts of human activities on climate change and support adaptation measures.

Official Development Assistance

Italian ODA volumes slowly declined through late 1990s, but have risen slightly since 2000.. Growth of the nation's official development assistance has been irregular, generally due to government-wide budget austerity policies, but periodically accelerated following major political initiatives (e.g. debt relief, Global Fund, Iraq).

In the latter part of the 1990s Italian development co-operation went through a process of clarification of its sector and thematic priorities, which resulted in a set of policy statements. In 1995 the Interministerial Committee on Economic Planning (CIPE - Comitato Interministeriale per la Programmazione Economica) approved the Guidelines for a New Policy on Development Co-operation which listed different sectors of intervention according to political, economic and humanitarian objectives. The subsequent adoption by the Directorate-General for Development Co-operation- DGCS- of the Poverty Reduction Guidelines in 1999 further refined the policy framework of the Italian development programme, putting it in line with DAC work on poverty reduction, and paving the way to a series of policy documents covering various work areas of DGCS. Italian ODA is almost entirely in the form of grants, with the exception of a small number of development loans (5% of total ODA). In terms of the volume of its aid, Italy is the seventh largest DAC donor, with a 2005 official development assistance (ODA) volume of USD 5 091 million, representing 0.29% of Italian Gross National Income (GNI) and an increase of more than 106% in comparison with 2001-2004 levels. Such increase responds to the commitment to development Italy has made since the 2000 Peer Review. It was agreed in Barcelona (2002) to more than double the volume of its ODA by 2006 to an ODA/GNI target of 0.33%.



Italy's national interests are closely intertwined with many other developing nations in proximity to its borders and elsewhere in the world. It has become one of the world's most active and innovative donors on debt relief since passage of a law on the topic (2000). It similarly took a lead position in launching its support for the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) in 2001, played a lead role in the OECD Bologna process for Small and Medium Enterprise and, at Palermo, hosted an initiative on e government (2002). Finally, it has made active contributions to the crises in both Afghanistan and Iraq, and it hosted the Rome High Level Forum on Harmonisation (2003).

OECD statistics show Italy's bilateral aid sector allocation priorities over 2002-03 has been heavily marked by actions related to debt relief (54%, against a Total DAC average of only 13%). Other notable priority sectors include social infrastructure and services (15%), commodity and programme aid (6%) and emergency assistance (8%). One noticeable trend of interest is the reduction in economic infrastructure investment, down to 1% from a high of 24% one decade earlier. Italy continues to be the DAC member with the highest percentage of multilateral aid (51% of total ODA in 2003).

Multilateral cooperation for the environment

The paragraph details the cooperation on environmental issues that Italy carried out from 2001 to 2005 jointly with international multilateral organisations. Such cooperation has involved a wide range of activities, from the supply of financial resources, to the design and implementation of programmes and projects, the promotion of transfer of environmentally-sound technologies aiming at reducing the impacts of human activities on climate change, and support to adaptation measures.

In particular, the cooperation was performed with UNESCO, the Regional Environmental Centre for Central and Eastern Europe (REC), the Global Environment Facility (GEF), the World Bank (WB), the Food and Agriculture Organisation (FAO) and the United Nations Development Programme (UNEP) and the Mediterranean Action Plan (MAP).

In January 2003, the Italian Ministry for the Environment Land and Sea (IMELS) together with **UNESCO** launched the partnership "Water Programme for Africa, Arid and Water Scarce Zones" (WPA) aiming at implementing projects in the field of sustainable and optimal management of water resources in critical areas.

During the First Phase (2005-2006) of the Programme, specific activities were carried out in five different countries (Algeria, Egypt, Eritrea, Vietnam, Yemen) in order to build up technical knowledge to central authorities for the definition of policies and projects on water resources management.

The Second Phase (2007-2008) of the Program, entitled "Water Programme for Environmental Sustainability - Towards adaptation measures to human and climate change impacts", is under development and aims to define projects dealing with sustainable water resources management in particularly vulnerable areas (North-Africa, Latin America, China, South-East Asia) to the effects of climate change.

For the program, IMELS allocated 1.3 mil. US$ for the first biennium, while the allocation for the second one, following the outstanding results of the first phase, rose to 3 mil. US$.

In Eastern Europe, the main multilateral activities are implemented through the Italian Trust Fund (ITF) established in 2001 as a targeted contribution to the **REC**. To date, the contribution from IMELS amounts at € 8.000.000. The ITF operates in support of environmental improvement and cooperation in Central and Eastern European countries. With particular reference to climate change and energy issues, several activities were carried out on training and capacity building, energy efficiency in small and medium-sized enterprises, public access to information and participation in climate-related decision-making, promotion of climate change mitigation and adaptation policies, development of solar passive and active systems and development of national greenhouse-gas emission registries.

International Year of Deserts and Desertification

The United Nations General Assembly, during its 58th session, adopted a resolution (A/Res/58/211) which declares 2006 the International Year of Deserts and Desertification. The decision was taken to help prevent the exacerbation of desertification around the globe. The General Assembly invited all countries, international and civil society organizations to celebrate the Year 2006 and to support public awareness activities related to desertification and land degradation. More and more desertification and land degradation processes are part of the interlinkages with climate changes, water and biodiversity.

In this framework the Italian Government co-financed and organized, together with the Algerian Minister for the Environment, Honorary Ambassador for the Year 2006, and with the UNCCD Secretariat several events and activities, including communication strategy and information material:

- 60th UN General Assembly: International Press Conference on Deserts and Desertification; *September 15, 2005 – New York*
- Round Table on "Global Challenges related to: Climate Change, Desertification, Biodiversity, Water Management"; *October 2, 2005 – Viterbo*
- 60th UN General Assembly: International Press Conference for the launch of the International Year of Deserts and Desertification; *November 2, 2005 – New York*
- International Conference on the role of NGO's in the Fight Against Desertification, Rome, Ministry of Foreign Affairs , January 2007
- International Conference "Women and Desertification"; *May 29- June 1, 2006 – Beijing*
- International Exhibition "Combating Desertification: science, technologies and daily life"; *June 12, December 15 2006, United Nations office, Geneva*
- International Conference "Youth and Desertification"; *September 2-4, 2006-Bamako*
- Round Table on "Assessing the UNCCD process and identifying challenges ahead"; *November 1-2, 2006 – New York*
- The Third Festival of Cultures and Civilization of World Deserts; *December 13-20, 2006 – Alger*
- International Film Festival "Desert Nights, Tales from the Desert", *Rome December 2006*

The GEF, in the period 2001-2006 received around 58 million euro as a financial contribution from Italy for its activities related to climate change. In the year 2003, Italy started its financial support to the new climate change funds by giving 780.000 euro to the LDC fund. In 2006, Italy announced its contribution of 1 additional million euro in support to the LDC fund and decided to pledge 10 million euro for the Special Climate Change Fund.

In addition to the Italian contribution to the **Global Environment Facility** (GEF) replenishment, the Italian Ministry for the Environment, Land and Sea co-financed the following GEF-funded projects.

In 2003, IMELS co-financed with US$ 100.000 the preparation phase for the development of a program of activities and outputs aimed at explicitly integrating the groundwater "variable" into the overall basin management, and as input to the GEF project "***A Framework for Sustainable Water Resources Management in the la Plata Basin, with respect to the Hydrological Effects of Climatic***

Variability and Change". The Italian contribution focused in particular on the semi-arid zone of the Gran Chaco Americano and its major aquifer, the Toba-Ieredà.

IMELS also participated with the amount of US$ 500.000 in the GEF/UNEP project "***Russian Federation – Support to the National Programme of Action for the Protection of the Arctic Marine Environment***". The project aims at developing a nationally-approved Strategic Action Programme to address damage and threats to the Arctic environment from land-based activities in the Russian Federation; improving the environmental protection (legislative, regulatory and institutional and technical capacity) within the Russian Federation; completing pre-investment studies to determine the highest priority and tractable interventions to correct or prevent transboundary impacts of land-based activities; and selecting categories of demonstration projects dealing respectively with marine environmental clean up, the transfer of two decommissioned military bases to civilian control, and involving indigenous peoples in environmental and resource management.

In 2003, IMELS joined UNEP and KfW in supporting with US$ 250.000 for the preparation phase of "***African Rift Geothermal Development Facility (ARGeo)"***. The project aims at establishing a regional platform for the development of geothermal energy, leading to a number of geothermal sub-projects in participating countries of the region. Six countries with geothermal resources and an expressed interest in their exploitation began project preparation activities with UNEP and KfW. As a result, the initial countries involved in the ARGeo project were: Kenya, Djibouti, Eritrea, Ethiopia, Tanzania and Uganda.

In 2003 IMELS entered into a partnership agreement with the **World Bank** to participate in a number of funds aiming at purchasing emission reductions from projects that both benefit the global environment and transfer clean technologies for sustainable development in developing countries and countries with economies in transition.
In particular, IMELS is participating in the ***Community Development Carbon Fund***, which has been established by the World Bank to promote mitigation projects and extend the benefits of carbon finance to the poorest countries and poor communities in all developing countries. The Italian contribution amounts at US$ 7 million. (while an additional of US$ 700.000 have been devoted to the CDCF-Plus, the related facility for technical assistance in project development
It also contributes with US$ 2.5 million to the ***BioCarbon Fund***, a public/private partnership that provides carbon finance for projects that sequester greenhouse gas emissions through land-use activities.
Finally, IMELS created in 2003 the ***Italian Carbon Fund***, a public/private partnership managed by the World Bank and, at present, with a capitalisation of US$ 150 million. The Italian Carbon Fund supports projects that generate emission reductions eligible under the Clean Development Mechanism (CDM) and Joint Implementation (JI), as well as the Emission Trading Scheme of the European Union. At the same time, the Fund is designed to assist developing countries achieve sustainable development by leveraging substantial investments in modern energy services and technologies, including investment from the private sector.

Furthermore, IMELS, together with the World Bank (through its Environment and Social Development Sector Unit of East Asia and Pacific Region) and the Government of China

established an *Italian Trust Fund for Environmental Protection in China* **in July 2004. The trust fund aims to support China's long-term strategy for balancing economic growth with sustainable natural resource use and environmental management, with a particular focus on climate change. A Steering Committee, comprised of Chinese and Italian officials and Bank staff, has been established as the decision-making body of the Trust Fund program. The secretariat of the Trust Fund program is housed in the World Bank. At its first annual meeting held in July 2004, the Steering Committee approved the work plan of the first tranche of the Trust Fund for a total contribution of US$ 8.5 million. The work plan includes the following two categories of activities – technical assistance and project co-financing.**

As far as the technical assistance component is concerned, three studies were funded, i.e. a Green National Accounting Study, a National Climate Change Strategy, and a Policy and Legal Framework for Promoting Circular Economy.

As for the project co-financing component, the Heilongjiang Dairy Product Project in Heilongjiang Province was funded with a grant of US$5.5 million to develop an environmental component related to the utilisation of innovative technologies to reduce greenhouse gas (GHG) emissions and increase carbon sequestration.

The Global Bioenergy Partnership

In the 2005 Gleneagles Plan of Action, the G8 +5 (Brazil, China, India, Mexico and South Africa) agreed to launch a Global Bioenergy Partnership to support wider, cost effective, biomass and biofuels deployment, particularly in developing countries. Following a consultation process among developing and developed countries, international agencies and the private sector, the Global Bioenergy Partnership (GBEP) was launched at the 14th session of the Commission on Sustainable Development (CSD-14) in New York on 11 May 2006.

GBEP's purpose and objectives are as follows:

- To suggest rules and tools to promote sustainable biomass and bioenergy development;
- To facilitate investments in bioenergy;
- To promote project development and implementation;
- To foster R&D and commercial bioenergy activities.

GBEP brings together public, private and civil society stakeholders. Current partners are: Canada, China, France, Germany, Italy, Japan, Mexico, Russian Federation, United Kingdom, United States of America, FAO, IEA, UNCTAD, UN/DESA, UNDP, UNEP, UNIDO, UN Foundation, World Council for Renewable Energy (WCRE) and European Biomass Industry Association (EUBIA).

Chair of the Partnership is Corrado Clini, Director General, Ministry for the Environment Land and Sea, Italy; Co-Chair is Juan Mata, Director General, National Energy Savings Commission, and Mexico. The GBEP Secretariat, hosted at FAO Headquarters in Rome with the support of Italy, is the coordinator of communications and activities.

GBEP aims to make a unique contribution to the sustainable development of bioenergy through its focus and membership:

- A specific focus on bioenergy as a key renewable energy source.
- Improved coordination on bioenergy both across sectors and between public, private and civil society parties.
- Facilitating the engagement of the private sector.
- Focusing on developing countries, where biomass use is prevalent, and facilitate an exchange of experiences and technologies not only North-South, but also South-South, South-North, and North-North.
- Raising visibility of bioenergy opportunities and issues at the international level and including bioenergy in relevant development initiatives.
- Reflecting and supporting the strong political commitment to promote bioenergy.

Additionally, GBEP works in synergy with other relevant initiatives, including: FAO's International Bioenergy Platform (IBEP); International Partnership for the Hydrogen Economy (IPHE); Mediterranean Renewable Energy Programme (MEDREP); Methane to Markets; Renewable Energy Policy Network for the 21st Century (REN21); Renewable Energy and Energy Efficiency Partnership (REEEP); UNCTAD BioFuels Initiative, and Bioenergy Implementing Agreements and related tasks of the IEA.

In 2003, within the framework of the Mediterranean Renewable Energy Programme (MEDREP) Finance Initiative, the Italian Ministry for the Environment Land and the Sea signed a Memorandum of

Understanding (MoU) with **UNEP-DTIE** in order to carry out projects helping the establishment of a regional RET market in the Mediterranean region.
To this end three RE financial support mechanisms have been established in Morocco, Tunisia and Egypt as the most promising "tools" for influencing RE sector investment. So far the Italian Ministry contribution amounts to about € 5.260.000.
The most successful initiative is the PROSOL (Solar promotion for Tunisia) programme aiming to develop the use of the Solar Water-Heater (SWH) in the residential sector, through the implementation of a number of supporting measures.

In addition, the Italian Government has been actively promoting synergies among the UN framework convention on climate change and other relevant conventions.
In particular, Italy represents one the most important world financial contributor to the UNCCD. At the same time, Italy has been actively engaged as well in the United Nations Forum on Forest processes, giving a special emphasis to the role of sustainable forest management in adaptation and mitigation of climate change.
Synergies between the under UNCCD national action programmes (NAPs), which are building bridges between development and environment policies, and the United Nations Framework Convention on Climate Change (UNFCCC) national adaptation programmes of action (NAPAs), present a unique opportunity to establish comprehensive policy instruments. Such an integrated approach to tackling desertification and climate change will have multiple benefits, especially for the poor in the world's drylands, who are suffering most from the double blow of desertification and climate change.
Linking the activities of the UNCCD, UNFFF and UNFCCC rather than designing, implementing and managing climate policy separately from combating desertification and deforestation makes sense from efficiency and mainstreaming perspective. In countries with scarce financial and human resources this is particularly true. Indeed, coordinating mitigation and adaptation strategies to address aspects of climate change and desertification and deforestation in one stroke is needed to facilitate the development of innovative poverty reduction strategies, strengthen the adaptation capacities of vulnerable lower income groups, and fight climate change through carbon sequestration and emission reductions.

Carbon sequestration projects in the wide expanses of drylands agro-ecosystems, for example, could have significantly greater benefits than expected through soils conservation. The sequestration of carbon in these soils has the potential to counter degradation and increase the productivity and sustainability of these ecosystems. Reforestation is a vital way but is not the only way. These projects could also provide significant social benefits by increasing food security which in turn would promote better habitat conservation. Local population could therefore mitigate climate change while combating desertification and protecting biological diversity.

Moreover, Italy has tried to tackle climate change issue even when dealing with other multilateral processes, such as FAO and IUCN: Some outstanding multilateral initiatives are the following:

The "Global Partnership for Sustainable Development in Mountain Regions" (GMP) was launched at the World Summit on Sustainable Development by the Governments of Italy and Switzerland together

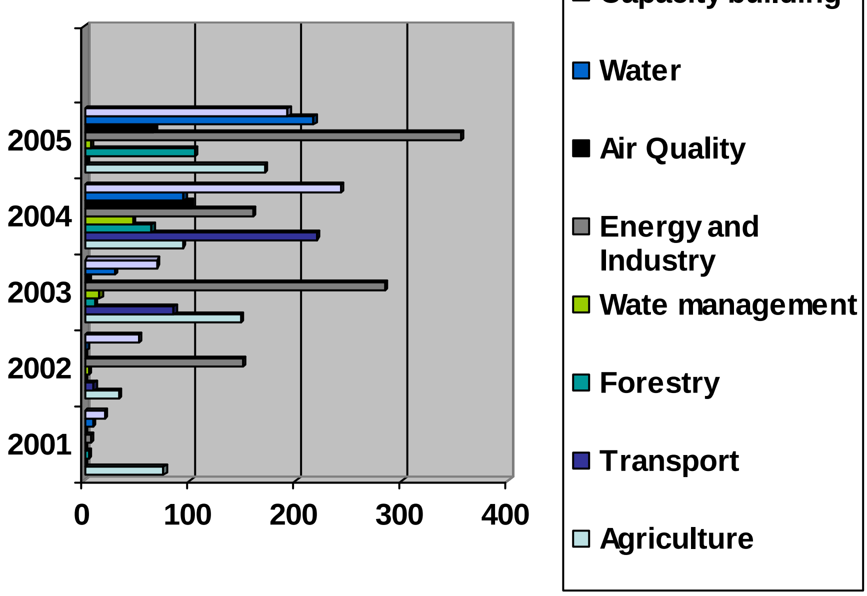
with FAO and UNEP in recognition of the global role played by mountains ecosystems services in the provision of strategic development resources and their tight correlation with climatic changes.
The partnership aims at providing a globally coherent institutional capacity and policy development framework to deal with the currently pressing impact of climatic trends on freshwater production, fertile soil erosion, as manifested by their ever increasing symptoms as avalanches, landslides and flooding, and the repercussions of such environmental degradation on poverty trends and loss of biological diversity. Under the policy strategic guidelines of to GMP a number of ODA programmes are implemented by the Italian cooperation.

The Global Partnership of Island biodiversity conservation and sustainable development was established by Italian Cooperation in collaboration with partner governments and international NGOs, building upon the **SIDS (Small Islands developing States)** partnership launched by the Italian Government in the framework of Mauritius conference on the sustainable development of SIDS. By promoting networking, south-south and north-south know-how and technology transfer, and focussing on institutional capacity building on priority conservation and protective issues including preparedness to cope with impacts of climatic events, resilience and disaster prevention.

Bilateral cooperation with developing countries

New and additional financial resources aimed at technology transfer in the environmental sector were triggered by the signature of the Kyoto Protocol and its ratification. These can be considered as additional resources responding to the commitments set forth by articles 4.3, 4.4 and 4.5 of the Framework Convention on Climate Change.
The aforementioned financial resources were initially provided through the so-called "Carbon tax", or ecological tax N° 448/1998 "aimed at the reduction of carbon dioxide emissions". Since 2002, in order to meet the commitment under decisions FCCC/CP/2001/L.14, FCCC/CP/2001/L.15 and the "Bonn Declaration" of 2001, the Italian Ministry for the Environment, Land and Sea, has been authorized by the law June 1, 2002, n° 120, to finance activities for 68 million euro/year in developing countries to substantively contribute to the implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

Table 7.2: Bilateral cooperation on climate change from 2001 to 2005



With the overall aim of supporting the implementation of Multilateral Environmental Agreements, IMELS implemented in the years 2001-2005 almost 90 projects on climate change and related topics with developing countries. The objectives are various and ambitious: efficient use of energy and water resources, promotion of renewable energy sources, professional training and exchange of know-how, promotion of eco-efficient technologies.
Among its major cooperation activities IMELS is developing programmes and projects in China, India, the Mediterranean region, Central and Eastern European countries, Latin America and the Caribbean and in the Pacific islands.

Cooperation on climate change with Asian and Middle East countries

In particular **China**, **Iraq**, **Thailand** and **India** are the main beneficiaries of the efforts of IMELS specifically addressed to Asian and Middle East countries.

IMELS started its environmental cooperation programme with the **People's Republic of China** in 2000. Under this programme, 65 projects have so far been developed for environmental monitoring and management, strengthening Chinese national and local institutions, protecting and conserving natural resources, water management, waste-to-energy, developing renewable energy sources, energy efficiency, sustainable urban planning, environmental protection in the poorest regions, developing low-emission transport systems and technologies, sustainable agriculture, biodiversity protection and forest management. Almost 43 projects are strictly related to climate change activities and have been identified in terms of the objectives and programmes established in the United Nations Convention on Climate Change, while the others can also be considered useful to create and enabling environment for mitigation and adaptation measures.

Project formulation has been entrusted to a permanent Sino-Italian task force made up of experts from the Italian Ministry for the Environment, Chinese Ministries and Agencies, scientific Institutions, Italian and Chinese Universities. This task force constitutes the Program Management Offices (PMO) based in Beijing and Shanghai.

IMELS entrusted the Italian Trade Commission, Beijing and Shanghai Offices, as this task-force project manager. The Italian Trade Commission ensures the cooperation of those Italian enterprises interested in joining the program design and co-funding.

Within this cooperation programme since 2001, IMELS has been co financing projects for EUR120 million in the form of direct grants to Chinese institutions and the use of the Trust Funds established at the World Bank and with other Multilateral Funds. The Chinese institutions have co-financed projects for EUR38 million, Italian businesses have provided EUR25 million for the cooperation programme, and the United Nations Foundation, the United Nations agencies - UNEP, UNDP, UNIDO, - the Global Environment Facility, the World Bank and the Multilateral Fund for the Implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer have contributed EUR29 million. Projects for approximately EUR212 million have so far been financed.

With regard to the cooperation with **Iraq**, in the spring of 2003, the Free Iraq foundation (IF), that gathers Iraqi intellectuals and scientists that fled the Iraqi Regime in the eighties and nineties, asked the Italian Ministry for the Environment, Land and Sea to collaborate in the identification of urgent actions for the environmental restoration and conservation of the water resources in the marshes of Southern Mesopotamia. The "New Eden" project was initiated with the collaboration of IF and the involvement of the Iraqi Ministries of Environment (MoE), Municipalities and Public Works (MoMPW) and Water Resources (MoWR).

In Iraq, the "Gardens of Eden", the Mesopotamian marshes at the confluence of the Tigris and Euphrates have symbolized from the start of our history, and along the centuries, the greatest and most efficient natural wetland system, keeping the balance between water and land and sustaining a lush biodiversity. The twenty five years of Saddam Hussein's policy on agricultural development and water resource

management, associated with the persecution of dissidents hiding in the marshes, have progressively transformed the Eden gardens into a desert. The climate has been drastically modified as the combined effect of the loss of evaporation and biological and photochemical processes has been halted. This has led to the modification of rainfall regimes, an average temperature increase of 5 degrees Celsius, and the increased intensity of sand storms. At least 300.000 people have been forced to a compulsory migration.
In the first eight months a preliminary analysis has been carried out on how water resources management has evolved in the last twenty years. The action plan identified with the project envisages two simultaneous actions, the immediate start of two pilot studies and the implementation of a general "master plan" for the re-establishment of the marshes. The Abu Zirig Marsh Pilot Study has allowed to "learn" from the natural systems on how to plan restoration of the marshes, and identified effective strategies for reinstating the fishing and agricultural production to bring population back. The feasibility study for the integrated use of water and energy in Southern Mesopotamia has been aimed at increasing the availability of freshwater, through the desalination of part of the water derived from the Tigris and Euphrates rivers. In parallel to the pilot studies, the "master plan" was completed in 2005 in order to define the actions required to restore at least 50% of the marshes of Southern Mesopotamia by the end of 2010.
Another significant project was developed in **Thailand** after the tsunami of 2004 in order to respond to the immediate needs of people deriving from the disaster suffered. Right after the emergency, the Italian Ministry for Environment, Land and Sea worked together with Thailand for the implementation of the "Coastal Risk Analysis of Tsunamis and Environmental Remediation –CRATER" project. The CRATER approach is subdivided into three modules:

- MODULE 1 – RAPIDO / Real time tsunami Alarm Program for the Indian Ocean,
- MODULE 2 – SAVE / Study Atlas on the Vulnerability of coastal areas required by rescue plans,
- MODULE 3 – DATE / Damage Assessment of Tsunami events on the Environment.

The results of the project were presented in a final workshop held in Bangkok in May 2007. Town planning indications for the creation of safety areas in villages, and suggestions and calculations for the design of features aimed at increasing the resistance of buildings were provided. Furthermore, in a country such as Thailand , which bases an important part of its economy on its tourist resources, safety policy enshrined the landscape preservation by quality and sustainable environmental an architectural solutions.

In 2005, IMELS started a co-operation program on sustainable development with the **Indian** government. In December 2005, a Memorandum of Understanding on "Co-operation in the Area of Climate Change and Development and Implementation of Projects under the Clean Development Mechanism of the Kyoto Protocol" was signed with the Indian Ministry of Environment and Forests (MoEF). This Agreement aims at promoting scientific and technical co-operation in the area of Climate Change with a particular focus on the transfer of low carbon technologies in the energy sector. The first project launched regards the assessment of the Carbon sequestration potential in India and includes the implementation of pilot studies.
In the last few decades, human activities have strongly perturbed the carbon cycle in India. In doing so the quality of the natural resources have been heavily undermined, large areas of natural forests have been exploited and soil degradation is an increasing prominent feature of India's land. In parallel the entry into force of Kyoto protocol has created also new opportunities in India through the Clean

Development Mechanisms for land restoration and improvement of hydrology, soil fertility and biomass production.

The project has the following main objectives:

1. To evaluate the state of land degradation of Indian soil and potential for land reclamation through reforestation in the framework of CDM mechanism of the Kyoto protocol
2. To establish a pilot study in an existing plantation for the development of advanced technologies for determination of carbon sequestration
3. To exchange students and researchers between Indian and Italian Institutions.

Furthermore, several initiatives are being implemented by the Italian Ministry of Foreign Affairs. Some successful examples of projects are the following:

Forest landscape restoration in China**: joining hands with the Chinese government, DGCS is working in the field of carbon sequestration and adaptation to climate trends by restoring critical forest functions and services, and by increasing the resistance and resilience of vulnerable landscapes and species versus the impacts of climate change. In particular, with the Environment and References Law Institute of Shanghai, DGCS implemented a number of relevant initiatives to modernise the environmental laws and policies of protected areas, sustainable development and biodiversity, to improve the ecological integrity of degraded forest landscapes and to enhance the wellbeing of the people living in the areas.**

Protected areas Ecosystem management in the Hindu Kush-Karakorum-Himalaya mountain range: DGCS implements this programme in collaboration with local governments of eight countries, scientific institutions, international and national NGOs and the Aga Khan Foundation, building upon the contention that in the very mountain range, more than in others, the impact of climatic event and trends can only be checked and effectively managed at the regional and/or transboundary levels. The programme aims at bringing together various stakeholders into dialogue, and identifying collaborative actions in support of the development of effective and regionally coherent national conservation and management policies. The initiative looks at such issues as objective decision support tools for integrated trans-boundary management of shared ecosystems and their productivity, the integration of the conservation of cultural heritage and that of natural resources, and the promotion of traditional management methods to build local institutional community capacity for resource management. Particular attention being given to monitoring and development of adaptive management responses to new processes such as glaciers melting, alteration of water catchments regimes; to enhancing post conflict social and economic stability through the establishment of transboundary protected areas (including peace parks), etc.

Post Tsunami disaster rehabilitation in Asia: together with a number of institutional and technical partners DGCS supported the recovery and rehabilitation process in the framework of the massive relief and reconstruction effort which was prompted by the earthquake and resulting Tsunami that hit Asia and Africa in 2004. The partnership resulted in direct recovery action, as well as in a better understanding of vulnerable ecosystems and -in the framework of current climatic trends- the way disasters can be prevented and mitigated, through sound coastal planning and protection of natural ecosystems’ structure and resilience. This initiative was realized in the framework of a DGCS programme, which addressed the reduction of the environmental disasters’ impact. Started in 2002, this programme had launched 79 initiatives for the amount of EUR 220 million.

Cooperation in the Mediterranean region and the African region on climate change

The **Mediterranean Renewable Energy Programme (MEDREP)**, launched by Italy in 2002 has been developed to reduce the cost of renewable energy by expanding markets and creating a strong market environment for renewable energy. The two principal objectives of MEDREP are to:

- provide sustainable energy services particularly to rural populations; and
- contribute to the climate change mitigation by increasing the share of renewable energy in the energy mix of the Region.

Within these objectives, the programme aims to develop a sustainable renewable energy market system in the Mediterranean Region through three main activities:

- Tailoring financial instruments and mechanisms to support renewable energy projects;
- Strengthening policy frameworks and overcoming barriers to renewable energy deployment; and
- Building stronger private sector infrastructure while considering the positive role of "Tradable Renewable Certificates" and "Certified Emission Reductions".

Within the MEDREP framework, the Italian Ministry for the Environment, Land and Sea, the Ministry for Industry, Energy and SME of Tunisia and the Tunisian National Agency for Energy Conservation, signed on January 26, 2004 a Memorandum of Understanding for establishing in Tunis a Centre for training, information dissemination, networking and development of pilot projects in the field of renewable energies (MEDREC).

MEDREC is part of the Global Network on Energy for Sustainable Development (GNESD), a UNEP facilitated network of developing world Centres of Excellence and network partners working on energy, development and environment issues.

The MEDREC main focus is the development of the wind energy and solar energy sectors, although mini-hydro, geothermal, biomass and fuel-cells are also considered. The objectives of the Centre are to:

- deploy finance sources and options to support renewable energy projects;
- develop regional competence in renewable energy;
- disseminate information to different sectors; and
- Develop renewable energy pilot projects and transfer technology.

MEDREC is already operational and plays the role of reference point for the programmes carried out by the MEDREP partners.

In addition, IMELS and the Moroccan Centre for Renewable Energy Development (CDER) are jointly developing a project of reinforcement of CDER Laboratories and Training Centre, with a view to setting up in Marrakech a major Centre of Excellency and technology transfer in the framework of MEDREP, with a special focus on equipment testing and certification.

Until today 28 projects have been developed with a total financial contribution from IMELS of 16 million euro.

The pilot projects, developed in Egypt, Algeria, Tunisia and Morocco, aimed at:

- ❖ delivering electricity to isolated rural populations, based on village-scale mini-grids;
- ❖ desalinating sea water and increasing agricultural water pumping, in order to improve drinking water supply and water availability for irrigation;
- ❖ addressing the global approach of renewable energy introduction in the building sector in coherence with the energy efficiency policy;

- disseminating cooling systems for the food conservation, powered by renewable, in farms and fisheries;
- implementing financial mechanisms to support local technological markets
- developing studies in the wind energy sector with the objectives to overcome technical and financial barriers to wind energy exploitation and to identify mechanisms and incentive tools to boost wind energy investments;

- Addressing, in the grid connected urban and tourist areas, the household and the community demand for lighting, food cooling, as well as creating joint ventures and other manufacturing, assembly and distribution/installation capabilities in partner countries.

Solar Water Heating System Interest Rate Facility (PROSOL – Tunisie)

Within the framework of its strategy for the development of renewable energies, the Tunisian Government has decided to launch an ambitious program aiming to develop the use of the Solar Water-Heater (SWH) in the residential and collective sector, through the implementation of a number of encouraging measures.

In the framework of MEDREP the Tunisian Ministry of Industry, Energy Small and Medium Size Enterprises, in collaboration with the Italian Ministry for the Environment, Land and Sea, and United Nations Program for the environment (UNEP)- DTIE launched, in April 2005 a financial mechanism, called PROSOL TUNISIA" (Solar promotion for Tunisia),to support the solar water-heaters market in Tunisia.

The main items of the PROSOL mechanism are the following:

- A subsidy of 20% on the cost of a SWH, financed by the government through the National Fund of energy with a maximum of 100 TD/m2
- A complementary subsidy of about 80 TD on the cost of a solar water heater of ***300l,*** financed by the Italian Ministry for the Environment, Land and Sea, through the MEDREC Funds.
- A loan mechanism for financing the left cost of a SWH for the consumer, granted over a period of 5 years, and recovered through STEG electrical bill.
- The reduction of the interest rate, through the year 2005, using the MEDREP/UNEP funds.
- The costumer takes in charge only 10% cash of the cost.

By May 2007 84730 m2 of solar water heaters have been commercialised in the residential Sector.

On the basis of the successful conclusion of Prosol, Tunisian Government and Italian Ministry for the Environment, Land and Sea, have decided to launch a new financial mechanism (tertiary Prosol) for promoting the use of solar heaters in the collective sectors (hospitals, hotel etc….)

The objective of PROSOL (residential and tertiary) over the period 2007 – 2009 consists in installing 360.000 m2 of SWH.

In the wider Mediterranean and Central Asian region, the Italian Ministry of Foreign Affairs- DGCS is working on a **project of water and environmental flows**: in collaboration with key river basin managers and scientific networks, DGCS is supporting an IUCN water programme that services 25 countries from Morocco to Kazakhstan which share, together with analogous arid/semiarid environments, also a number of management challenges face to the current climatic changes. By promoting and supporting integrated catchments management policies and activities, at the national and regional level, the programme aims at improving standards in the management of water resources, and the sustainable management of arid and semi-arid lands. The collaboration has led to strengthened technical networks in each country, and the building of platforms for cross-sector exchange of information, experiences and technology.

Furthermore, the Italian Ministry of Foreign Affairs- DGCS is promoting **natural resources conservation in the Horn of Africa**. With the involvement of local institutions and communities, DGCS is working on the survival of the region's fragile ecosystems which is tightly correlated to the varying climate conditions. The narrow dependency of local communities on agriculture, entail their heavy pressure on such increasingly scarce resources as water, land and biodiversity which adds to that of ongoing land conversion, degradation and desertification processes and is compounded by current climatic changes. The projects tackles such obstacles to local sustainable development as the inadequacy of policies and guidelines for the management of natural resources and the environment; the need for awareness building on how natural resource management contributes to livelihood security and poverty reduction, by providing studies, assessments and on the job and formal training in conservation, land use planning, as well as implementing actual restoration initiatives of degraded lands.

Cooperation with Central and Eastern European countries on climate change

The collaboration of the Italian Ministry for the Environment, Land and Sea in Central and Eastern Europe started in 2002 with the former Ministry for Protection of Natural Resources and Environment of the Republic of Serbia and Montenegro, when the two Parties signed the Memorandum of Understanding (MoU) called "Environmental Protection Co-Operation". This agreement was aimed at developing a programme of bilateral cooperation in the fields of sustainable development, institutional strengthening and harmonization to both International and European legislative standards according to funds available from the Italian Law 84/2001 on Balkans' reconstruction. The program coordination has been committed to an *ad hoc* Task Force responsible for activities in the whole Central Eastern Europe including its active role in the promotion of Italian firms' participation in Serbian activities in environmental protection and sustainable energy use sectors.

At the beginning of its activities (2004), the Task Force headquarters were established in Belgrade with the duty of developing and coordinating the activities of the Italian Ministry for the Environment in the framework of environmental cooperation including renewable energies, sustainable development strategies, environmental impact assessment, rehabilitation of polluted sites, capacity building, with the engagement of both Italian and Serbian experts.
Until today 49 Human Resources (Coordinator, Country Manager, Technical Engineers) have been employed, cooperation activities with international institutions such as EAR, World Bank, EBRD, UNDP, UNOPS, OSCE have been strengthened, 53 projects in the fields of renewable energy, water management and waste management have been implemented in Albania, Bosnia, Croatia, Bulgaria, Serbia, Montenegro, Macedonia, Poland, Romania, Turkey, Hungary, Kyrgyzstan and Tajikistan.

The projects aim at:

- strengthening local and national capacities on environmental governance,
- transferring know-how and technologies to prevent and control environmental pollution and water management,
- Promoting renewable energy and energy efficiency.

In particular, the cooperation between Italy and Serbia aims at supporting:

- the environmental governance and management in the public and private sectors;
- the identification of environmental risks and "hot spots" in the industrial and urban areas;
- the implementation and compliance with the international environmental Conventions and Protocols, starting from the Kyoto Protocol;
- the promotion of the best available technologies in reducing the consumption of natural and energy resources, in protecting water and air quality, in managing urban and hazardous wastes;
- the use of renewable energies, to address the internal energy demand, using innovative market mechanisms like the CDM under the Kyoto Protocol and the Green Certificates

In **Croatia**, different activities have been implemented for the environmental management of coastal areas, the use of renewable sources in islands and costal areas and the efficient requalification of urban energy plans. In **Bulgaria** a study on integrated water services and systems was carried out.

More in detail, **in the former Republic of Serbia and Montenegro** the IMELS is present with the following activities:

- Since September 2003 IMELS has been developing activities of Environmental monitoring and sustainable requalification of the Municipality of Pancevo, considered as the heaviest polluted industrial areas.
- In October 2004 a technical assistance programme was launched to provide legal and technical assistance in order to facilitate the Kyoto Protocol ratification and also the evaluations of the national greenhouse gases emissions and the climate changes impacts necessary for the "First National Communication" were carried out.
- Since October 2004 the Italian Ministry has been providing institutional building activities to promote the Green Certificates incentive mechanism, involving representatives of the Serbian Ministry of Energy and Mining and the Serbian Ministry of International Economic relations.

With the **Republic of Albania, IMELS** signed a Memorandum of Understanding on 31 May 2005 on "Cooperation in the field of the Clean development mechanism under article 12 of the Kyoto Protocol", aimed at facilitating the implementation of the Kyoto Protocol through legal support to the national competent authority (DNA) and technical support for potential CDM project assessment in the field of renewable energy sources, energy efficiency, waste and forest management.

Considering major Albanian environmental problems such as management of coastal areas, river basin water quality, planning of investments and emergency management the ADRICOSM-STAR Agreement (Integrated river basin and Coastal zone management system) has been signed, as a component of the Adricosm Partnership enriched with new and innovative elements such as studies on climate change impacts on water resources and sediment transport.
Considering the Albanian air quality issue, IMELS has decided to supply technical assistance for the implementation of Air Pollutants Emission Inventories and for Air Quality Planning. The target of this assistance is first of all the support to the republic of Albania in the compilation of a national emission inventory for the integration of Albania in LRTAP Protocol and then the support to the Albanian team to develop capacity to assess and plan air quality on local/urban scale, in particular in urban and industrial areas regulated in the frame of the EU Air Quality Framework Directive 96/92/CE and relative "daughters" Directives.

With the **Republic of Macedonia IMELS** has been cooperating since august 2005 with a particular focus on the Kyoto Protocol and sustainable development.

Cooperation on climate change in Latin America, the Caribbean and the Pacific Islands

Among its other bilateral activities IMELS is promoting several projects in
Latin America and the Caribbean
In the year 2001, it co-financed to **Samoa** government the Island Climate Update, a monthly bulletin, still existing, that provides weather forecasts for the South Pacific islands and that mainly serves as a prevention risks assessment for climate change.

A project of great significance to the region is the creation in **Belize** of the Caribbean Community Climate Change Centre that became fully operational in 2005 thanks to the financial contribution of the Italian Government under the terms of a Memorandum of Understanding jointly signed in Buenos Aires in December 2004 during COP 10. The Centre’s main tasks consist in developing and implementing programmes, projects and activities to protect the region ecosystems; strengthen national and regional institutional capabilities to address the negative impact of climate change; and provide technical support for climate change vulnerability and risk assessment in the region.

In **Brazil** projects for the development and promotion of technologies for the use of solar energy and for the cultivation and use of biomass for energy production have been implemented. In **Cuba**, the Caribbean Risk Management Initiative (CRMI) has been co-financed by the Italian Ministry for the Environment. The CRMI is designed to build capacity within the Caribbean region to adequately address the growing occurrence of natural hazards and environmental risks as well as to emphasize the concept of climate change and social vulnerability. The activities for the Initiative are implemented via the UNDPs’ offices in Cuba, Barbados, Dominican Republic, Haiti and Jamaica.

In addition, the Italian Ministry of Foreign Affairs is working on a project of **forest economic valuation in support of its sustainable utilization in South America.** In cooperation with Centro de Educación y Promoción Popular and the Centro Agronomico Tropical de Investigación y Enseñanza, (DGCS) has been working toward tapping the economic potentials correlated to the perspectives to preserve the forest biome under the increasingly heavy climatic and anthropic pressure. By working on the valuation of forest goods and services, the initiative pursues the development of a strategy for capacity building on forest economic valuation, as well as on stakeholders and users awareness rising on how the use of economic instruments can help manage the forests sustainability and hence lead to a sustainable and collaborative management of South-American forests.

Scientific co-operation

The Italian Ministry for the Environment, Land and Sea since 2001 is promoting and supporting programmes on scientific and technological research in the Mediterranean Region, Balkan area, and Asia with the involvement of the academic and business sectors.
These initiatives are focused on the implementation of R&D projects whose technological components will play a key role in the next future to reduce greenhouse gases emissions and address the negative impacts of climate change.

So far, R&D projects have been implemented in Egypt, Israel, Tunisia, Morocco, Serbia, Montenegro, Albania, India and China in collaboration with the universities of Firenze, Padova, Pavia, Pisa, Tuscia, Politecnico di Milano, Consorzio Pisa Ricerche, Tel Aviv University, Egyptian Environmental Affairs Agency, Tunisian National Agency for Energy Conservation (ANME), National Institute of Geophysics and Vulcanology (INGV), Republic HydroMeteorological Service of Serbia (RHMSS), University of Belgrade (UB), University of Sassari, Italian Institute of Agrarian Economy (INEA), Italian National research council (CNR), Italian National Agency for New Technologies, Energy and the Environment (ENEA), Moroccan Centre for Renewable Energies Development (CDER).

The projects aim to develop, test and optimize new technologies in the following sectors:

- Solar thermal driven cooling system for the food and agro industry;
- Building Integrated Spherical Collector system (PV concentrator), providing electricity, heating and cooling, whose size and cost will be appropriate for urban areas;
- Water heating, water desalination and electricity production from solar pond technology;
- Carbon sequestration;
- Multi-disciplinary impact assessment of Artificial Marine Structures on the marine environment;
- Combating Desertification trough the identification of drought- and salt-resistant plant species that could replace sensitive species;
- Multi-disciplinary approach for the remediation of polluted stream sediments, combining engineering, agricultural and biological mechanisms and development of an economically viable, environmentally sound system (biological treatment methods combined with electro-flocculation) for treating effluents to a level that maximizes their potential for reuse.

Furthermore cooperation agreements are being stipulated both with Serbia in order to strengthen Serbian institutional capacity in global climate modelling by transferring tools (*SINTEXG global couple atmosphere-ocean model configuration*) and knowledge to perform reliable global climate scenario simulations and Montenegro for studying the climate change impacts on the water resources and sediment transport (Adricosm- Star).

The implementation of these projects is contributing to improve research and knowledge, among others, on optical solutions, new materials, new fabrication processes, innovative tracking systems and system modelling.

A project of great significance for the Mediterranean Region is the establishment of a new research infrastructure, the ***Euro-Mediterranean Centre for Climate Change,*** *(Centro Euro-Mediterraneo per i Cambiamenti Climatici, CMCC)*, acting as a network of Public and Private Research Centres focused on research on and impacts of climate change over the Mediterranean area.

Several Italian institutions also participate actively in the cooperation projects within the European Commission Research Framework Programme. Some successful examples are the following ones:

- *MEDACTION (2001-2003)* aims to 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.

- *MEDRAP – (Concerted Action of the European Commission, 2001-2003)* aims at supplying scientific support to the formulation of a Regional Programme to combat desertification in Northern Mediterranean countries.

- *Urban Photovoltaic Polygeneration with Solar Energy (UP-SOL)* aims to demonstrate a solar photovoltaic system that provides electricity, heating and cooling, integrated into the urban environment. The system is based on miniature solar collectors using concentrating photovoltaic technology developed jointly in Italy and Israel.

- *MEDISCO- (Mediterranean food and agro industry application of solar cooling technologies)* aims to develop, test and optimize solar thermally driven cooling concepts for the food and agro industry in the Mediterranean region.

- *MEDRES – (Cost-effective Renewable energy for rural and urban areas in the Mediterranean region*) aims to assess the opportunities for cost –effective renewable energies for rural areas and villages and the real effectiveness of "new" technologies trough better knowledge of end –user acceptability for energy efficient technologies.

Furthermore, the Italian Ministry for Foreign Affairs is working on the **Atmospheric Brown Cloud project**: in collaboration with UNEP, DGCS is working on such a new atmospheric issue, whereby brown clouds by intercepting solar radiation, significantly affect climate, water, health and agriculture. The work aims at integrating science with impact assessment (on human health, food security and water) in order to provide a scientific base for informed decision making. The particular focus being the management of the impacts of the increase in minimum temperature by greenhouse gases, in conjunction with the decrease in rainfall due to aerosol radioactive forcing of Atmospheric Brown Cloud, which, in turn, may lead to significant slow down of agricultural production. The initiative will pursue the consolidation of regional capacity for scientific community as well as policy setting to mitigate and address the emerging issue.

Finally, technical and scientific institutions such as ENEA and CNR support scholarship programmes for researchers from developing countries and countries with economies in transition in the field of global environment issues.

Sino-Italian scientific and technological cooperation

In the framework of the Sino-Italian cooperation several scientific and technological research projects have been implemented in collaboration with the Chinese Ministry of Science and Technology, major Chinese scientific institutions, companies and prestigious universities, such as Tsinghua University in Beijing, and Tongji University in Shanghai.

New processes and technologies are being developed in the following sectors:

Air pollution prevention and control (Suzhou, Beijing, Lanzouh, Shanghai): development of an innovative pollution source monitoring system aiming at reducing emissions trough a programme to take action on traffic and industrial sources

Sustainable transport: development of an advanced laboratory for vehicles emissions control and an "Intelligent Transport System" for the regulation of urban traffic and to reduce consumption and emissions

Renewable Energies and Energy efficiency: testing of a diagnosis model for the evaluation of the energy and environmental performances in the Shanghai industrial sector and exploitation of geothermal energy with application of the re-injection technology in Tibet and the Tianjin area.

Hydrogen innovative technologies: promotion of technologies to produce energy and hydrogen from waste in co-combustion with coal.

Adaptation to climate change: sandstorm prevention and control in Beijing, development of sustainable agricultural techniques and optimisation water use and arid zones through the utilization of an Italian-designed system (Vallerani method) for the reforestation in Inner Mongolia.

A point of strength of the Sino – Italian R&D cooperation has been the establishment of the two following research centres:

-The Sino-Italian Sustainable Urban Mobility Research Centre, launched in 2005 together with Tongji University of Shanghai, is intended to study and implement environmentally friendly technologies. In this framework the first high-output micro-turbine for tri-generation has been installed on the campus of Tongji University, as an innovative and clean response to the increasing demand for energy in China.

-The Euro-Asian research and training on CLImate change MAnagement (CLIMA), launched in March 2006, is intended to develop an integrated scientific/educational approach to the problems of climate change.

Table 7.1 – Financial contribution to the Global Environment Facility (GEF)

	Contribution (Euro)				
	2001	**2002**	**2003**	**2004**	**2005**
GEF	13.427.879,37	18.075.991,47	12.394.965,58	12.394.965,58	101.569.965,58

Source: Ministry of Economy and Finance

Table 7.2 – Financial contributions to relevant multilateral institutions and programmes

Institution or Programme	**Contribution (million US dollars)***				
	2001	**2002**	**2003**	**2004**	**2005**
1. World Bank (IBRD)	9.51	0.47	-	4.01	8.82
IDA	240.22	126.40	1.69	-	679.31
2. International Finance Corporation	1.39	-	1.69	-	-
3. African Development Bank	70.22	1.87	4.49	2.46	2.46
African Development Fund	-	35.77	-	-	165.12
4. Asian Development Bank	-	-	-	-	-
Asian Development Fund	-	-	-	136.94	-
5. European Bank for Reconstruction and Development (BERS)	21.45	-	34.84	26.75	-
IFAD	1.39	8.40	8.59	49.03	18.28
6. Inter American Development Bank	5.52	1.88	15.93	25.06	-
7. Other Regional Banks and Special Funds	-	6.70	13.05	4.97	-
8. United National Development Programme	16.19	17.85	21.98	24.78	24.02
9. United Nations Environment Programme	0.26	13.82	16.18	14.29	9.31
10. UNFCCC	0.63	0.09	3.01	0.99	0.75
FAO	10.64	10.56	12.66	12.49	44.53
Consultative Group on International Agricultural Research – CGIAR	4.40	1.88	2.26	11.24	-
IUCN – International Union for the Conservation of Nature	-	0.71	0.86	1.29	2.11
UNCCD (Euro millions)	0,5	1,2	1	1	1,6

Source: DAC-OECD. International Development Statistics

*Net annual disbursements

Table.7.3a - Bilateral and regional contributions related to the implementation of the Convention, Year 2001
(Thousands of Euro)

Recipient Country	Agriculture	Transport	Forestry	Waste Management	Energy and Industry	Air Quality	Water Resources and Coastal Zones Management	Capacity Building	*Total*
Albania			104						**104.3**
Angola	258.1								**258.1**
Argentina			103,2						**103,2**
Brazil								65.1	**65.1**
Ciad	142								**142**
China	803,5				320				**1123.5**
Costarica	6.8								**6.8**
Egypt								527.1	**527.1**
Ethiopia	502.1								**502.1**
Honduras								6.9	**6.9**
India	29.6						2.9		**32.5**
Jordan								16.4	**16.4**
Kenya	16.8								**16.8**
Libya	157.7								**157.7**
Morocco							60.2		**60.2**
Mozambique	633.1								**633.1**
Niger	916,1							39.5	**955.60**
Palestinian Territory								23.4	**23.4**
Peru								197.2	**197.2**
Rwanda	292.4								**292.4**
Uganda							172.5		**172.5**
Vietnam								6.5	**6.5**
Zimbabwe								7.7	**7.7**
Other							162.3	78.1	**240.4**
Total	**3758.2**	**0**	**207.2**	**0**	**320**	**0**	**397.9**	**967.9**	**5651.5**

Table.7.3b - Bilateral and regional contributions related to the implementation of the Convention, Year 2002
(Thousands of Euros)

Recipient Country	Agriculture	Transport	Forestry	Waste Management	Energy and Industry	Air Quality	Water Resources and Coastal Zones Management	Capacity Building	*Total*
Albania	11.7								**11.7**
Angola							11.8		**11.8**
Ciad	14.1								**14.1**
China	566.9	450		200	5589.9			1463.6	**8270.5**
Egypt								281.7	**281.7**
Ethiopia	577.3								**577.3**
India	68								**68**
Jordan								4.8	**4.8**
Kenya						56.4			**56.4**
Niger	155.3							86.7	**242**
Mozambique								231.3	**231.3**
Serbia					1880				**1880**
Sudan	261.3								**261.3**
Uganda							52.7		**52.7**
Vietnam								17.5	**17.5**
Zimbabwe								450.4	**450.4**
Other								70.4	**70.4**
Total	**1654.6**	**450**	**0**	**200**	**7469.9**	**56.4**	**64.5**	**2604.4**	**12501.9**

Table 7.3c - Bilateral and regional contributions related to the implementation of the Convention, Year 2003
(Thousands of Euros)

Recipient Country	Agriculture	Transport	Forestry	Waste Management	Energy and Industry	Air Quality	Water Resources and Coastal Zones Management	Capacity Building	*Total*
Albania	4.9								**4.9**
Algeria								450	**450**
Angola							260.4		**260.4**
Argentina			25.8						**25.8**
Brazil								590.8	**590.8**
China	770.2	4.226,17		750	13.276,9	180		1.320	**20523.3**
Croatia			283.8					180	**463.8**
Cuba							443.6.		**443.6**
Egypt								660.6	**660.6**
Ethiopia	6061								**6061**
Iraq							480		**480**
Israel			196		298.2		256		**750.2**
Jordan								17.5	**17.5**
Kenya					359.9			4.2	**364.1**
Libya	151.9								**151.9**
Morocco	220.7				300				**520.7**
Mozambique								6.2	**6.2**
Niger	212.4							200.6	**413**
Sudan	12.7								**12.7**
Uganda							8.5		**8.5**
Zimbabwe								3.3	**3.3**
Total	**7433.8**	**4226.17**	**505.6**	**750**	**14235**	**180**	**1448.5**	**3433.2**	**32212.3**

Tablr 7.3d - Bilateral and regional contributions related to the implementation of the Convention, Year 2004
(Thousands of Euros)

Recipient Country	Agriculture	Transport	Forestry	Waste Management	Energy and Industry	Air Quality	Water Resources and Coastal Zones Management	Capacity Building	*Total*
Albania	54						171.1		**225.1**
Algeria			3200						**3200**
Angola	5.3								**5.3**
Brazil								724.5	**724.5**
Bulgaria							352,5		**352,5**
China	472,5	10991		2300	7350	5.018	1009,9	5954,5	**33095,9**
Croatia					59				**59**
Cuba							533,9		**533,9**
Egypt							136	4524.7	**4660.7**
Ethiopia	3356.9								**3356.9**
Honduras							62.5		**62.5**
Iraq							2175		**2175**
Israel					53,7				**53,7**
Jordan								17	**17**
Kenya					12.9				**12.9**
Libya	250.2								**250.2**
Mozambique								145.4	**145.4**
Niger	61.1							195.7	**256.8**
Rwanda								9.2	**9.2**
Serbia							256.9		**256.9**
Slovenia					154,9				**154,9**
Sudan	235								**235**
Tunisia	219.9				335			495,5	**1050.4**
Uganda							9.7		**9.7**
Zimbabwe								4.2	**4.2**
Other								29.5	**29.5**
Total	**4654.9**	**10991**	**3200**	**2300**	**7965.5**	**5018**	**4707.5**	**12100.2**	**50937.1**

Table 7.3e - Bilateral and regional contributions related to the implementation of the Convention, Year 2005

(Thousands of Euros)

Recipient Country	Agriculture	Transport	Forestry	Waste Management	Energy and Industry	Air Quality	Water Resources and Coastal Zones Management	Capacity Building	*Total*
Albania							138.9		**138.9**
Algeria			1168						**1168**
Angola	257.7								**257.7**
Argentina			643,8						**643.8**
Belize								322,7	**322.7**
Bolivia			244.8						**244.8**
Brazil					246			1768.1	**2014.1**
China	24.8	110	1846,4	257,5	15450,3	3280	1817,1	5431.9	**28218**
Egypt					80		375	585.1	**1040.1**
Ethiopia	2259.3				58.4				**2317.7**
Honduras							101.7		**101.7**
Iraq							8190,2		**8190.2**
Israel					108,5				**108.5**
Jordan								65.3	**65.3**
Libya	5803.6								**5803.6**
Mozambique								4.8	**4.8**
Morocco	178.4				766,3				**944.7**
Niger	19.5							329.4	**348.9**
Serbia/ Montenegro			1326,2	49,5	232		5,3	536	**2148.3**
Sudan	4.4								**4.4**
Tanzania					476.9				**476.9**
Tunisia	4.9				390			439,3	**834.2**
Uganda							215.2		**215.2**
Ukraine							13,9		**13.9**
Zimbabwe								143.8	**143.8**
Total	**8552.6**	**110**	**5229.2**	**307**	**17808.4**	**3280**	**10857.3**	**9626.4**	**55770.1**

CHAPTER 8
RESEARCH AND SYSTEMATIC OBSERVATION

Introduction

This chapter describes some of the Italian activities in the area of climate change research and climate systematic observations. It covers National research programmes, International research programmes and projects funded from Italian Institutions and some international projects where Italian Institutions have been involved. In addition it provides an overview of the funding involved especially in the research sector.

Italian scientists continue to play an active role in climate change research and climate systematic observations and also a number of them played leading roles in the preparation of the *Fourth Assessment Report (AR4)* of IPCC (Intergovernmental Panel on Climate Change). The Italian climate research covers different aspects, such as climate observations, climate modelling and impacts assessments.

General policy on and funding of research

Climate research in Italy is conducted by a variety of organisations and institutions including government research agencies and universities. A support to scientific research and technological development is provided by the ***Special Integrative Fund for Research (FISR - Fondo Integrativo Speciale per la Ricerca)***, aimed at funding specific activities with particular strategic relevance, pursuant to the ***National Research Programme (PNR - Programma Nazionale della Ricerca)*** and its updated versions.

The PNR 2001-2003, approved by the Interministerial Committee for Economic Planning (C.I.P.E. - Comitato Interministeriale per la Programmazione Economica) in December 2000, includes the topic "Environment and Sustainable Development". Within this framework, the FISR co-funds the ***Strategic Programme for Sustainable Development and Climate Change*** (***Programma Strategico Sviluppo Sostenibile e Cambiamenti Climatici)***, whose activities extend in the period 2005-2007, pursuant to the PNR 2005-2007, approved by the C.I.P.E. in March 2005. The FISR is financed by the Italian Ministries of: Economy and Finance (MEF - Ministero dell'Economia e delle Finanze), University and Research (MUR - Ministero dell'Università e della Ricerca), Environment, Land and Sea (MATTM - Ministero dell'Ambiente e della Tutela del Territorio e del Mare), Ministry of Agriculture Food and Forestry Policies (MIPAAF - Ministero delle Politiche Agricole Alimentari e Forestali). See Chapter 0 *"National Programmes on climate research"* for details.

Furthermore, several Italian Research Institutes, Organizations and Universities are conducting direct research on climate change.

These following recent publications provide an overview of the climate and climate change research activities conducted from ENEA (Ente per le Nuove Tecnologie, l'Energia e l'Ambiente; Italian National Agency for New Technologies, Energy and Environment) and CNR (Consiglio Nazionale delle Ricerche; National Research Council):

- ENEA - F. Antonioli, V. Artale, C.A. Campiotti, S. Cocito, R. Delfanti, N. Colonna, B. Della Rocca, G. Delmonaco, G. Di Sarra, M. Frezzotti, C. Giraudi, M. Iannetta, C. Margottini, S. Marullo, P. Menegoni, B. Narcisi, A. Peirano, P. Picco, P. M. Ruti, M. Sciortino, M. V. Struglia, E. Valpreda, V. Verrubbi, 2007 "*Dossier ENEA per lo studio dei cambiamenti climatici e dei loro effetti - workshop ENEA per lo studio dei cambiamenti climatici e dei loro effetti, 20 marzo 2007, Roma*"
- Department Earth and Environment of the National Research Council (CNR - Dipartimento Terra e Ambiente del Consiglio Nazionale delle Ricerche) - Bruno Carli, Giuseppe Cavarretta, Michele Colacino, Sandro Fuzzi, 2007 "*Clima e Cambiamenti Climatici - le attività di ricerca del CNR*"; ISBN 978-88-8080-075-0

The following publication shows the recent results in a sector of climate change research conducted from CMCC (Centro Euro-Mediterraneo per i Cambiamenti Climatici; Euro-Mediterranean Centre for Climate Change):

- o CMCC Technical Report and FEEM Working Paper - Carlo Carraro, Alessandra Sgobbi (2007) "*Climate Change Impacts and Adaptation Strategies in Italy. An Economic Assessment*". The report was prepared for the First National Conference on Climate Change, 12-13 September, Roma, Italy. (in press)

Major Italian research institutions and organisations working in the field of Climate Change

The major Italian research institutions and organisations working on climate change are reported below.

- **Abdus Salam International Centre for Theoretical Physics (ICTP)**, http://www.ictp.it/
  ICTP conducts international research in, among others, the disciplines: earth system physics including the Aeronomy and Radiopropagation Laboratory, physics of weather and climate, structure and nonlinear dynamics of the earth, soil Physics, and energy and environment.

- **Agricultural Research Council** (CRA - Consiglio per la Ricerca e la sperimentazione in Agricoltura), http://www.entecra.it/
  CRA includes twenty-eight Italian research institutes active in the field of agriculture, and carries out research in the field of, among many others: the linkages between agriculture and climate change, including climatic analysis and future scenarios, and climate change impacts on the agriculture sector in Italy. Activities also include monitoring and analysis of the main agro-meteorological events with an impact on the cultivars development and on the agriculture activities in the Italian territory.

- **Emilia-Romagna Regional Agency Prevention and Environment, HydroMeteorological Service** (ARPA SIM - Agenzia Regionale Prevenzione e Ambiente della Regione Emilia-Romagna, Servizio IdroMeteorologico), http://www.arpa.emr.it/sim/
  ARPA SIM is involved in operational, research and development activities in meteorology, climatology, agrometeorology, radarmeteorology and environmental meteorology.

- **ENI Enrico Mattei Foundation** (FEEM - Fondazione ENI Enrico Mattei), http://www.feem.it/
  FEEM is a no-profit, no-partisan research institution carrying out research at the national as well as international level in the field of sustainable development. FEEM also supplies technical support and advice to the public and private decision-making process in the economic and environmental field.

- **Environmental Protection and Technical services Agency** (APAT - Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici), http://www.apat.gov.it
  APAT conducts research at the National level in the fields: water management, air quality monitoring, environmental emergency management, renewable energy, industry, technology, infrastructure, noise and electromagnetic pollution monitoring, green market, nature and biodiversity protection, global atmosphere protection, radioactivity and radiations monitoring, waste management, soil and territory protection, sustainable development.

- **Institute of Agro-environmental and Forest Biology of the National Research Council** (IBAF CNR - Istituto di Biologia Agroambientale e Forestale del Consiglio Nazionale delle Ricerche), http://www.ibaf.cnr.it/
  Research carried out by IBAF CNR include: structure and functioning of terrestrial ecosystems; phytoremediation, bioremediation and mitigation of global change; ecophysiology of the intra- and inter-specific competition and population dynamics in natural and cultivated plant communities; poly-specific models and systems in agriculture and agroforestry; genetic conservation of plants and fungi of interest in agriculture and forestry; identification and management of biodiversity in relation to global change and sustainable development; biogeochemical cycles and exchange dynamics among biosphere, atmosphere and ocean.

- **Institute of Atmospheric Sciences and Climate of the National Research Council** (ISAC CNR - Istituto di Scienze dell'Atmosfera e del Clima del Consiglio Nazionale delle Ricerche), www.isac.cnr.it
ISAC CNR conducts and promotes research and technology transfer in the disciplines: meteorology and its applications, climate change and predictability, atmospheric structure and composition, observations of the planet Earth. The scope of research is both national and international.
- **Institute of Biometeorology of the National Research Council** (IBIMET CNR - Istituto di Biometeorologia del Consiglio Nazionale delle Ricerche), http://www.clima.ibimet.cnr.it/
IBIMET CNR established the Climate Observatory to answer the basic and applied research opportunities and questions in the field of climate sciences and eco-systems. The Observatory carries out scientific research on: the variability of the statistic methods of the climate analysis, the characterization of the climate risks, the dynamic and environmental modelling of the terrestrial systems, the application of the statistic methods to the climate analysis.
- **Italian National Agency for New Technologies, Energy and Environment** (ENEA - Ente per le Nuove Tecnologie, l'Energia e l'Ambiente), www.enea.it
Basic and applied research is carried out by ENEA in the fields of energy, environment and new technologies to support competitiveness and sustainable development, including: solar thermo-dynamic, hydrogen and fuel cells, global climate biotechnologies, protection of health and ecosystems, renewable energy sources and innovative energy cycles, advanced physics technologies, fusion, protection and development of the environment and territory and environmental technologies, materials and new technologies, Antarctica, computing and modelling, sustainable development. The scope of research is both national and international.
- **National Centre of Meteorology and Aeronautical Climatology of the Italian Air Force** (CNMCA - Centro Nazionale di Meteorologia e Climatologia Aeronautica dell'Aeronautica Militare), http://www.meteoam.it/
Activities carried out by CNMCA (within the Meteorological Service of the Italian Air Force) include: climatological graphs (ex. CLimate NOrmals), observation of climatology elements (ex. monthly maximum, minimum and average temperatures, monthly extreme values for temperature and precipitation), and production of monthly as well as ten-day climate bulletins (temperature and precipitation).
- **National Consortium of Universities for Atmospheric and Hydrospheric Physics** (CINFAI - Consorzio Interuniversitario Nazionale per la Fisica delle Atmosfere e delle Idrosfere), http://www.cinfai.it/
CINFAI is a Consortium of more then twenty Italian universities with academic/scientific competences of international level in the field of atmospheric physics (meteorology, atmospheric circulation and planetary atmospheres) and hydrospheric physics (oceanography, hydrology).
- **National Institute of Experimental Oceanography and Geophysics** (OGS - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), http://www.ogs.trieste.it/
OGS carries out research in the Earth Sciences, with a particular emphasis on marine sciences and seismology, and in the mineral exploration and environmental management fields. OGS has become

specialized in the field of Carbon Capture and Storage (CCS), and is involved in several international and European research projects and networks.

National Institute of Geophysics and Volcanology (INGV - Istituto Nazionale di Geofisica e Vulcanologia, www.bo.ingv.it).

With a national as well as international scope of research, INGV carries out applied research in the field of climate dynamics (numerical simulations and theoretical studies of the variability of the climate system), volcanology, seismology and active tectonics, operational oceanography. INGV is also very active in international projects, often with a leading role.

- **National Interuniversity Consortium for Marine Sciences**, Local Research Unit: Department of Geological Sciences and Geotechnologies - Milano-Bicocca (CoNISMa - Consorzio Nazionale Interuniversitario per le Scienze del Mare, Unità locale di ricerca: Dipartimento di Scienze Geologiche e Geotecnologie, Università degli Studi di Milano-Bicocca http://www.geo.unimib.it/Conisma/
Research projects on climate change impacts and adaptation carried out by CoNISMa include: 'Climate variability during the Eemian: Mediterranean paleo-ecosystem dynamics', 'The impact of the large explosive eruptions on environment and climate: Campanian Ignimbrite the most powerful eruptions of the last 200,000 years in the Mediterranean area'. The scope of research by CoNISMa is national and International.

Major funding bodies in the field of Climate Change

The major Italian funding bodies for climate change research are reported below.

- **Environmental Protection and Technical services Agency** (APAT - Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici), http://www.apat.gov.it/site/en-GB/default.html
- **Ministry of Agriculture Food and Forestry Policies** (MIPAAF - Ministero delle Politiche Agricole Alimentari e Forestali), http://www.politicheagricole.it/default.html
- **Ministry of Economy and Finance**, (MEF - Ministero dell'Economia e delle Finanze), http://www.finanze.it/
- **Ministry of Environment, Land and Sea** (MATTM - Ministero dell'Ambiente e della Tutela del Territorio e del Mare), http://www.minambiente.it
- **Ministry of Foreign Affaires** (MAE - Ministero degli Affari Esteri), http://www.esteri.it/
- **Ministry of University and Research**, (MUR - Ministero dell'Università e della Ricerca) http://www.miur.it/

General policy on and funding of systematic observation

Material produced by each institute participating to climate research and systematic observation qualifies for respective copyright protection. However according to the Italian law (39° one issued during 1997 year) and to the Rio 10 principle (Aarhus Convention 1998, effective since 2001) environmental information produced by governmental and public institutions may be accessed at the sole marginal costs and free of charge in respect of the cost of production of the information itself. Such a law provides a general right of access to government environmental information, regardless of the motivation for such access. In addition, information is provided totally free of charges for judicial proceedings or to civil protection authorities.

GCOS Data

All national observations and data sets that have been declared as contributions to GCOS (Global Climate Observing System) are submitted to the appropriate Data Centres. Additionally, all meteorological and oceanographic data and products that are produced by Members (national meteorological services) to support WMO (World Meteorological Organization) programmes such as WWW (World Weather Watch Programme), or cosponsored programmes such as GOOS (Global Ocean Observing System), WCRP (World Climate Research Programme) and IGOSS (Integrated Global Ocean Services System), are available under the terms of WMO Resolution 40 (WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities). Such data are "freely" available "without charge" (i.e. at no more than the cost of reproduction and delivery, without charge for the data and products themselves, and with no conditions on their use).

Hydrological data and products are similarly covered under WMO Resolution 25

Similarly, IOC (Intergovernmental Oceanographic Commission) is expected to adopt a data policy which provides for free and open access to data that are collected, produced or exchanged as part of programmes conducted in association with IOC.

MeteoAM Data

The National Meteorological Service of the Italian Air Force (MeteoAM - Servizio Meteorologico Nazionale dell'Aeronautica Militare) data policy is to encourage the widest possible use of data and products, for genuine research, in order to realize their potential value, whilst preserving the associated rights. Data requested will normally be subject to a charge covering only the cost of extraction, transmission and data handling.

The station network is composed by 77 meteorological manned stations, 78 automatic stations and 10 GAW (Global Atmosphere Watch) stations regarding surface data; 6 upper air stations are present too.

ENAV Data

Other meteorological data are collected by the National Agency for Aviation Aids (ENAV - Ente Nazionale per l'Assistenza al Volo), which operates a network of 35 meteorological stations. Most of them are circulated over the GTS (Global Telecommunication System) and ICAO (International Civil Aviation Organization) Network.

UCEA Data

The Research Unit for Climatology and Meteorology applied to Agriculture of the Agricultural Research Council (CMA CRA - Unità di ricerca per la Climatologia e la Meteorologia applicata all'Agricoltura del Consiglio per la Ricerca e la sperimentazione in Agricoltura), former Central Office of Agriculture Ecology (UCEA - Ufficio Centrale di Ecologia Agraria), of the MIPAAF manages a network of 86 agro meteorological stations and observatories; part of them includes very long data of daily minimum and maximum temperature and precipitation.

ENEA Data

ENEA is responsible of meteorological measurements in Antarctica and GAW data of Lampedusa.

APAT Data

APAT is responsible for the standardization, collection and delivery of environmental data, including those of interest for the study of the climate. National environmental data and indicators are transmitted to the European Commission (EC) through the European Environment Agency (EEA) and to other international bodies such as Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). APAT data policy is to diffuse as much as possible without additional cost quality-assured environmental data.

ISAC CNR Data

A large part of research activity in Italy is devolved to ISAC CNR, but the only routine measurements are collected on the top of Mt. Cimone, where ISAC CNR manages instrumentation inside the MeteoAM observatory. Surface ozone, CFCs (Chlorofluorocarbons) and methane, in collaboration with Urbino University (Università di Urbino), are the most important measures. Participation to EMEP by the Institute for Atmospheric Pollution of the National Research Council (IIA CNR - Istituto sull'Inquinamento Atmosferico del Consiglio Nazionale delle Ricerche) of Roma is included.

CESI Data

Regarding upper air meteorological measurements, in Turbigo station (close to Novara, Piemonte Region) there is a SODAR (*sonic detection and ranging*) system working in continuous doing wind profile observation and storing them as hourly means. The Italian Experimental Electrotechnical Centre (CESI - Centro Elettrotecnico Sperimentale Italiano) manages the Plateau Rosà CO_2 measuring station and sends data regularly to the World Data Centre for Greenhouse Gases (WDCGG).

Research

National Programmes on climate research

The Strategic Programme for Sustainable Development and Climate Change (Programma Strategico Sviluppo Sostenibile e Cambiamenti Climatici)

Overview

The *Strategic Programme for Sustainable Development and Climate Change*, running onward since 2006, has been launched to meet the research needs identified by the PNR 2000 in fields such as:

- study of the evolution of climate variability and its impacts on urban, agricultural and forestry sectors;
- characterization of local soil structures, regional climate simulation and optimization of land management, with a special emphasis on water resources, agriculture and forestry resources, and fishery resources;
- regional studies on vulnerability of coastal zones and impacts assessments;
- projections for land and water ecosystems, with a special emphasis on biodiversity;
- atmospheric processes dynamics (aerosols, clouds, past climate reconstruction);
- applications of remote sensing to understand the climate processes;
- monitoring, assessments, simulations and predictions of the evolution of the agricultural systems in relation to climate change;
- sustainable methods and techniques for carbon sinks;
- studies of the oceanic carbon cycle;
- sustainability of the renewable resources to reduce GreenHouse Gases (GHGs) emissions.

Aim

The main objective of the programme is to conduct simulations, assessments and projections of climate change.

Focus of research

The Programme focuses on: climate, climate change, climate protection, vulnerability and impacts assessment.

- Climate science research includes observations and modelling (from simple linear models to general coupled atmosphere-ocean models).
- Climate protection research includes study of innovative instruments for Kyoto Protocol implementation and of soil carbon sinks.
- Vulnerability assessment research includes coastal areas and marine ecosystems.
- Climate impact research includes: socio-economic topics (energy, industry, insurance, transport and tourism), soil degradation (ex. salinization, acidification, eutrification and pollution), water ecosystems (ex. river catchments, lakes, coastal, oceanic and ground water), biodiversity, human health, human settlements (ex. urban, coastal, etc.), marine biology, forestry, agriculture.

The main geographic focus is on coastal zones, oceanic zones and the Mediterranean Area.

Funding and Managing Organizations

In 2000, the C.I.P.E. deliberated the PNR [35] which set up the features for the *Strategic Programme for Sustainable Development and Climate Change*.

The *Strategic Programme for Sustainable Development and Climate Change* has been funded through the FISR[36] by the MATTM, MUR and MIPAAF.

The budget for the first three-year phase is: 26855758.75 € for nine projects and 27098493.49 € for the Euro-Mediterranean Centre for Climate Change (CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici) (see section"National Projects funded by National Programmes").

The managing organization of the National Programme is the MUR.

National Projects funded by National Programmes

Through the *Strategic Programme for Sustainable Development and Climate Change* nine Projects have been funded: AEROCLOUDS, CARBOITALY, CLIMESCO, GENIUS LOCI, MESCOSAGR, M.I.C.E.N.A., MICRO-GENERATION OF ELECTRIC POWER AND DE-SALTED WATER FROM BIOMASS AND WASTES BY THE TECHNOLOGY OF PYROLISIS COMBINED WITH INTERNAL COMBUSTION ENGINE, SOILSINK and VECTOR.

Project	**Leader Institution**
AEROCLOUDS: Study of the direct and indirect effects of aerosols and clouds on climate (Studio degli effetti diretti e indiretti di aerosol e nubi sul clima) Aim: to study the direct and indirect effect of aerosols and clouds on climate, and the direct effect of natural and anthropic aerosols. The project is subdivided into the following four thematic lines: 1. radiative properties of aerosols and their direct climatic effects; 2. interactions between aerosol and clouds: indirect climatic effects; 3. climatic role of clouds and precipitations; 4. modelling of the aerosol effects on the climatic system on the regional and global scales. Duration: three years, from February 2006 to February 2009 Assigned budget: 4.076.800 € by the FISR Status of research: the first year activity has been completed. The Scientific Report of the activities developed by the four thematic lines of the project has been submitted to the MUR in June 2007. Web site: http://www.isac.cnr.it/~aeroclouds/ (the access is limited only to the	ISAC CNR

35 **PNR 2001-2003**: National Research Programme based on the Guidelines proposed by the Ministry of University and Scientific and Technological Research (MURST - Ministero dell'Università e della Ricerca Scientifica e Tecnologica), approved by the C.I.P.E. on the 25th May 2000 session and took in the Document of Economic and Financial Planning (D.P.E.F. - Documento di Programmazione Economico-Finanziaria) (approved by Ministries Council on 29th June 2000; approved by the C.I.P.E. on the 21st December 2000 session).
PNR 2005-2007: National Research Programme (Legoslative Decree 204/1998, Art. 1, comma 2)].

36 **FISR 2002**: Interministerial Decree 17th December 2002 (Published on Official Gazette 14th January 2003 n.10)

AEROCLOUDS partners)	
CARBOITALY: Innovative instruments for Kyoto Protocol implementation - creation and harmonization of the Italian net for the measurement of agricultural and forest sinks, and development of the national system for assessing and projecting greenhouse gas uptake (Strumenti innovativi per l'implementazione del Protocollo di Kyoto - creazione ed armonizzazione della rete italiana di misura dei sink forestali ed agricoli e sviluppo del sistema nazionale di stima e previsione dell'assorbimento di gas ad effetto serra) Aim: to quantify the carbon sinks by forest and agriculture ecosystems in Italy. Five main research lines have been planned: 1. measurement of CO_2 fluxes in terrestrial ecosystems using eddy covariance and chamber systems; 2. regionalization of the information trough modelling approaches; 3. validation of the carbon budget assessment at regional scale using aircraft CO_2 fluxes measurement; 4. fluxes of non- CO_2 trace GHGs measurement and modelling; 5. scenarios and politics. Duration: 3 years, from February 2006 to February 2009 Assigned budget: about 4 Million € by the FISR Status of research: ongoing, first year closed in February 2007 Web site: http://gaia.agraria.unitus.it/carboitaly	University of Tuscia (Università degli Studi della Tuscia)
CLIMESCO: Evolution of cropping systems as affected by climate change (Evoluzione dei sistemi colturali a seguito dei cambiamenti climatici) Aim: to identify integrated approaches for optimizing water resources use by maximizing the cropping systems Water Use Efficiency (WUE), approaches that could be utilized by political stakeholders in spatial planning activity, in a context characterized by climate change, high evaporative and transpirative demands, poor availability of water resources and/or decreasing of water quality for irrigation. The water use optimization will involve several agronomical practices in order to ensure high productive levels by maximizing the WUE in periods long enough to include the forecast climatic scenarios. Duration: three years plus one, from February 2006 to February 2010 Assigned budget: 2.377.900 € by the FISR Status of research: research activities of the first year have regularly started as scheduled in the Project. The principal activities of this year concern: - spatial characterization of the two test area (Capitanata in Puglia Region and Delia-Nivolelli Basin in Sicilia Region) based on spatially distributed data concerning soil characteristics, climate variability to individuate homogeneous areas; - generation of climatic data to provide temperature, precipitation and radiation scenarios according to the emission scenarios by using General Circulation Models	Agronomical Research Institute of the Agricultural Research Council (ISA CRA - Istituto Sperimentale Agronomico del CRA - Consiglio per la Ricerca e la sperimentazione in Agricoltura)

(GCM) and downscaling the GCM output to estimating local weather forecast for several decades at daily scale; - set up of field experiments, determination of the most important chemical and physical soil parameter, crop growth analysis, monitoring of soil water content, etc.; - sensitivity analysis of soil- and crop-simulation models and constitution of data-set needed for their calibration. Web site: currently not available. Information in Italian is available at: http://www.isac.cnr.it/schedaprog.php?idmenu=2&idprog=734	
GENIUS LOCI: Role of the building sector on the climatic change (Ruolo del settore edilizio sul cambiamento climatico) Aim: to perform simulations, analysis and forecasts of the climate change. The main topics are: a) research on the evolution and on the climatic variability, cause of climatic changes and the role of the urban and productive systems, included the agro-forest one; b) sustainability of the employment of the renewable energy resources to limit the emissions of GHGs. Activities will be oriented towards the development of a "National Plan of action for Sustainable Building", able to send clear messages to all the actors of the building sector and planning. This plan should contain, in a coherent framework, objectives, priorities and actions. Duration: three years, from July 2006 to July 2009 Assigned budget: 1.808.100 € by the FISR Status of research: about 90% of anticipated activities for the first year of project have been completed. Web site: http://www.ipassnet.it/linguait/attivita_genius.htm	Consortium Engineering for Environment and Sustainable development (Consorzio IPASS - Ingegneria Per l'Ambiente e lo Sviluppo Sostenibile)
MESCOSAGR: Sustainable methods for the sequestration of organic carbon in arable soils. Effects on the chemical, physical, biological, and agronomic quality of soils (Metodi Sostenibili per il sequestro del carbonio organico nei suoli agrari. Valutazione degli effetti sulla qualità chimica, fisica, biologica ed agronomica dei suoli) Aim: the subject of research is "Methods and Techniques for Carbon Storage (Carbon Sink)". This research has the aim to further develop the knowledge on the carbon cycle in soils, and compare the capacity of two innovative techniques in sequestering carbon with the GHGs emitted from soil during traditional and minimum tillage. Duration: three years, from August 2006 to August 2009 Assigned budget: 1.808.100 € by the FISR Status of research: after the first year of project, the following status of research was achieved: - set up of experimental field in four experimental sites: Torino and Piacenza (North), Napoli and Potenza (South); - production of common 13C- and 15N-labelled compost to be used in all experimental fields; - synthesis of 25 grams of the biomimetic catalyst;	University of Napoli Federico II, Department for Soil, Plant, Environment and animal productions sciences (Dipartimento di Scienze del Suolo, della Pianta, dell'Ambiente e delle Produzioni Animali, Università di Napoli Federico

- already two distributions on soils of compost and biomimetic catalyst were performed; - a production yield for both maize and wheat was achieved; - monitoring of the changes in soil quality over the first year of experimentation; - set up of selected experiments in laboratory for the assessment of carbon sequestration in the selected soils of the project; - purchase and set up of instrumentation to begin field monitoring of GHGs emissions; - setting up of the different soil and climatic conditions to be monitored in the new predictive model of carbon sequestration to be validated by field measurements. Web site: currently not available. Information in Italian is available at: http://www4.unicatt.it/icaa/project.asp?id=69&title=MESCOSAGR&type=P	II)
M.I.C.E.N.A.: An integrated model for the evolution of natural and agricultural ecosystems in relation to climate change in the Mediterranean area (Modello integrato per l'evoluzione degli ecosistemi naturali e agricoli in relazione ai cambiamenti climatici nell'area Mediterranea) Aim: to assess the impact of climate change on natural, including marine, freshwater and terrestrial ecosystems, and agricultural systems in the Mediterranean area. The research project is aimed to fulfil the following tasks: 1) identification of the main patterns of climate evolution in the Mediterranean area, from a regional to a meso-scale, by the analysis of meteorological, geological, hydrological and biological records. The task involves the creation of territorial historical databases, which should also put the basis for future monitoring programmes. Numerical simulation of the present and future scenarios at different spatial scales will be performed based on the RAMS-CLIMA model; 2) evaluation of the impacts of climate-connected environmental changes on natural systems, with particular reference to the impact on biodiversity (intraspecific, specific and ecosystemic) and water resources. Identification of critical spots of biodiversity and water resource losses; 3) evaluation of the impacts of climate-connected environmental changes on agricultural systems, with particular reference to changes in the cultural cycle of key species, cultural practices, land and water use, local economy; 4) development of forecasting models for the evolution of natural and agricultural systems and planning sustainable management strategies for mitigating climate change impacts. Duration: three years, from March 2006 to February 2009 Assigned budget: 1.902.158,75 € by the FISR Status of research: the first year of activity is in line with the time schedule of the project. The following activities have been fulfilled: - selection of natural biotopes and agricultural system of interest; - collection of territorial historical data of meteorological, geological, hydrological and agricultural parameters; - database preparation and validation; - time series analysis;	University of Perugia, Department of Economy, Finance and Statistics (Università degli Studi di Perugia, Dipartimento di Economia, Finanza e Statistica)

- climate model set up; - collection of biological samples in the selected biotopes for population density estimates; - collection of samples for archive preparation (sedimentary records, germoplasm bank) and laboratory analyses; - calibration of analytical methods, preparation of image archives; - dendrochronology: testing LA-ICP-MS spectrophotometry for determining metal isotope concentrations in tree rings; - paleolimnology: optimising the protocol of quantitative counting of siliceous microfossils and sub-fossils in sediment cores; - water resources: defining the natural content of heavy metals in groundwater in Umbria Region; - fishery resources: AF analysis; DVM assessment, genetic analyses; - inland analysis through GIS technology and satellite photo survey. Web site: http://www-b.unipg.it/micena/ .	
MICRO-GENERATION OF ELECTRIC POWER AND DE-SALTED WATER FROM BIOMASS AND WASTES BY THE TECHNOLOGY OF PYROLISIS COMBINED WITH INTERNAL COMBUSTION ENGINE - From the laboratory to the trading of integrated systems aimed to lowering greenhouse gases and improving coastal areas sustainability (MICRO-COGENERAZIONE DI ENERGIA ELETTRICA ED ACQUA DISSALATA DA BIOMASSA E RIFIUTI CON TECNOLOGIA DI PIROLISI ASSOCIATA A MICROTURBINA E MOTORE A COMBUSTIONE INTERNA - Dal laboratorio alla commercializzazione di sistemi integrati per il contenimento diffuso dei gas serra e la sostenibilità delle aree costiere.) Aim: to develop the process of pyrolisis (the chemical decomposition of organic materials by heating in the absence of oxygen) to produce electric power from organic matter (biomass and/or waste) with high efficiency. The technology will be developed in order to promote the small scale combined generation of de-salted water; this approach is mainly addressed to coastal areas where the availability of organic matter is emerging together with the need of water (i.e. isles or tourist villages where the production of waste is associated to water consumption). The project will be approached on laboratory scale with up to the plant design, prototype realisation and *in situ* testing of the integrated system. Duration: 3 years, from May 2006 to May 2009 Assigned budget: 2.446.500 € by the FISR Status of research: in progress. The first year of the project has been successfully completed with the experimental phase on laboratory scale and the realisation of a 'pyrolisis' dedicated laboratory (pilot scale). Web site: currently not available	High Institute for Research and Education on Special Materials for Advanced Technologies and for Environment (ISRIM - Istituto Superiore di Ricerca e Formazione sui Materiali Speciali per le Tecnologie Avanzate e per l'Ambiente)
SOILSINK: Climate change and agro-forestry systems, impacts on soil carbon sink and microbial diversity (Cambiamenti climatici e sistemi produttivi agricoli e forestali, impatto sulle riserve di carbonio e sulla diversità microbica del suolo)	Experimental Institute for Plant Nutrition of the Agricultural

Aim: to identify the most efficient production systems in terms of soil carbon storage and organic matter increase in two case studies in the Mediterranean area (Italy). The main areas of research are: 1) agro-forestry production systems; 2) simulation models and land evaluation; 3) genetic and functional microbial diversity; 4) carbon sink and biogeochemical cycles. The Project is based on two research sites with different pedoclimatic, agricultural and contextual characteristics: Agugliano (AN), in Marche Region, and Berchidda (OT) in Sardegna Region. Duration: three years, from July 2006 to June2009 Assigned budget: 2.558.556 € by the FISR Status of research: - characterization and in-depth knowledge of the potential productive level of the agricultural and agro-forestry systems, the physical, chemical and climatic characteristics of the two sites (in progress); - assessment of the genetic and functional diversity of soil micro-organisms, and of the vegetation of specific importance in the C and N cycle in the soil (in progress); - availability of data-sets to run the simulation models on soil organic C and to improve the knowledge of the C sink processes (in progress); - evaluation of future climatic scenarios through Global Circulation Models, as input for C cycle models in comparison with the actual climate, and to study their effects on the microbial diversity and the C dynamic (in progress); - involvement of local communities and stakeholders to increase the awareness towards the climate change and the potential role of the agro-forestry sector in the mitigation strategies (in progress). Web site: under construction	Research Council (ISNP CRA - Istituto Sperimentale per la Nutrizione delle Piante del Consiglio per la Ricerca e la sperimentazione in Agricoltura)
VECTOR: Vulnerabilities of Italian coastal areas and marine ecosystems and their role in the oceanic organic carbon cycles (Vulnerabilità delle coste e degli ecosistemi marini italiani ai cambiamenti climatici e loro ruolo nei cicli del carbonio oceanico) Aim: to study the most important current climate change impacts on the Mediterranean marine environment, and the role of this basin in the global carbon cycle, and to produce possible future impacts scenarios for Italian coasts. Proposed scenarios will concern changes in the length of coastal areas, in the morphology of emerged beaches, in the structure of the water column, in the long-shore transport, in the transport of aerosols from the sea to the coastal areas, and the relative impacts on structures and settlements areas on freshwater layer of coastal plains. These scenarios will be linked, in certain areas, to those related to changes in marine and lagoon ecosystems in terms of biodiversity, productivity, distribution of invasive species and of species important for the economy. Risks connected to the proposed scenarios will focus on the consequences of	CoNISMa

climate change on coastal areas biodiversity also from a socio-economic point of view and on the further consequences on tourism, agriculture, fishery and breeding. Duration: three years, from 2006 to 2009 Assigned budget: 5.775.000 € by the FISR - Fondo Integrativo Speciale per la Ricerca Status of research: in progress Web site: http://vector-conisma.geo.unimib.it	

In addition, the *Strategic Programme for Sustainable Development and Climate Change* has included the creation of a research network: the **Euro-Mediterranean Centre for Climate Change (CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici)**, whose research activities focus primarily on climate change and the impacts of climate change over the Mediterranean area.

The CMCC includes Universities, Public Research Centres, Foundations and Consortiums led by INGV. The other members of the CMCC are: University of Lecce (Università degli Studi di Lecce), FEEM, Italian Space Agency (ASI - Agenzia Spaziale Italiana), Italian Centre for Aerospace Research, (CIRA - Centro Italiano Ricerche Aerospaziali), Venice Research Consortium (CVR - Consorzio Venezia Ricerche), University of Sannio (Università degli Studi del Sannio).

Euro-Mediterranean Centre for Climate Change (CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici) Aim: to study climate change and the impacts of climate change on economy, agriculture, sea and earth ecosystems, coastal zones, and health over the Mediterranean area, and relative interactions with the global climate. Duration: 2005 - onward Budget: 27.098.493,49 € for the first three years Status of Research: CMCC develops and verifies documented numerical models for climate simulations. In particular: a global simulation model of the Earth System that includes the atmosphere, the oceans, the sea ices, the terrestrial biosphere and the sea ecosystems, coupled with a high resolution model of the Mediterranean Sea; climatic simulations over long periods; ensembles of checked quality; suite of simulation models of the socioeconomic impact of climate change. The research activities developed by the CMCC divisions follow the following lines: - technologies, grid applications and operations; - evaluation and diagnostics of the impacts of climate change on agriculture; - numerical applications; - models and socio-economic scenarios; - impact evaluation and diagnostics; - special projects. Web site: http://www.cmcc.it	**Leader Institution** INGV

National Projects not funded by National Programmes

Further main National research Projects carried out by Italian Research Institutions, Universities and Agencies working on climate change are reported below.

Project	**Leader Institution**
AgriScenari Focus of research: irrigation and climate change in Italy Aim: to define a strategy and a methodology in order to minimise agricultural water needs keeping at the same time productions and incomes, in the context of a changing climate and drought risk increase Duration: from 2007 to 2010 Budget: still to be decided Status of Research: not started, yet Web site: not available yet	ARPA SIM
Climate change and agriculture (CLIMAGRI - Cambiamenti Climatici e Agricoltura) Aim: to improve the knowledge of linkages between agriculture and climate change and to obtain a climatic analysis of the national territory, evidencing climatic anomalies and changes in action or hypothesis with a specific impact on Italian agricultural sector. The focus is on climate change impacts, but in a view to support implementation of response measures, and to draw recommendations for adaptation. Subprojects: 1) climatic analysis and future scenarios; 1) Italian agriculture and climate change; 2) drought, desertification and water resources management; 3) data dissemination and communication. Duration: three years and ten months, from February 2001 to December 2005 Budget: about 3 Million € by the MIPAAF Partnership: 52 Italian Research Institutions, including University institutes and departments, INGV, institutes of the CNR, institutes of the Council for Research and Experimentation in Agriculture (CRSA - Consiglio per la Ricerca e la Sperimentazione Agricola), some Regional meteorological services and the General Office for Air Space and Meteorology of the Italian Air Force (Meteorological Service) (USAM - Ufficio Generale Spazio Aereo e Meteorologia dell'Aeronautica Militare (Servizio Meteorologico Nazionale)) Status of Research: completed. The final report and publications are available at the project's web site Web site: http://www.climagri.it/	Research unit for Climatology and Meteorology applied to Agriculture of the Agricultural Research Council (CMA CRA - Unità di ricerca per la Climatologia e la Meteorologia applicata all'Agricoltura del Consiglio per la Ricerca e la sperimentazione in Agricoltura), former Central Office of Agriculture Ecology (UCEA - Ufficio Centrale di Ecologia Agraria)

Climate change and Kyoto (Cambiamenti climatici e Kyoto) Aim: to develop models and scenarios for the evaluation of the impact of climate change over the long term (until after 2020), with a view to implement measures aimed at mitigating and adapting to climate change; to contribute to the international effort to monitor GHGs emissions and to conduct analysis and assessment activities on measures and programmes relating to short- and mid-term national commitments under the Kyoto Agreement and on post-Kyoto issues. This is an ENEA special new research project. Duration: three years Budget: ENEA institutional funding Status of Research: in start-up Web site: http://www.enea.it/com/web/Attivita/kyoto.html	ENEA
Evolution in the frequency of extreme precipitation and drought events in Italy over the last 120 years and relative impact on bioecosystems (Evoluzione nella frequenza di eventi precipitativi estremi e di siccità in Italia negli ultimi 120 anni e relativo impatto sui bioecosistemi) Project type: Fund for Investments in Basic research (FIRB - Fondo per gli Investimenti della Ricerca di Base) Aim: to give a complete view, from the daily series analysis, on the evolution of precipitation in Italy for the last 120 years concerning both heavy and extreme precipitation events as well as dry spells. The results of the analysis will be evaluated as climate change indicators. Duration: four years, from November 2002 to November 2005 Budget: the contribution by ISAC CNR is 250.000 € Status of Research: completed Website: http://www.isac.cnr.it/~climstor/firb.html	ISAC CNR

Global change (Cambiamenti globali) Aim: to evaluate, through models and field measurements, ancient and recent climate change of the Earth system, due to natural and anthropic causes, and to project the relative ecologic responses of species and communities. Research lines of the activities are: - climate change: dynamic climatology; - climate change: recent climate change; - climate change: paleoclimatology; - climate change: hydrologic cycle; - variation of atmospheric composition; - variation of marine biogeochemic composition; - natural biogeochemic exchanges (C, N, P) at the interface biosphere-atmosphere-ocean; - dynamics of micro-pollutants exchanges at the biosphere-atmosphere-ocean interface; - terrestrial ecosystems response to global change; - aquatic ecosystems response to global change; - evolution processes in extreme polar environments. Duration: three years, from 2006 to 2008 Budget: project total cost (2006) 28,79 Mil €; (2007) 23,80 Mil €; (2008) 24,34 Mil € Status of Research: achieved results are basically coherent with expected results, involving the set up of methodologies for polluters' detection and their inter-relations. Web site: currently not available. Information in Italian is available at: http://www.cnr.it/commesse/dipartimenti-progetti/1/TA-P02.html	Department Earth and Environment (Dipartimento Terra e Ambiente) of the CNR

Integrated Research for Applying new technologies and processes for combating DEsertification (RIADE - Ricerca Integrata per l'Applicazione di tecnologie e processi innovativi per la lotta alla DEsertificazione) Aim: development of an integrated and technologically innovative system for monitoring desertification processes localized in the southern areas of Italy, able to contribute at determining the cause - effect relationship in the observed phenomena, and to promote interventions for the territory safeguard. The project shall provide a set of products for desertification modelling and forecast, and also a decision making system for supporting the public administration in the environmental planning processes. Duration: three years, from October 2002 to October 2005 Budget: 7.826.000 € for the research project and 900.000 € for the training project, co-financed by the EU and the MUR within the 2000-2006 National Operative Program of "Research, Technological Development and High Level Training" (Programma Operativo Nazionale di "Ricerca, Sviluppo Tecnologico ed Alta Formazione"). Partnership: ENEA, Advanced Computer Systems A.C.S. S.p.A., Desertification Research Group (NRD) of the University of Sassari (Gruppo di ricerca sulla desertificazione dell'Università di Sassari). The Italian Regions of Basilicata, Puglia, Sardegna and Sicilia are also involved. Status of Research: completed Web site: http://www.riade.net/	ENEA
Kyoto Club - Emission Trading per i Comuni e le Province in Italia (KYOTO CLUB - Emission Trading for Local Municipalities and Provinces in Italy) Project type: MATTM, 2006-2008 Aim: to test the EU Emissions Trading Scheme (EU-ETS) system, established by the Emissions Trading Directive 2003/87/EC, on a small range of Italian municipalities and provinces, building a system for the reduction of emissions from the public building sector and the transport fleet. Duration: about two years, from November 2005 to December 2007 Budget: 150.000 €; funding institution: MATTM Status of Research: the kick-off meeting took place in Vicenza on the 28th of April 2006 during the SolarExpo Exhibition. The meeting has recorded a very successful participation and a very high level of interest by local decision makers and public administration stakeholders. A draft outline of the ETS system has been presented to the selected local municipalities in September 2006 at the CO_2 Expo Exhibition in Roma. Web site: http://www.kyotoclub.org/ita/EELL_ET	Kyoto Club
Local climate variability related to the phenomenon of global climate change (La variabiltà del clima locale relazionata ai fenomeni di cambiamento	

climatico globale) <u>Project type:</u> Research Programmes with Relevance at the National level (PRIN - Progetti di Rilevante Interesse Nazionale) <u>Aim:</u> to reconstruct and validate the main temperature and precipitation Italian centennial series of data, in order to create a data base useful to identify, at the regional Mediterranean scale, the year-to-year and annual variability that characterize climate change in Northern Italy. <u>Duration:</u> two years, from 2001 to 2002 <u>Budget:</u> 165266 € assigned by the MUR <u>Status of Research</u>: completed <u>Website</u>: currently not available. Information in Italian is available at: http://cercauniversita.cineca.it/php5/prin/scheda.php?codice=2001048123&testo=sinottica	University of Genova (Università degli Studi di Genova)
Natural and anthropic risks of the territory (Rischi naturali ed antropici del territorio) <u>Aim</u>: to improve understanding of drivers of natural and anthropic risks, in submarine and emerged areas, and develop methods for prevention and mitigation. Research lines including climate change issues are (4 of 5): - geologic recent evolution, soil formation and soil erosion; - spates and floods; - natural and anthropogenic risks assessment and mitigation strategies; - landslides and other mass movements. <u>Duration:</u> three years, from 2006 to 2008 <u>Budget:</u> project total cost (2006) 27,23 Mil €; (2007) 22,51 Mil €; (2008) 23,02 Mil € <u>Status of Research:</u> achieved results are mostly coherent with expected results, including the establishment of study modules to determine the risk threshold for phenomena such as erosion, landslides, flooding, with relative early warning system. <u>Web site:</u> currently not available. Information in Italian is available at: http://www.cnr.it/commesse/dipartimenti-progetti/1/TA-P05.html	Department Earth and Environment (Dipartimento Terra e Ambiente) of the CNR
Optimisation of agro-environmental scenarios for bioenergy crops (Ottimizzazione degli scenari agro-ambientali per colture da energia) <u>Project Type:</u> PRIN <u>Aim</u>: to give answers on actual suitability of biomass crops, in relation to EU CAP (Common Agricultural Policy), and to develop methodological approaches to integrate knowledge of different nature (agronomical, meteorological and climatic, environmental, economic) and so to give instructions for developing decisions (private and public) in relation to objectives and with different levels of risk about scenarios of different time length. <u>Duration:</u> 2005-2006 <u>Budget:</u> 85.000 €; funding institution: MUR <u>Status of Research:</u> completed <u>Web site</u>: information is available at: http://www.ricercaitaliana.it/prin/dettaglio_completo_prin_en-2005077778.htm	University of Udine (Università di Udine)

Sustainability of terrestrial and aquatic systems (Sostenibilità dei sistemi terrestri e acquatici) Aim: to define the functioning of environmental systems and their responses to human activities, in order to set up methods and standards allowing a sustainable management. Research lines including climate change issues are (3 of 8): - inner water sustainable management; - environmental modelling for sustainability; - coastal zone sustainable management. Duration: three years, from 2006 to 2008 Budget: project total cost (2006) 29,91 Mil €; (2007) 24,72 Mil €; (2008) 25,29 Mil € Status of Research: achieved results are mostly coherent with expected results, including the set up of innovative instruments for a sustainable use of marine resources and of databases for the hydrologic balance in Mediterranean environment. Web site: currently not available. Information in Italian is available at: http://www.cnr.it/commesse/dipartimenti-progetti/1/TA-P04.html	Department Earth and Environment (Dipartimento Terra e Ambiente) of the CNR
Sustainable use of the territory and energy (Uso sostenibile del territorio ed energia) Aim: to develop and promote renewable energy and energy efficiency in the civil and industrial sectors. This is an ENEA special research project. The research lines are: - renewable energy sources; - innovative methods and tools in support to energy efficiency governance; - development of methodologies and indicators for energy management; - education and dissemination. Duration: three years Budget: ENEA institutional funding Status of Research: in start-up Web site: http://www.enea.it/com/web/Attivita/UsoSostenibile.html	ENEA
The earth system: interactions between solid earth, sea, inland water, atmosphere and biosphere (Il sistema terra: interazioni tra terra solida, mare, acque interne, atmosfera e biosfera) Aim: to improve understanding of the processes regulating the earth system and the interactions among its components in order to project their main evolution trends. The Project includes 12 research lines and 31 modules. An example is the research line "marine circulation and production" and its module "dynamics of dissolved organic matter (DOM)", focusing on the study of the DOM's dynamics in the Mediterranean Sea, with a special emphasis on its role as source or stock of CO_2. Duration: three years, from 2005 to 2007 Budget: project total cost (2006) 51,94 Mil €; (2007) 42,93 Mil €; (2008) 43,91 Mil € Status of Research: with reference to the above mentioned example, several interdisciplinary oceanographic campaigns have been carried out in the	Department Earth and Environment (Dipartimento Terra e Ambiente) of the CNR

Mediterranean Sea Web site: currently not available. Information in Italian is available at: http://www.cnr.it/commesse/dipartimenti-progetti/1/TA-P01.html	
Valuing the costs of climate change in Italy: the case of Sangro, Abruzzo (Valutazione dei costi dei cambiamenti climatici in Italia: il caso di Sangro, Abruzzo) Aim: to provide an overview of the most crucial methodological issues that climate change cost assessment and climate change control policies must face and to develop a methodological framework to be implemented when trying to estimate the costs of climate change in practice, on peculiar case-studies. The project tests the goodness of the methodological approach developed, by applying the costing methodology to one Italian costal area, the Sangro area, located in the Abruzzo Region. Duration: one year, from May 2005 to May 2006 Budget: 20.000 € Status of Research: completed Web site: currently not available. Information is available at: http://www.feem.it/Feem/Pub/Programmes/Climate+Change/Activities/200601-ENEA.htm	ENEA

International research and capacity building

Main EU Projects with Italian participation

The main research Projects on climate change related topics funded by the EC and carried out by Italian Research Institutions, Universities and Agencies are below synthetically reported.

ACCENT: Atmospheric Composition Change, the European Network of Excellence

Project type: EC Framework Programme 6 (FP6), Network of Excellence (NoE)

Focus of research: atmospheric composition change

Aim: changes in atmospheric composition directly affect many aspects of life, determining climate, air quality and atmospheric inputs to ecosystems. In turn, these changes affect the fundamental necessities for human existence: human health, food production, ecosystem health and water. Atmospheric composition change research is therefore fundamental for the future orientation of Europe's Sustainable Development strategy.

Duration: five years, from 2004 to 2009

Leader Institution: ISAC CNR

Italian Partners: ISAC CNR, Urbino University "Carlo Bo" (Università degli Studi di Urbino "Carlo Bo")

Web site: http://www.accent-network.org/

ALP-IMP: Multi-centennial climate variability in the Alps based on Instrumental data, Model simulations and Proxy data

Project type: EC FP5, Key Action "Global Change, Climate and Biodiversity" within the "Energy, Environment and Sustainable Development" Programme

Focus of research: regional climate variability in the Alps

Aim: to collect, to complete, to evaluate, to validate and to understand the existing information on millennium scale climate variability in the European Alps and their surroundings (GAR - "Greater Alpine Region") within the project and to provide the integrated GAR dataset as well as the project's findings ready for use in the public domain for further climate and climate impact studies.

Duration: three years and a half, from March 2003 to August 2006

Leader Institution: Central Institute for Meteorology and Geodynamics (ZAMG), Austria

Italian Partners: ISAC CNR

Web site: http://www.zamg.ac.at/ALP-IMP/

AMMA: African Monsoon Multidisciplinary Analysis

Project type: EC FP6, Integrated Project (IP)

Focus of research: African monsoon and global climate change

Aim: to provide the African decision makers with improved assessments of similar rainfall changes which are likely to occur during the 21st century due to natural fluctuations and as a result of anticipated global climate change. An essential step in that direction is to improve our ability to forecast weather and climate in the West African region, in particular:

1) to improve our understanding of the WAM and its influence on the physical, chemical and biological environment regionally and globally;
2) to provide the underpinning science that relates climate variability to issues of health, water resources and food security for West African nations and to define relevant monitoring strategies;
3) to ensure that the multidisciplinary research is effectively integrated with prediction and decision making activity.

Provided services include: research activities on geophysical process studies, surface atmosphere feedbacks, land productivity and on the assessment of vulnerability framework of west Africa human dimension, and demonstration activities on early warning systems for food security.

Duration: four years, from January 2004 to December 2008

Leader Institution: CNRS - Centre National de la Recherche Scientifique, France

Italian Partners: IBIMET CNR, ISAC CNR, ENEA, University of Perugia, GEOPHYSICA-EEIG

Web site: https://www.amma-eu.org/

CASTOR: CO_2, From Capture To Storage

Project type: EC FP6, IP

Focus of research: capture and sequestration of CO_2 associated with cleaner fossil fuel plants, with a special focus on "Post-combustion capture technologies for CO_2" and "CO_2 storage confidence building"

Aim: to develop and validate, in public/private partnerships, all of the innovative technologies needed to capture CO_2 at the post-combustion stage and store CO_2

Duration: four years, from February 2004 to January 2008

Leader Institution: IFP, France

Italian Partners: OGS and ENI S.p.A.

Website: http://www.co2castor.com

CIRCE: Climate Change and Impact Research: the Mediterranean Environment

Project type: EC FP6, IP

Focus of research: climate change and climate change impacts in the Mediterranean area

Aim: to develop for the first time an assessment of the climate change impacts in the Mediterranean area. In particular:

- to predict and to quantify physical impacts of climate change in the Mediterranean area;
- to evaluate the consequences of climate change for the society and the economy of the populations located in the Mediterranean area;
- to develop an integrated approach to understand combined effects of climate change;
- to identify adaptation and mitigation strategies in collaboration with regional stakeholders.

Duration: four years, from April 2007 to March 2011

Leader Institution: INGV, Italy

Italian Partners: INGV, CLU srl, ENEA, FEEM, IBAF CNR, IBIMET CNR, ISAC CNR, Water Research Institute of the National Research Council (IRSA CNR - Istituto di Ricerca Sulle Acque del Consiglio Nazionale delle Ricerche), Local Health Agency of Roma (ASL Roma), University of Tuscia, Zadigroma srl, University of L'Aquila - CETEMPS Excellence Centre (Università degli Studi di L'Aquila - Centro d'Eccellenza CETEMPS), University of Salento - Department of Material Science (Università degli Studi del Salento - Dipartimento di Scienze dei materiali), CMCC, OGS, University of Bologna - Department of tree cultivars (Università degli Studi di Bologna - Dipartimento di colture arboree)

Web site: http://www.circeproject.eu/

CIRCLE: Climate Impact Research Coordination for a Larger Europe

Project Type: EC FP6, ERA-Net: Coordination and cooperation of research activities carried out at national or regional level

Focus of research: national programmes and initiatives on climate change impacts assessment, vulnerability, adaptation

Aim: to coordinate European research on climate change impact assessment and adaptation to facilitate the research needed by European and national decision makers to design effective yet economically efficient and feasible adaptation strategies.

Duration: four years, from October 2005 to September 2009

Leader institution: Umweltbundesamt GMBH (Austrian Federal Environment Agency), Austria

Italian participants: MATTM as contractor and INGV as sub-contactor

Web site: http://www.circle-era.net

CLARIS: A Europe-South America Network for Climate Change Assessment and Impact Studies

Project type: EC FP6, Specific Support Action (SSA)

Focus of research: climate change and impact issues in the subtropical region of South America

Aim: to strengthen collaborations between research groups in Europe and South America to develop common research strategies on climate change and impact issues in the subtropical region of South America through a multi-scale integrated approach (continental-regional-local).

The main objectives of the project are:

1) to set up and favour the technical transfer and expertise in Earth System and Regional Climate Modelling between Europe and South America, as well as to provide a list of climate data (observed and simulated) required for model validations;
2) to facilitate the exchange of observed and simulated climate data between the climate research groups and to create a South American high-quality climate database for studies in extreme events and long-term climate trends;
3) to strengthen the communication between climate researchers and stakeholders, and to demonstrate the feasibility of using climate information in the decision-making process.

Duration: three-years, from 2004 to 2007

Leader Institution: CNRS - Centre National de la Recherche Scientifique, France

Italian Partners: INGV, Experimental Institute for Industrial Cultivars of the Agricultural Research Council (ISCI CRA - Istituto Sperimentale Colture Industriali)

Web site: http://www.claris-eu.org/

ClimChAlp: Climate Change, Impacts and Adaptation Strategies in the Alpine Space

Project type: INTERREG III B ALPINE SPACE PROGRAMME

Focus of research: climate change impacts assessment and adaptation in the Alpine area

Aim:

1) assessment of climate change in the Alpine area and of its impacts on natural hazards, spatial and economic development, based on historical data and climate models (past and future scenarios),
2) development of a flexible net of trans-national response,
3) provision of strategic recommendations for improving relevant policies, instruments and administrative structures particularly in the area of risk prevention and spatial planning.

Duration: three years, from March 2006 to March 2008

Leader Institution: Bavarian State Ministry of the Environment, Public Health and Consumer Protection (Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz, Referat Klimaschutz, StMUGV), Deutschland

Italian Partners: MATTM (along with CMCC as sub-contractor), Friuli Venezia Giulia Autonomous Region (Regione Autonoma Friuli Venezia Giulia), Autonomous Province of Bolzano (Provincia Autonoma di Bolzano), Valle d'Aosta Autonomous Region (Regione Autonoma Valle d'Aosta), Piemonte Regional Agency Prevention and Environment (ARPA Piemonte - Agenzia Regionale Prevenzione e Ambiente della regione Piemonte)

Web site: http://www.climchalp.org/

COST: European cooperation in the field of scientific and technical research

Project type: EU RTD FP, Research Network (intergovernmental European framework for international co-operation between nationally funded research activities)

Focus of research: "Advances in homogenisation methods of climate series: an integrated approach" (ACTION ES0601)

Aim: to achieve a general method for homogenising climate and environmental datasets.

Duration: three years, from 2007 to 2010

Italian Partners: ISAC CNR

Web site: http://www.cost.esf.org/index.php?id=1077

CO_2GeoNet: the European Network of Excellence on Geological Storage of CO_2

Project type: EC FP6, NoE

Focus of research: underground carbon dioxide (CO_2) storage as a GHGs mitigation option

Aim: to form a durable and complimentary partnership comprising a critical mass of key European research centres whose expertise and capability become increasingly mutually interdependent. The initial partnership is between 13 institutes, most of whom have a long and established history of research in geological sequestration.

Duration: five years, from April 2004 to March 2009

Leader Institution: BGS, UK

Italian Partners: OGS and University of Roma "La Sapienza" (Università "La Sapienza" di Roma)

Web site: http://www.co2geonet.eu

CO_2 ReMoVe - CO_2 Geological Storage: Research into Monitoring and Verification Technology

Project type: EC FP6, IP

Focus of research: CCS

Aim: to develop innovative research and technologies for the monitoring and verification of CO_2 geological storage. CO_2ReMoVe is a consortium of industrial, research and service organizations with experience in CO_2 geological storage. The consortium proposes a range of monitoring techniques, applied over an integrated portfolio of storage sites, which will develop:

- methods for base-line site evaluation;
- new tools to monitor storage and possible well and surface leakage;
- new tools to predict and model long term storage behaviour and risks;
- a rigorous risk assessment methodology for a variety of sites and time-scales;
- guidelines for best practice for the industry, policy makers and regulators.

Duration: five years, from March 2006 to February 2011

Leader Institution: TNO, The Netherlands

Italian Partners: OGS and University of Roma "La Sapienza" (Università di Roma "La Sapienza")

Website: http://www.co2remove.eu/

DEMETER: Development of a European Multimodel Ensemble system for seasonal to year-to-year prediction

Project type: EC FP5, Key action "Global Change, Climate and Biodiversity" within the "Energy, Environment and Sustainable Development" Programme

Focus of research: seasonal to year-to-year prediction modelling

Aim: development of a well-validated European coupled multi-model ensemble forecast system for reliable seasonal to year-to-year prediction.

Duration: three years and five months, from April 2000 to September 2003

Leader Institution: ECMWF - European Centre for Medium Range Weather Forecasts, UK.

Italian Partners: INGV, ARPA SIM, Commission of the European Communities - DG Joint Research Centre (IT)

Web site: http://www.ecmwf.int/research/demeter/

DESERTNET

Project type: INTERREG IIIB MEDOCC

Focus of research: study, monitoring and sustainable management of desertification risk areas in the Mediterranean basin

Aim: to implement a platform as a common system of services to support National and European policies to combat desertification, according to the United Nations Convention to Combat Desertification (UNCCD), and to promote sustainable management of natural resources (especially soil and water)

Duration: phase I three years, from 2002 to 2004; phase II three years, from October 2005 to June 2008

Leader Institution: research unit on desertification of University of Sassari (NRD UNISS - Nucleo Ricerca Desertificazione Università di Sassari), Italy

Italian Partners: phase II - Italian Regions Basilicata, Calabria, Sicilia, Toscana, Sardegna (Le Regioni Ialiane Basilicata, Calabria, Sicilia, Toscana, Sardegna), ARPA SIM, IBIMET CNR and with: APAT, ENEA, University of Basilicata (Università degli Studi della Basilicata) in the Scientific Committee

Web site: http://www.desertnet.org/content/view/19/74/lang,en/

ENSEMBLES

Project type: EC FP6, IP

Focus of research: climate change impacts on timeframes ranging from seasonal to decadal and longer, at global, regional and local spatial scales

Aims:

1) to develop an ensemble prediction system for climate change based on the principal state-of-the-art, high resolution, global and regional Earth System models developed in Europe, validated against quality controlled, high resolution griddled datasets for Europe, to produce for the first time, an objective probabilistic estimate of uncertainty in future climate at the seasonal to decadal and longer timescales;

2) to quantify and reduce the uncertainty in the representation of physical, chemical, biological and human-related feedbacks in the Earth System (including water resource, land use, and air quality issues, and carbon cycle feedbacks);

3) to maximise the exploitation of the results by linking the outputs of the ensemble prediction system to a range of applications, including agriculture, health, food security, energy, water resources, insurance and weather risk management.

Duration: five years, from September 2004 to September 2009

Leader Institution: Met Office's Hadley Centre for Climate Prediction and Research, UK

Italian Partners: INGV, ARPA SIM, ISAC CNR, IBIMET CNR, Firenze University (Università di Firenze), FEEM, ICTP

Web site: http://ensembles-eu.metoffice.com/

EUCAARI: European Integrated Project on Aerosol Cloud Climate Air Quality Interactions

Project type: EC FP6, IP

Focus of research: aerosol cloud climate and air quality interactions

Aim: to investigate the role of aerosol on climate and air quality, bringing together the leading European research groups, state-of-the-art infrastructure and key players from third countries

Duration: four years, from 2007 to 2010

Leader Institution: University of Helsinki, Finland

Italian Partners: ISAC CNR

Web site: http://www.atm.helsinki.fi/eucaari/index.php?option=com_frontpage

EU GeoCapacity: Assessing European Capacity for Geological Storage of Carbon Dioxide

Project type: EC FP6, Specific Targeted Research Project (STREP)

Focus of research: CCS

Aim: to provide the data required for the Europe wide adoption of CCS. The project focus on applying advanced evaluation techniques (DSS and GIS) and complementing the datasets by emission, infrastructure and storage site mapping as well as undertaking economic evaluations. This enables source-to-sink matching across Europe. Site selection criteria, standards and methodologies are created and applied to the project.

Duration: three years, from January 2006 to December 2008

Leader Institution: GEUS, Denmark

Italian Partners: OGS and ENI S.p.A.

Website: http://nts1.cgu.cz/portal/page/portal/geocapacity/project

FORALPS: Meteo-Hydrological Forecast and Observations for improved water resource management in the ALPS

Project type: INTERREG III B ALPINE SPACE PROGRAMME

Focus of research: water management, meteo-hydrological forecast and observations in the Alpine area

Aim: to evaluate the sustainable management of environmental resources, and in particular water. To meet this expectation, various environmental processes have to be taken into account, such as atmospheric, hydrological and geographical factors affecting the water cycle, which cannot be encompassed within administrative borders, but have to be jointly faced by neighbouring regions and countries. Recent advances will be transferred to operational public services in the alpine regions and disseminated to decision makers.

Duration: three years, from January 2005 to December 2007

Leader Institution: University of Trento (Università di Trento)

Italian Partners: Autonomous Provinces of Bolzano and Trento, Autonomous Region Valle d'Aosta, APAT, ARPAs of the Regions: Veneto, Friuli Venezia Giulia and Lombardia, Centre of Engineering and Development of Models for the Environment (CISMA - Centro di Ingegneria e Sviluppo di Modelli per l'Ambiente), ISAC CNR, Politechnical University of Torino (Politecnico di Torino), CINFAI

Web site: http://www.unitn.it/foralps/index.htm

GESTALP: management models for the valorisation of biodiversity in the trans-boundary alpine environment

Project type: INTERREG IIIA Alcotra (Italy-France)

Focus of research: biodiversity management

Aim: to set-up models and tools for biodiversity management through analysis of the territorial context and involvement of public and private stakeholders on the territory

Duration: 2000-2006

Leader Institution: Université de Savoie Valle d'Aosta, France

Italian Partners: research centre management of wild fauna (Centro ricerche gestione della fauna selvatica), Gran Paradiso National Park (Parco Nazionale Gran Paradiso), Valle d'Aosta Autonomous Region (Regione Autonoma Valle d'Aosta), University of Torino (Università di Torino)

Web site: http://www.interreg-alcotra.org/project.asp?itemid=173&lang=it

InCA-CO_2: International Co-ordination Action on CO_2 Capture and Storage

Project type: EC FP6, Specific Support Action (SSA)

Focus of research: CCS

Aim: to strengthen European excellence and to enhance technical competitiveness of Europe in the area of CCS, by:

- providing support to European stakeholders for the international forums such as CSLF (Carbon Sequestration Leadership Forum);
- establishing international relations with international projects and programs (U.S., Canada, Japan, Australia) for exchanging information on past and ongoing projects, and identifying opportunities for future co-operation;
- analysing new information on CCS and providing a coherent view on international activities for input in policy.

Duration: three years, from October 2004 to September 2007

Leader Institution: IFP, France

Italian Partners: OGS

Website: not available

MAP: Marine Aerosol Production

Project type: EC FP6, STREP

Focus of research: marine aerosols modelling

Aim: to consolidate the current state-of-the-art in the fields of aerosol nucleation and growth and Primary Marine Aerosol (PMA) production to quantify the key processes associated with primary and Secondary Marine Aerosol (SMA) production from natural sources.

Duration: two years, from 2006 to 2008

Leader Institution: National University of Ireland, Galway (NUIG), Ireland

Italian Partners: ISAC CNR, Polytechnical University of Marche Region (Università Politecnica delle Marche - UNIVPM)

Web site: http://macehead.nuigalway.ie/map/index.html

MIPAIS: Méthodologies et Instruments pour la Planification et la gestion durable de l'Irrigation en condition de Sécheresse

Project type: INTERREG III B MEDOCC

Focus of research: Methodologies and instruments for sustainable planning and management of irrigation in drought conditions

Aim: to implement experimental methods and procedures in the Mediterranean climate, and for different crops of sustainable irrigation in drought conditions

Duration: from 2005 to 2007

Leader Institution: Consortium for reclamation of Southern Sardegna (CBSM - Consorzio di Bonifica della Sardegna Meridionale), Italy

Italian Partners: ARPA SIM, APAT, ARPA of Emilia-Romagna Region (ARPA Emilia-Romagna), Province of Potenza (Provincia di Potenza)

Web site: http://www.mipais-interreg3b.com/description_du_projet.htm

MOVECBM: Monitoring and Verification of CO_2 storage and ECBM in Poland

Project type: EC FP6, STREP

Focus of research: CCS

Aim: the two principal objectives of this project are:

- to address the monitoring on the long-term sorption behaviour and the associated diffusion of CO_2, well integrity and caprock integrity, as well as the extended surface and mine monitoring and the related guidelines and certification of CO_2 storage in coal;
- to establish and strengthen the co-operation in the area of CO_2-ECBM with third countries, such as China, Australia and U.S. It is paramount that the findings of this MOVECBM research project are to a broad extent applicable in these countries with large coal reserves.

Duration: two years, from October 2006 to September 2009

Leader Institution: TNO, The Netherlands

Italian Partners: OGS and University of Roma "La Sapienza" (Università di Roma "La Sapienza")

Website: not available

Noah's Ark: Global Climate Change Impact on Built Heritage and Cultural Landscapes

Project type: EC FP6, STREP

Focus of research: climate change impacts on built heritage and cultural landscapes

Aim: prediction of the impact of climate and pollution on cultural heritage and investigation of the response of materials and structures of the historic built environment to future climate scenarios at European scale, and definition of guidelines and adaptation strategies.

Duration: three years, from June 2004 to May 2007

Leader Institution: ISAC CNR

Italian Partners: ISAC CNR

Web site: http://noahsark.isac.cnr.it/

PESETA - Projections of Economic Impacts of Climate Change in Sectors of Europe Based on Bottom-up Analysis

Project type: EC's Joint Research Centre (JRC) project

Focus of research: impacts of climate change on coastal systems, energy demand, human health, agriculture, tourism, and floods, and costs of climate change

Aim: to make an assessment of the monetary estimated impacts of climate change in Europe, based on bottom-up or sectoral physical assessments, given the state-of-the-art of today's methods and knowledge on the physical impacts of climate change

Duration: 2006-2007

Leader Institution: Institute for Prospective Technological Studies (IPTS) of the EC's JRC

Italian Partners: FEEM

Web site: http://peseta.jrc.es/index.htm

SCOUT - 03: Stratosphere - Climate Links with emphasis on the Upper Troposphere and Lower Stratosphere

Project type: EC FP6, IP

Focus of research: global assessments on ozone depletion and climate change, for the Montreal and Kyoto Protocols.

Aim: to provide predictions about the evolution of the coupled chemistry/climate system, with emphasis on ozone change in the lower stratosphere and the associated UV and climate impact, to provide vital information for society and policy use.

Duration: five years, from May 2004 to April 2009

Leader Institution: University of Cambridge, UK

Italian Partners: CNR, ENEA, INGV, National Institute of Applied Optics (INOA - Istituto Nazionale di Ottica Applicata), University of L'Aquila (Università degli Studi di L'Aquila)

Web site: http://www.ozone-sec.ch.cam.ac.uk/scout_o3/

SESAME: Southern European Seas, Assessing and Modelling Ecosystem changes

Project type: EC FP6, IP

Focus of research: ecosystems and climate change modelling of Southern European Seas

Aim: to assess and predict changes in the Southern European Seas (Mediterranean and Black Sea) ecosystems and in their ability to provide key goods and services with high societal importance, such as tourism, fisheries, ecosystem biodiversity and mitigation of climate change through carbon sequestration in water and sediments.

Duration: three years, from November 2006 to November 2009

Leader Institution: HCMR - Hellenic Centre for Marine Research, Greece

Italian Partners: CoNISMa, University of Bologna (Università degli Studi di Bologna), Department of Biological and Environmental Sciences and Technologies of University of Salento (DiSTeBA - Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali dell'Università del Salento), ISAC CNR, IBF CNR, IAMC CNR, IRSA CNR, Institute of Marine Sciences of the National Research Council (ISMAR CNR - Istituto di Scienze Marine del Consiglio Nazionale delle Ricerche), ENEA, FEEM, Central Institute for scientific and technological Research Applied to the Sea (ICRAM - Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare), OGS, International Marine Centre (Fondazione IMC - Centro Marino Internazionale - Onlus), INGV, Zoological Station "Anton Dohrn" (Stazione Zoologica "Anton Dohrn"), Polytechnic University of Marche Region (Università Politecnica delle Marche), CLU srl.

Web site: http://sesame-ip.eu/

SMOCC: Smoke Aerosols, Clouds, Rainfall and Climate: Aerosols from Biomass Burning Perturb Regional and Global Climate

Project type: EC FP5, Key action "Global Change, Climate and Biodiversity" within the "Energy, Environment and Sustainable Development" Programme

Focus of research: links between smoke aerosols, clouds, rainfall and climate

Aim: to investigate the connection between the composition and abundance of biomass burning aerosol, the lowering of the size of cloud droplets formed on this aerosol, and the climatic consequences of the resulting perturbation of cloud physics

Duration: three years, from November 2001 to October 2004

Leader Institution: Max Planck Institute for Chemistry, Germany

Italian Partners: ISAC CNR, Department of Chemistry of University of Bologna (Dipartimento di Chimica, Università di Bologna)

Web site: http://dionysos.mpch-mainz.mpg.de/smocc/

TOCSIN: Technology-Oriented Cooperation and Strategies in India and China, Reinforcing the EU dialogue with Developing Countries on Climate Change Mitigation

Project type: EC FP6, STREP

Focus of research: technology options to significantly reduce GHGs emissions in China and India, in key sectors such as power generation and transport

Aim: to evaluate climate change mitigation options in China and India and the conditions for a strategic cooperation on RD&D and technology transfer with the EU.

The main objective of research is to assess the benefits and costs of possible technology based international agreements involving the EU, China and India with the aim to stabilize the long term atmospheric concentrations of GHGs.

Duration: two years, from January 2007 to January 2009

Leader Institution: EPFL - Ecole Polytechnique Fédérale de Lausanne, Switzerland

Italian Partners: FEEM

Web site: not available; information can be found at
http://www.feem.it/Feem/Pub/Programmes/Climate+Change/Activities/200701-TOCSIN.htm

VULCAN: Vulnerability assessment of shrubland ecosystems in Europe under climatic changes

Project type: EC FP5, Key action "Global Change, Climate and Biodiversity" within the "Energy, Environment and Sustainable Development" Programme

Focus of research: effects of climate change on the functioning of European shrublands

Aim: to investigate the effects of climate change on the functioning of vulnerable European shrublands, and to provide a risk assessment and guidelines for European shrubland managers. Activities involve experimental manipulation of the climatic conditions at field scale and the employment of a newly developed "night time warming" technique.

Duration: three years, from January 2001 to January 2004

Leader Institution: RISØ - National Laboratory, Denmark

Italian Partners: University of Tuscia, Department of Forest Resources and Environment (Università della Tuscia, DISAFRI - Dipartimento di Scienze dell'Ambiente Forestale e delle sue Risorse), Laboratory for

Monitoring of Agroecosystems of IBIMET CNR, former CNR IMAes, University of Sassari (Università di Sassari)

Web site: http://www.vulcanproject.com/

Main other international Projects with Italian participation

Italy also participates to other international research Projects on climate change related issues. Main international research Projects carried out by Italian Research Institutions, Universities and Agencies working on climate change are synthetically reported below.

Bioassay assessment of the impact of temperature/pollutant in interactions in aquatic ecosystems

Project type: project within the bilateral agreement Québec - Italy for scientific and technological cooperation for the years 2007 - 2009, under the section: "environment and climate change"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: Università Cattolica del Sacro Cuore, Istituto di Agraria, Piacenza

Website: not available. Information at http://www.esteri.it/MAE/doc/PE_ITALIA_QUEBEC.rtf

Changes in the characteristics of extreme climate events in southern and south-eastern Europe

Project type: project within the bilateral agreement Romania - Italy for scientific and technological cooperation for the years 2006 - 2008, under the section: "earth science"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: ARPA SIM

Website: not available. Information at http://www.esteri.it/MAE/doc/4_28_67_81_91_89_119.pdf

CILSS-Italy fund "Fight against desertification for poverty eradication in the Shael" (Fondo Italia-CILSS "Lotta contro la desertificazione per la riduzione della povertà nel Shael")

Project type: project within a multi-bilateral agreement for cooperation development

Aim: to improve the socio-economic conditions of local people in Burkina Faso, Mali, Niger and Senegal through the development and creation of policies and strategies for food security, natural resources rational management, support to the process of decentralization, investments.

Duration: three years, from January 2004 to December 2006

Budget: total 15.500.000 €

Italian funding institution: MAE

Executing Agency: UNOPS - United Nations Office for Project Services - (Ufficio delle Nazioni Unite per Servizi ai Progetti)

Website: currently not available. Information at

http://www.cooperazioneallosviluppo.esteri.it/pdgcs/italiano/iniziative/SingleSchedaIniziativa.asp?id=213

C I R: Italy-Romania Cooperative Programme on Environment Research and Training

Aim: transfer of scientific-technical know-how to Romania in order to develop a scientific cooperation between Italian and Romanian scientific Institutions, aimed also at preparing a joint proposal for a possible future call of the EC FP7.

The scientific fields are: climate change modelling; extreme climate events and their changes in frequencies and intensities; assessment of their impacts on agriculture, energy distribution, tourism and public health; management strategies of these risks and extreme events warning; integrated and sustainable development; sustainable management of the natural resources; adaptation.

Duration: two years, from 2006 to 2008

Italian Partners: CMCC

Website: currently not available.

Climate change and its impact on land surface processes and vegetations at regional scale

Project type: project within the bilateral agreement Korea - Italy for scientific and technological cooperation for the years 2007 - 2009, under the section: "energy and environment"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: University of Torino (Università di Torino)

Website: not available. Information at http://www.esteri.it/MAE/doc/PESTKOREA_2007-2009.rtf

DIS/MED: Desertification Information System to support National Action Programmes in the Mediterranean

Project type: Inter-Regional network

Focus of research: desertification and drought management

Aim: to improve the capacity of national administrations of Mediterranean countries to effectively plan measures and policies to combat desertification and the effects of drought. This goal will be achieved by reinforcing communication, facilitating the exchange of information and establishing a common information system to monitor the physical and socio-economic conditions in areas threatened or affected by desertification and drought and to assess the extent, severity and trends of land degradation in those areas.

Duration: three years and two months, from October 2000 to December 2003

Budget: total 800.000 €

Italian funding institution: MAE

Executing Agency: UNCCD Secretariat

Technical and scientific backstopping: IBIMET CNR and the EEA

Other Italian Partners: ENEA, APAT

Web site: http://www.case.ibimet.cnr.it/dis-med/index.htm#

Evaluation of the carbon sink potential of an ecosystem of the oasis in Algeria (Valutazione del potenziale di assorbimento di carbonio di un ecosistema delle oasi in Algeria)

Project type: project of high relevance within the bilateral agreement Algeria - Italy for scientific and technological cooperation for the years 2006 - 2009

Aim: the main aim of the feasibility study is to assess the possibility to execute afforestation projects in the oasis of Algerian Sahara, joining environment protection of the oasis with the possible creation of carbon credits under the Kyoto Protocol, thus supporting the Italian energy sector in meeting its Kyoto targets, as well as providing benefits to the Algerian economy.

Duration: year 2007

Budget: 70.000 € for the year 2007 by the MUR plus 70.000 € co-financed

Leader Italian Partner: DISAFRI of University of Tuscia

Website: not available. Information at:

http://www.esteri.it/mae/doc/2007_sito_MAE_inclusi_finanziamenti_MUR.pdf

Impact of the physical and chemical properties of aerosol on cloud formation and on the earth's radiative budget

Project type: project within the bilateral agreement Romania - Italy for scientific and technological cooperation for the years 2006 - 2008, under the section: "earth science"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: ISAC CNR

Website: not available. Information at http://www.esteri.it/MAE/doc/4_28_67_81_91_89_119.pdf

Integrating observation data and modelling for improved water resources management and environmental risk assessment

Project type: project within the bilateral agreement Québec - Italy for scientific and technological cooperation for the years 2007 - 2009, under the section: "environment and climate change"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: Department of Agriculture Sciences of Modena e Reggio Emilia University (Dipartimento di Scienze Agrarie, Università degli Studi di Modena e Reggio Emilia)

Website: not available. Information at http://www.esteri.it/MAE/doc/PE_ITALIA_QUEBEC.rtf

Italian-Romanian Initiative for Development of sustainable Energy from renewable sources

Project type: project within the bilateral agreement Romania - Italy for scientific and technological cooperation for the years 2006 - 2008, under the section: "environment and renewable energy"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: Department of Electric Engineering of Politechnical University of Torino (Politecnico di Torino, Dipartimento di Ingegneria Elettrica)

Website: not available. Information at http://www.esteri.it/MAE/doc/4_28_67_81_91_89_119.pdf

Landfill emissions reduction by waste stabilisation processes: an effective way of managing renewable energy sources AEB

Project type: project within the bilateral agreement South Africa - Italy for scientific and technological cooperation for the years 2005 - 2007, under the section: "agriculture, environment and biotechnology"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: University of Cagliari, Department of Geoengineering and Environmental Technology, Faculty of Engineering (Università di Cagliari, DIGITA - Dipartimento di Geoingegneria e Tecnologie Ambientali, Facoltà di Ingegneria)

Website: not available. Information at http://www.esteri.it/MAE/doc/africa.pdf

Membranes and membrane processes in CO_2 separation for clean environment and energy saving

Project type: project within the bilateral agreement Korea - Italy for scientific and technological cooperation for the years 2007 - 2009, under the section: "energy and environment"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: Institute for Membrane Technology of the National Research Council (ITM CNR - Istituto per la Tecnologia delle Membrane del Consiglio Nazionale delle Ricerche)

Website: not available. Information at http://www.esteri.it/MAE/doc/PESTKOREA_2007-2009.rtf

Monitoring system for CO_2 captured in a used deposit of hydrocarbons (Sistema di monitoraggio dell'anidride carbonica sequestrata in un giacimento sfruttato di idrocarburi)

Project type: project of high relevance within the bilateral agreement Algeria - Italy for scientific and technological cooperation for the years 2006-2009

Aim: in this project, OGS and CRAAG, the Algerian scientific partner, intend to improve the seismic techniques (active and passive ones) for imaging the subsurface, and to jointly use them in a prototype system, to get information on the interaction between rocks and fluids due to CO_2 re-injection. Duration: three years 2007

Budget: 200.000 € for the year 2007, 50% financed by the MUR. Envisaged budget for the whole project: 648.000 €.

Leader Italian Partner: OGS

Website: not available. Information at
http://www.esteri.it/mae/doc/2007_sito_MAE_inclusi_finanziamenti_MUR.pdf

Optimization of water use by native plants in arid lands facing climate change and desertification (Ottimizzazione dell'uso dell'acqua nella vegetazione dei territori aridi soggetti a processi di desertificazione ed ai cambiamenti climatici)

Project type: project of high relevance within the bilateral agreement Pakistan - Italy for cultural, scientific and technological cooperation for the years 2006 - 2008

Aim:

1) to evaluate and characterise the ecophysiology and genetic variability in water use of native plants growing in arid environments of the Thal desert,
2) to evaluate the range of vegetation responses to possible scenarios of rainfall variations and temperature increase along an extreme arid transect in order to designate specifically interesting species/ecotypes for preservation in germplasm banks and improving Water Use Efficiency (WUE) in the Thal desert,
3) to evaluate the range of responses to drought and to several water saving irrigation systems, with particular emphasis on WUE, yield production and quality for those native species potentially important as alternative crops,
4) to obtain knowledge of the factors that control ecosystem composition, structure and functioning in the face of global climate change,
5) to provide training facilities for young scientists, improving integration, achieving global excellence.

Duration: year 2007

Budget: total budget for the year 2007 130.000 € of which 50.000 € by the MAE, 60.000 € by IBAF CNR and 20.000 € by University of Arid Agriculture, Rawalpindi, Pakistan

Leader Italian Partner: IBAF CNR

Website: not available.

Information at http://www.esteri.it/mae/doc/2007_sito_MAE_inclusi_finanziamenti_MUR.pdf

Predicting the impact of climate change on agricultural forest ecosystems (Previsione dell'evoluzione dei sistemi agroforestali in relazione ai cambiamenti climatici)

Project type: project within the bilateral agreement Estonia - Italy for cultural, educational, scientific and technological cooperation for the years 2005 - 2008, under the section: "energy and environment"

Duration: year 2007

Italian funding institution: MAE

Leader Italian Partner: IIA CNR

Website: not available. Information at http://www.esteri.it/MAE/doc/estonia05-08.pdf

U.S. - Italy Co-operation on Science and Technology of Climate Change

Aim: to improve the capacity of understanding, monitoring and forecasting both natural and anthropogenic climate change, and its effects. Research focuses on global and regional simulations, atmospheric processes, carbon cycle, socio-economic impacts, health scenarios, low-carbon technologies (within a common initiative for cooperation between Italy and the U.S.).

Duration: first phase (from May 2003 to May 2005); second integrating phase (from May 2004 to October 2006); third phase (from December 2006 to November 2008)

Budget: first phase Total 7720000 €; second phase Total 5255000 €; third phase Total 3465000 €; of which from the MATTM respectively: 7720000 €, 2255000 € and 3052500 €

Italian Partners: first and second phases, INGV, ISAC CNR; third phase, CMCC, University of Tuscia DISAFRI, ISAC CNR, FEEM, Ansaldo Researches (ARI - Ansaldo Ricerche Spa).

Website: currently not available. Information is available at: http://www.bo.ingv.it/contents/Scientific-Research/Projects/climate2/climate-3.html

Systematic observation

Many agencies in Italy engage in the systematic observation of elements of the climate system. Invariably the retrieval, quality control and archiving of such data are designed to meet the integrated needs of these agencies, which derive from their overall missions. Italy has a very comprehensive observational coverage of its home territories, although not always such coverage can be used concurrently to estimate climate related parameters. In addition, Italy contributes significantly to shared programmes involving ocean and space-based measurements; it has among the longest instrumental temperature record in the world.

Long-term systematic observation of environmental or ecological characteristics in Italy have arisen both from operational and research needs. Examples of the former are to be found in the capture of meteorological data required for statistical and predictive services by MeteoAM or hydrological data required for resource management purposes by the corresponding national authority such as the APAT.

Meteorological and Atmospheric Observations

Italy fully participates to the GCOS Surface Network (GSN), the GCOS Upper Air Network (GUAN) and the GAW, as shown and described below.

GCOS Surface Network (GSN) Stations

The designated GSN stations in Italy run by MeteoAM are reported in the following table

Station WMO Index	Station Name	Latitude** (°,')	Longitude** (°,')	Altitude m.s.l.	Measurements since
16022	PAGANELLA	46, 08 N	11, 02 E	2129	1951
16134	MONTE CIMONE	44, 12 N	10, 42 E	2173	1946
16224	VIGNA DI VALLE	42, 05 N	12, 13 E	266	1954
16258	MONTE SANT'ANGELO	41, 42 N	15, 57 E	847	1952
16550	CAPO BELLAVISTA	39, 56 N	9, 43 E	150	1951

GCOS Upper Air Network (GUAN) Stations

The designated GUAN station in Italy is:

Station WMO Index	Station Name	Latitude** (°,')	Longitude** (°,')	Altitude m.s.l.	Measurements since
16245	PRATICA DI MARE	41, 39 N	12, 26 E	21	1986

This station satisfies the basic requirements for data to at least 30hpa.

Global Atmospheric Watch (GAW) Stations

Established in 1989 by the Eleventh World Meteorological Congress (Cg-XI) as a major priority programme, GAW is one of WMO's most important contributions to the study of environmental issues in the post-UNCED (United Nations Conference on Environment and Development, 1992) period. GAW is considered the atmospheric chemistry component of the GCOS. MeteoAM runs at Monte Cimone one Regional GAW.

Station WMO Index	**Station Name**	**Latitude** (°,′)**	**Longitude** (°,′)**	**Elevation**
16052	PIAN ROSA'	45,56 N	07,42 E	3488 m a.s.l.
16134	MONTE CIMONE	44,12 N	10,42 E	2173 m a.s.l.
16022	PAGANELLA	46,09 N	11,02 E	2129 m a.s.l
16224	VIGNA DI VALLE	42,04 N	12,19 E	266 m a.s.l.
16258	MONTE SANT'ANGELO	41,42 N	15,57 E	847 m. a.s.l.
16360	SANTA MARIA DI LEUCA	39,49 N	18,21 E	112 m a.s.l.
16420	MESSINA	38,12 N	15,33 E	54 m a.s.l.
16429	TRAPANI	37,54 N	12,30 E	9 m a.s.l.
16522	CAPO CACCIA	40,34 N	08,10 E	204 m a.s.l.
	LAMPEDUSA	35,31 N	12,38 E	

This station provides an additional set of atmospheric measurements. In particular carbon dioxide (since 1979) is carried out with the longest record in Europe in continuous working.

Lampedusa (GAW station operated by ENEA)

Other measurements of climatic parameters are carried out by ENEA at the Station for Climate Observations at Lampedusa (35.31°N, 12.38°E). Lampedusa is a small, rocky, and very poor vegetated island, isolated in the central Mediterranean, far from large islands or continental areas, and from relevant sources of pollution. Measurements of CO_2 atmospheric concentration were started in 1992. In 1995 other GHGs (CH4, N2O, CFC-11 and CFC-12) were added. In 1998 the Station was established on the island, and other measurements were added. Total ozone and spectral ultraviolet radiation are measured since 1998.

Pian Rosà (GAW station operated by CESI)

All data collected at Plateau Rosà can be found in the site http://greeninfo.ricercadisistema.it/; CESI participates in GAW Program and sends CO_2 data to http://gaw.kishou.go.jp/wdcgg.html.

CO_2 data of GAW stations in Italy are grouped in http://greeninfo.ricercadisistema.it/ website.

ISAC CNR Monte Cimone Laboratory (Ottavio Vittori)

The principal measurement activity, under responsibility of ISAC CNR, regards surface ozone reported to WDCGG since 1996, NO_2 is measured by DOAS (Differential Optical Absorption Spectrometer) instrument since 1993, ^{7}Be and ^{210}Pb activity is monitored over paper filter collected on the top of the mountain, PM10 is measured since 1998, since June 2000 is active the Aerosol Size Distribution Analyzer. CFCs have been measured in flask from 1999 until 2000 and since 2001 the measurements are in continuous inside the SOGE (System for observation of halogenated GHGs in Europe) project (http://www.nilu.no/soge/) and CH_4 since 2004 by Urbino University in cooperation with ISAC CNR.

Surface Climatic Networks

Climatic observations are needed to monitor and determine the Italian climate and are important for providing input to a whole series of application in social agricultural and economic context. These data are collected by MeteoAM for use in real-time (weather reports) or in arrears (preparation of long-term averages or assessment of climate change).

Core climatic data are collected to define the climate of Italy and to create a national database for a wide range of requirements. Most climatic work involves the production of annual or monthly statistics including means, percentiles and standard deviations. Many of the CLIMAT stations are at sites with an unchanging environment. However, with changes due to urbanization some stations are located in areas where the environment is changing.

Monthly means, exceeding measurements, extremes, totals and departures from average for the GCOS and CLIMAT stations are routinely sent via GTS to the World Data Centre for Meteorology at Asheville, U.S. using the CLIMAT message.

Other meteorological data are collected by:

- CMA CRA, former UCEA, with three different instrumental networks: 34 automatic stations measuring all conventional meteorological parameters every ten minutes since 1992 whose measurements are online at www.ucea.it; 24 manned stations observing all conventional meteorological parameters at 8, 14 and 19 local hours and 28 thermal-rain manned stations observing only once a day at 9 local hour working since 1960;
- ENAV with a network of 34 meteorological stations. They are included in civilian Italian airports.

Regional bodies such as regional environmental protection agencies or regional meteorological and hydrometeorological services manage local networks of meteorological or agro meteorological stations, whose characteristics don’t correspond sometimes to WMO standards.

Regions are also responsible for the management of the most significant rainfall network, formerly coordinated by the National Hydrographic and Sea Service (Servizio Idrografico e Mareografico Nazionale). Since 1921 rainfall data form about 4000 station have been archived. Data from a few hundred stations are received hourly or daily. For the remainder, daily or longer period totals are received as monthly collectives.

Networks over the Italian territory

APAT is managing, in collaboration with MeteoAM, CMA CRA, former UCEA, and regional services, a system (denominated SCIA http://www.scia.sinanet.apat.it/scia_eng.asp) for the coordinated collection, calculation, representation and periodic update of ten-days, monthly and yearly climatic data. SCIA was born to establish, among all the relevant institutions involved in meteorological networks and observations, a common procedure for calculating, updating and representing climatological data useful for the representation of the state of climate and its trend.

Surface Radiation and Sunshine Observing Networks

MeteoAM Networks

Networks also exist for the measurement of surface radiation (solar) and sunshine observing. These include the Climatic Radiation and Climatic Sunshine Networks which were established to maintain the climatology of radiation and sunshine in Italy. The Climatic Radiation Network comprises some 34 stations which make measurements of daily totals of solar irradiation and sunshine, supported by full three-hourly meteorological observations. Quality controlled data are sent to the World Radiation Data Centre at St. Petersburg, Russia at monthly intervals. Measurements have been archived since 1958 for Vigna di Valle station and few others; the largest part of the instruments has been installed since the end of eighties.

Sun UltraViolet Radiation Networks

MeteoAM Networks

The Solar Ultraviolet (UV-B) radiation is measured with Brewer spectrophotometers by MeteoAM at three sites around Italy (Monte Cimone, Vigna di Valle, Messina). Data are collected but they have not been sent to international centre until now.

Other Networks

Spectral ultraviolet (UV) irradiance is routinely measured by ENEA at the Station for Climate Observations at Lampedusa (35.31°N, 12.38°E) since early 1998. The station is also equipped with a calibration system that uses NIST traceable 1000 W lamps to maintain the absolute scale of UV measurements.

Total ozone measurements

MeteoAM Networks

Three stations are performing measurements of total ozone and are operated by MeteoAM. Two of them are observing using both Dobson and Brewer spectrographs. Data have been collected since 1957 at Vigna di Valle with Dobson and since 1998 with Brewer. At Sestola since 1975 with Dobson and since 1992 with Brewer.

Other Networks

Total ozone is measured at Lampedusa by ENEA since 1998 with the Brewer spectrophotometer.

Precipitation Chemical analysis

Since 1975 monthly (since 1988 weekly) sampling of precipitation, with chemical analysis purposes, has been carried out on seven sites. They measure:

- PH;
- Cations (Na, K, Ca, Mg, NH4)
- Anions (nitrates, sulphates, fluorides, chlorides)

Radar's rainfall network

Recently Italy is implementing a more extensive integrated network of weather radars for defining the location and intensity of near surface precipitation. Weather radar data (precipitation type, rate and rainfall) are used in support of operational forecasting. The weather radar network is operated by MeteoAM and by regional institutions. At present the MeteoAM Radar Network has four operational radars: Istrana, Grazzanise, Pisa and Decimomannu. This network measures data every 30 minutes and send them to CNMCA where they are elaborated and site images are obtained together with mosaics showing rainfall intensity.

Since January 2004 a national mosaic program is working and several Regional bodies are involved. The radar stations participating to the mosaic network are: Istrana, Grazzanise and Pisa from MeteoAM, Gattatico and S. P. Capofiume (Emilia-Romagna Region); Bric della Croce and Mount Settepani (Piemonte Region); Teolo (Veneto Region) and Mount Macaion (Trentino Alto Adige Region). Also French radar of Aleria and Collobrieres are sending their observations together with the Swiss radar of Mount Lema.

Air Quality Monitoring

APAT is responsible for the preparation and delivery of the information on emission inventories and air quality at the national and European level. Air quality data are available at the web site: http://www.brace.sinanet.apat.it/web/struttura.html?p_livello_1=18&p_main=web/area_download.inizio&p_scroll= .

IPCC reference methodology is adopted for GHGs emission inventories, while for the other atmospheric pollutants the standard methodology is CORINAIR (COoRdination-InformatioN-AIR) of the EEA. Based on 2003 environmental data yearbook, 884 air quality monitoring stations, managed by local authorities like regional environmental agencies, continuously measure the concentrations of the most relevant atmospheric pollutant as indicated by the Air Quality Framework Directive 1996/62: SO2, NO2, PM10, Ozone, NMVOC, CO, Benzene. There is a network of two stations carried on by IIA CNR participating to EMEP and measuring atmospheric trace gases and several compounds in precipitation water. Daily measurements have been performed since 1996 in two stations: Montelibretti close to Roma and another in Roma in the green park of Villa Ada.

Upper Air Measurements

Radiosonde and Wind Profiler Observations

MeteoAM operates a group of six conventionally manned radiosonde stations each performing 4 launches per day. Regional authorities are operating two additional fully automatic stations. Currently there are two additional fully automatic upper-air station in Bologna (WMO- 16144) and in Levaldigi (WMO-16113) reporting twice a day.

Lightning Network (LAMPINET)

MeteoAM is running operational a lightning network, which relies on 15 sensors. Over national area (Italian islands and peninsula) the Network performs a location accuracy of 0.5 Km and a detection efficiency of 95%, with the capability of telling apart cloud to ground from cloud to cloud/intra cloud strokes. Central facilities made available current observations and archived ones. Contacts with other National Met services (Spain and Greece) are ongoing to achieve a common operational wider coverage over the Mediterranean sea.

Oceanographic Observations

The main oceanographic and marine network in Italy is operated by APAT that is responsible both for measurements of mean sea level and for measurements of waves; data are available at the web site www.apat.gov.it/site/it-IT/Servizi_per_l'Ambiente/Dati_Meteo_Marini/.

Tide Gauges

The main Italian Tide gauge network consists of 26 new stations uniformly distributed along the Italian coasts. It is composed of 28 sea-level gauges located at the following sites: Imperia, Genoa, Livorno, Civitavecchia, Porto Torres, Carloforte, Cagliari, Napoli, Salerno, Palinuro, Palermo, Lampedusa Island, Porto Empedocle, Catania, Messina, Reggio Calabria, Crotone, Taranto, Otranto, Bari, Vieste, Tremiti Islands, Ortona, Pescara, Marina di Ravenna, Ancona, Lido di Venezia and Trieste. At each station sea level is measured by means of one ultrasonic gauge with temperature compensation and one float gauge with analogue record on paper. The station benchmarks are levelled relative to the closest Army Geographic Institute (IGM - Istituto Geografico Militare) datum. Other parameters are observed, namely wind vector at 10 m height, atmospheric pressure, air temperature and sea temperature. All data are stored locally and transmitted in real time to APAT headquarters in Roma.

Moored Buoys

The national wave measurement network has been in operation since 1989. The first network consisted of 8 directional pitch-roll buoys displaced at La Spezia, Alghero, Ortona, Ponza, Monopoli, Crotone, Catania and Mazara. Each buoy, anchored at the average depth of 100 metres, was measuring wave height and direction. In 1999 two further translational buoys were added at Cetraro and Ancona and Catania buoy was replaced with a translational one. In case of sea-storms Hs greater than 3.0 m for Ancona, Pescara, Monopoli, Crotone e Catania, 4.5 m for La Spezia, Ponza, Cetraro e Mazara del Vallo and 5.0 m for Alghero, data acquisition is triggered in continuous mode and data are produced every thirty minutes and transmitted to the control centre in Roma. After 2002 the number of station has been increased to 14 adding buoys at Capo Linaro (Civitavecchia, Central Tyrrhenian sea), Capo Gallo (Palermo, Sicilia), Punta della Maestra (North Adriatic Sea) and Capo Comino (East Sardegna).The network has been working continuously since ten years with an overall efficiency of 92%. The actual moored buoy number and location can be obtained at: doga.ogs.trieste.it/edios/data.htm.

Ocean carbon measurements

The Italian national project VECTOR (see also section"National Projects funded by National Programmes") has three research lines related to Ocean carbon measurements. They are devoted respectively to exploring:

1) the role of plant and animal populations of the Mediterranean continental shelf in the carbon cycle,
2) the carbon cycle in the pelagic Mediterranean area,
3) the carbon cycle in oceanic environment with a special emphasis on the Southern Ocean.

Observation activities in Italian seas are aimed at estimating the CO_2 absorbed by the ocean and its variability in time and space (sinks), providing data on national seas Carbon stocks, in support also to international negotiation. This implies, for ex., the recovery of the historical time series of the Southern Ocean and the integrated quantification of the carbon cycle through box models and global coupled models, and also the recovery, organization and census of the existing Italian data sets (Carbon and biogeochemical fluxes), and the identification of gaps in order to estimate the CO_2 air/sea flux.

Terrestrial Observations

Carbon flux monitoring

The Italian national project CARBOITALY (see also section *"National Projects funded by National Programmes"*) is aiming at coordinating the Italian observational network for measuring forest and agriculture carbon sinks and sources, and to develop a system to predict the absorption of greenhouse gases by terrestrial ecosystems. The main objective is to quantify the net carbon absorption by Italian ecosystems, in order to provide the Italian government with the needed scientific information in support to the Italian commitment to the UNFCCC and its Kyoto Protocol. The observational network is distributed on 24 sites of continuous monitoring of GHGs, ranging in different vegetation and climate distribution (from alpine to Mediterranean regions). The project is implemented through five main research lines:

1) measurement of CO2 fluxes in terrestrial ecosystems;
2) regionalization;
3) building and experimental testing of a predictive system;
4) fluxes of non-CO_2 trace greenhouse gases (CH_4, N_2O and BVOC);
5) policies and scenarios.

GTOS

Italy is also supporting the GTOS (Global Terrestrial Observation System) through its office at FAO in Rome (http://www.fao.org/gtos/).

ICOS

The Italian science community working on carbon research is also involved in the EC FP7 project ICOS (Integrated Carbon Observation System), which is aimed to build an infrastructure for coordinated, integrated, long-term high-quality observational data of the greenhouse balance of Europe and of adjacent key regions of Siberia and Africa.

Ecological monitoring

The National network for the forest ecosystems monitoring (CONECOFOR - Rete Nazionale per il CONtrollo degli ECOsistemi FORestali, http://www.corpoforestale.it/wai/serviziattivita/CONECOFOR/cittadino/programma_conecofor.htm) was established in 1995 by the Italian Forest Department (C.F.S. Corpo Forestale dello Stato) with the aim to study the ecological interactions between the structural and functional components of the forest ecosystems and the large scale stress and change factors (air pollution, climate change, biodiversity changes). The CONECOFOR programme is based on 31 permanent study areas spread in the whole national territory and representative of all the main Italian forest communities. Here deep analyses of vegetation, conditions of the forest canopy, chemic content of leafs and soil, trees' growth variations, atmospheric deposition, climate and microclimate, ozone and biodiversity are regularly carried out.

Other National Terrestrial Observations

The service is operated by the Italian Army Alpini Group (Gruppo Nazionale degli Alpini) and the C.F.S. in collaboration with MeteoAM. The Meteomont Service by Italian Forest Department (www.meteomont.org) operates 88 automatic and 175 manned stations since 1978 with an electronic database beginning in 1985. The Italian Army manages 48 manned and 47 automatic stations and the database is available since the beginning of the ninety decade.

The Italian Glaciological Committee (C.G.I. - Comitato Glaciologico Italiano) was born in 1913 in the place of the Italian Alpine Club Glaciological Commission founded in 1895, with the purpose of promoting Italian Glacial Masses knowledge and their evolution. Many Institutions collaborated on it: the National Company for Electric Power (ENEL - Ente Nazionale per l'Energia eLettrica), CNR, MUR, Italian Alpine Club (CAI - Club Alpino Italiano). The C.G.I. operates annual measurements campaign of glacial front's altitudes.

Space-based Observations

Italy contributes to space-based observations through the ESA (European Space Agency, (http://www.esa.int/esaCP/Italy.html), a partnership of 17 European Member Governments, with Canada affiliated and EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites), a partnership of 18 European Governments, with 3 Cooperating States. MeteoAM represents Italy on EUMETSAT. Italy strategy for Earth Observations (EO) is delivered, largely, through participation in international programmes.

Italian Space Agency (ASI - Agenzia Spaziale Italiana)

ASI goal is to plan end execute the National Space Plan and to address strategic decision, ASI represents Italy in ESA.

Oceanographic Sensing

Italy is active in EuroGOOS, which is aimed to further pursue the goals of GOOS.

Observations in the Antarctica

Italy is supporting a research base in the Antarctica, which includes a meteorological observation site. Furthermore, ISMAR CNR executes regular cruise campaigns in Antarctica since 1994 to measure surface ozone O_3 and CO_2 in continuous.

CHAPTER 9

EDUCATION, TRAINING AND PUBLIC AWARENESS[37]

Introduction

As reported in the Third Italian Communication the main objective of education on climate change is to create a new sustainable development driving model of cultural reference, which provides instruments to increase the citizens' environmental responsibility.

Recent documents, as well as Barroso's Report, emphasize the need to establish more sustainable relationship among government, citizens and stakeholders. Because climate change depends, in large part, on the sustainable use of fossil energy, Italian activities consider education on energy and education on environment the right approach in order to implement a policy of information, public participation and public awareness.

Climate change social activities of public administrations

The activities of Ministries

MIUR (Ministry of Public Instruction, University and Research) promoted a national system in order to guarantee public information to citizens on technical and scientific culture; the instrument has been the organization of "Scientific and technological cultural week". During this event, from 2004 to today, twenty events for year has been organized in order to increase climate change public awareness.

These events consist in seminaries, conferences, round tables and show rooms developed in all Italian Regions. In particular a major numbers of events has been developed on energy in relation with climate. During the last year the week of scientific culture has been dedicated specifically on climate and on water resources management. The above mentioned activities has been included in the national network called INFEA, managed by Environment Ministry.

During 2005 the Ministry of Public Instruction, University and Research signed a protocol in order to promote a training plane for teachers and the production of informative materials useful for the development of climate culture. Inside this activity assumes particular importance two specific topics: geo climatic change and atmospheric change and energy transformation.

The recent education reform of Italian government, that established large autonomy in Italian schools, does not permit to furnish a complete picture on climate change activities in schools. Nevertheless we can affirm that an increased request of material on the climate change to Ministries by schools is today present.

The Italian Ministry of Environment (MATT) during the last three years and through program agreement with ENEA promoted activities of public participation on climate change and desertification. In this project are involved the cities of Licata and Cammarata (Sicily), Alghero (Sardinia) and a consortium of little towns in Basilicata mountains.

The aim of the project has been to test European methodology EASW (European Awareness Scenario Workshop) for promoting the local participation for mitigation measures due to desertification process. Four steps have been considered in the study. The first one describes the desertification phenomenon

[37] Edited by G. Borrelli (ENEA). Authors: G. Borrelli (ENEA), M.G. Chianello (APAT)

and the approach used. UNCCD approach for local studies is considered. The second step takes into account the local social and economic situation. This step is fundamental in order to understand the social contest. Also comparison among cities, Region and nation is considered. The third step describes the local activities. A certain numbers of deep interview to local actors have been realized and more than 400 local newspapers' articles on water problems have been collected and analysed. At last, more two hundred citizens are involved in EASW, realized with the support of European Union. On the basis of the main results and on the basis of citizens' opinion some possible hypothesis for the resolution of water problem and for the limitation of negative green house effect impact have been shared.

The last initiative of Ministry of Environment is a web site, www.casarinnovabile.it, for the promotion of the new Energy Bill. Through a brief thematic path the section of new Energy Bill explains in a simple way modalities to obtain incentives for using solar energy. In the section dedicated to the ecologic house are available useful suggestions on saving energy following some practical actions in order to contribute a reduction of fossil sources energy. The mechanism is very simple: to give technical support to the citizens that can choice the best solution for their houses; to give a long time financial support in order to recovery the investment cost; to give support to reduce the burocratic practices. The final objective is to combat the environmental emergency because one of the causes of climate change is the increasing use of fossil sources as well as oil, coal and gas.

The Regional, Provincial and Local Administrations

Different activities have been developed on climate change in Italian Region, Provinces and Municipalities. One of the most interesting is the project named "Forecasting of climate change connected with the behaviour's observation of little animals and insects" developed by Trento Autonomy Region. The main purpose of the project is to develop the capacity of children observation about natural phenomena and their relationship with the daily experience. The characteristic of this learning project is the involvement of physic and social territory. In fact parents, inhabitants, notables are involved in the activities. Through the observation of insects-animals' behaviour it is possible to observe climate change in relationship with their attitude. In order to have considerable results the project has to be two years long.

In the following table are showed a selection of other activities developed by Regions and Provinces. The selection takes into account the following items:

- integration with the public
- dissemination of communication
- effectiveness of operative tools
- target consideration
- innovation in communication
- public involvement
- feedback for public administration.

Institution	Initiative typology	Title	Description
Campania Region	Communication campaign	**Facciamo luce sugli sprechi**	Save energy public campaign
Abruzzo Region	Communication campaign	**Kyoto - La Luce Che Non Consuma Il Pianeta**	Save energy public campaign through the use of low energy lights
Puglia Region	Communication campaign	**Energeticamente**	Save energy public campaign inside local administration Puglia Region and information on renewable sources of energy, using INFEA system.
Marche Region	Communication campaign	**10 giorni per Kyoto**	Trip campaign inside the Region in order to give economic and social information on save energy programs also related to Kyoto protocol obligation.
Emilia Romagna Region	Informative resource centre	**Ermes Ambiente**	Informative web site on: sustainable use of energy; sustainable policy; energy saving
Emilia Romagna Region	Informative resource centre	**Vetrina della sostenibilità**	Communication project in order to promote techniques, products, organizing and management systems about sustainable development, climate changes and save energy.
Modena Province	Informative resource centre	**Bioecolab – sportello di informazione, formazione, ricerca**	Information, training, research and implementation for industrial, public sector and citizens. The main purpose to implement sustainable buildings construction
Milano Province	Informative resource centre	**Infoenergia – lo sportello amico per l'energia e l'ambiente**	Informative network in order to give information on sustainable use of energy to firms and citizens
Chieti Province	Learning	**Traborgo – Obiettivo ambiente**	Travelling learning laboratory about information service to citizens on energy
A21- Bologna Province	Decision making	**Forum tematici sull'energia**	Implementation of public forum, in order to realize the local energy plane. The aim is the sharing with citizens and local actors
Milano Province	Decision making	**Forum per l'energia**	Public forum on the use of energy and its effectiveness. The aim is to meet final users and producers

For what concern activities of municipalities different cities are involved in Agenda21. Here we want quote the project "*Roma per Kyoto*" financed by LIFE Environment Programme. The general objective of the project is to define an action plan for the city of Roma in order to give a strong contribution for the goal of Kyoto protocol in short time.

In particular:

- evaluation of percentage of greenhouse effect reduction in order to respect the Kyoto objectives;
- implementation of local plane to reduce greenhouse emissions;
- implementation of demonstrative action at level of municipalities;
- quantitative and qualitative assessment of action plane results;
- information and communication activities on Kyoto protocol.

In this project have been involved not only the municipality of Roma but the Province of Roma, the local agencies for energy and scientific (ENEA) and Nature Conservation Agency (ROMA NATURA).

Activities involving national agencies: ENEA, CNR AND APAT

ENEA

Italian student in front of climate change

The research introduces the opinion of Italian university students on climate change. After Nairobi Conference (November 2006) and EU Report (January 2007) climate change is again a first page topic.
The object of the research, developed in four countries, USA, New Zeeland, Czech Republic and Italy, is to verify, after 10 years from the signature of the Protocol, if today is present a public opinion on this topic. Researches suppose that University students can be considered a good example taking into account political, environmental, social, economic impact of climate change.

In Italy the research has been developed on 200 students of University "La Sapienza" in Rome through a questionnaire taking into account the following questions:

- the level of interest;
- the perception of an increase of temperature;
- the possible impact on own life;
- opinion on actions useful for the reduction of greenhouse gasses;
- opinion on different renewable energy sources useful for the effect mitigation;
- opinion on different "actors and institution" for the implementation of these actions.

Students are involved in 5 faculties:

- Sociology
- Communication Science
- Chemistry
- Pharmacy
- Architecture

The data collection considers three different study areas: socio-humanistic (Sociology and Communication Science), scientific (Chemistry and Pharmacy), technical (Architecture).
The main results:

- only 20% is very interested to climate change.
- 37% indicate an increase between 3°- 6° and 9% indicate an increase of more than 6°!
- 61% of students think that catastrophes is already in act. It is interesting to note 8.5% don't know when they will appear.
- majority supposes climate change will have negative effect on their living site (69%). Nevertheless 20% doesn't express an opinion.
- more relevant consequences (high and very high impact) are related to decreasing drinking water resources (84%), appearance of new diseases (78.5), increased economic costs for businesses and households (73.5%), accelerated species extinction (64.5)
- 44% of students disagree with the quality and quantity of information on CO_2 emissions. Data show the need of more information on this topic and on environmental issue in general, not connected with day for day emergency.

- 58% is oriented toward a normative approach. Students of technical faculties express more preferences for this item (69.4%). This opinion is strictly connected with Kyoto Protocol philosophy. We must underline 29% prefers more flexible measures as well as reduction of taxes, or government benefit in favour of voluntary reduction of CO_2.
- We must emphasize two main issues. First the indication of ozone depletion as consequence of climate change (68%) and second the fact that half of them studies in scientific faculties (48%). This item has been insert in order to evaluate the level of knowledge of students on climate change. In fact climate change is not directly responsible of ozone depletion.
- Solar (63.5%) and hydroelectric power are indicated with favour. Indecision is frequent for biomass, more than an half of sample. 33.0% of students disagree on the use of nuclear energy, both fusion than fission.
- Students agree with the opportunity of involvement of over national Institutions (UN and EU), but the necessity of an involvement of business and industries is underlined too.

For Professionals involved on environmental training, information and education, is very difficult to try out conclusions. A comparison with past may be useful. A report of Gaetano Borrelli, dated 1997, reported the following conclusion: "It is clear a very strong deficit of environmental information on global themes, as climate change, on which we have not a *minimum* of common knowledge and, as consequence, the possibility of a correct interpretation. Public opinion answer to environmental topics, not having an immediate understanding, is generally of large sensibility but at last a sense of removal happen also in presence of scientific community disagreement.
High preoccupation for environment testifies, in any case, a relevant disappointment expressed *via* a urgent request of normative actions by citizens" (G. Borrelli, Stampa e cambiamento climatico, un confronto internazionale, ENEA Report 1996, pg. 17).
This conclusion is still valid today with a burden: the report was referred to general public, today we are in front of university students and the research was developed before the Kyoto Protocol. If these conclusion are today valid too, we must suppose that the *locomotive* doesn't start, nevertheless the greenhouse effect is well represented in our society.

DESERTART Project: Use of artistic codes of communication to arise public awareness to desertification among young people

Education to sustainable development can make use of cognitive styles which relies on imagination and on the sensitive and subjective perception. Literature and art with their strong and universal communicative codes can better convey to young people awareness to the problem, with a more interiorized form of knowledge.
For this reason we decided to ask the help of the "magicians of communication", those that know very well how to use words and symbols: poets and artists.
We have introduced students of II and III classic Lyceum (a number of about 60 students, 18-19 year old) to the desertification thematic starting from the composition of Iranian nomadic poets. The selection of the Iranian texts have been done by Mrs Khadija Razavi of the Non Governmental Organisation of Teheran, Cenesta. The texts proposed show the relationship between man and its territory, marked by the cognitive features of the Qashai Tribe, who knows how to survive in their arid and semi-arid

territories. These poems put in evidence also the fragility of an eco-system that may disappear if its beauty and dignity are not clearly understood. Together with the profound, lyrical expressions, students became aware of the important role of the nomadic tribes and in particular of women, of their precious ability, their ancient science, the local traditional knowledge and technique.
Students have received also seminars on the scientific aspects of desertification: climate change, agriculture and desertification, agriculture in arid land, the institutional national and international aspects of the subject, desertification in Italy.

The results of this experience which has accompanied students during the scholastic year, for a total of eight seminars and laboratory activity, and exhibition concerning desertification in Italy, are many compositions and essays concerning desertification that students have chosen to elaborate. The experience has included, in a sort of "holism in practice", different disciplines: from natural sciences to Italian literature, philosophy, English language. Many Italian literature productions concerning the relation between man and its territory have been compared with the Iranian poems. The intercultural comparison has contributed to renew the reading of the national writers, enriching the analysis made by students of new and wider meanings. The discussion between nomadic and settler lifestyle has been introduced helping to discover a new value also to the thoughts of some classic Western philosophers who have dealt this aspect of human existence.
The subject of desertification is officially entered among the scientific compositions of the school final exam. A web page has been also created, where students can publish their production.
The results of this experience will be printed in the next months.
Among the composition made by students it is noteworthy to mention a theatre divertissement, concerning a sort of confrontation between Western values, or disvalues, and the Iranian nomadic world values students have become familiar with thanks to this initiative. At the beginning of next scholastic year this pièce will be put into stage by the students themselves.
Students from a hospital school have also been introduced to desertification starting from the Iranian poems. Their comments are touching artistic production which together with the problem of desertification, their profound thoughts reveal as a background their personal dramatic situation.
Next year, this experience will be repeated in the same school and in other Italian schools. The artistic production, including music, handcraft, dancing, of other countries will be included in the project. African countries and in particular the Mediterranean African ones will be taken into consideration. Exchange of experience and visits between students will also be promoted.
It has been supported by the Italian National Committee to Combat Drought and Desertification.

The project "Educarsi al futuro"

This project, promoted by ENEA in collaboration with the cities of Spoleto, Viterbo and Sicily Region, is composed by four main actions:
1.development of new-multidisciplinary educational ways inside thematic laboratories and open classrooms. Students are coordinated by teachers and ENEA researches;
2.creation of informatics platform in order to develop a network among schools and a web data base implementation for the co division and diffusion of materials;
3.demonstrtive projects on sustainable technologies inside the involved cities; awareness campaign for adults operated by students;

4. international studies and cooperation with developing countries, i.e. Burkina Faso, in order to promote, in collaboration with local ONGs operating in the south of the world, sustainable development.

APAT and Agency System

APAT is integrated into a network-type system, the Environmental Agency System, which today includes 21 Regional (ARPA) and Provincial (APPA) Agencies, established by special regional laws. It is an example of a consolidated federal system, which combines direct knowledge of the local area and local environmental problems with national environmental protection and prevention policies, so as to become a point of institutional and technical/scientific reference for the entire country. The creation of APAT represents the System's cohesiveness, while respecting local realities, and promotes uniform development in terms of cooperation and collaboration.

In fact, since the first regional agencies were established, the need has arisen to create opportunities for comparison and discussion among the ARPA-APPA, so as to promote coordinated development. It is for this reason that the new law establishing APAT set up a Federal Council, presided over by the APAT. Other offices common to multiple Agencies are the National Topic Centres (NTC), which resemble what was called for by the European Environment Agency, in which the Agencies participate in the common project according to their specific skills and technical expertise.

The need to "coordinate, promote and make nationally uniform the technical and operational methods for exercising the activities of the regional and provincial agencies," and the need to discuss common topics and explore matters of an organisational/managerial nature, led the Agencies to create a research and monitoring facility, the ARPA-APPA Organisation and Management Observatory (ONOG), created in November 1999 by a voluntary agreement among ARPA, APPA and ANPA, and renewed in March 2003 with a three-year agreement between APAT and ARPA-APPA, with the task of conducting surveys and funding research on topics of particular interest for the Agency System.

In the following table are showed a selection of activities developed in order to climate change and related arguments.

Organization	Initiative typology	Title	Description
APAT	Documentation activities	**Conoscere l'ambiente**	Informative tools on environment, sustainable development and climate change through a set of videos available on internet
APAT	Training	**Cultura ambientale e sviluppo sostenibile**	Training on line on different arguments connected to environmental protection policy
APAT	Training	**Corso-laboratorio di educazione ambientale per lo sviluppo sostenibile**	The aim of this laboratories is to develop a number of educational paths about the most important environmental themes as well as climate change

ARPA Veneto	Training	**Corso di climatologia e meteorologia alpina applicata**	The aim is **to give** to participants a picture of climate change **in progress** and of impacts of these changes on the mountain. Users are teachers, local public agency technicians and tourist operators
ARPA Veneto	Trianing	**Il clima in classe tra storia e previsioni**	The course **is an interdisciplinary approach** to climate change. It is dedicated to teachers
ARPA Lazio	Training	**Cambiamenti climatici, effetto serra, protocollo di Kyoto**	Formative path on environmental education and information dedicated to teachers.
ARPA Piemonte	Training	**Corso di educazione ambientale sul cambiamento climatico**	An interactive scientific **and** cultural path on climate system from historical definition to more recent knowledge. Users are public notables and technicians.
ARPA Liguria	Training	**E- learning sui comportamenti sostenibili**	This project is promoted by Liguria Region and the aim is the realization of environmental education regional centre in order to deep air, energy, climate change topics.
ARPA Emilia Romagna	Informative resource centre	**Siccità e desertificazione**	Web site and thematic section on climate change
ARPA Molise	Public campaign	**Campagna europea "climate change"**	Dissemination of climate change arguments **through a** distribution of a booklet promoted by E.U. to the students 13-18 age. The aim is to give information of different aspects of climate change and the indication of possible actions in order to limit negative effects.
APPA Trento	Education	**Insieme per il clima**	The exhibition may be considered a **starting** point for climate change study. Pupils are accomplished through an interactive path, learning what is the greenhouse effects, its causes, its consequences and what they may do for contributing day for day to safeguard of climate.

ARPA Sicilia	Education	**Io vedo.... gli effetti dei cambiamenti climatici**	Graphic and photographic competition for non professionals, born or resident in Sicily, Region on climate change impacts in the Region.
ARPA Veneto	Communication campaign	**Ribelli per natura**	Collaboration between ARPA Veneto and RAI TV educational in order to promote students and teachers awareness on climate change and sustainable development.

CNR and Universities

Institute of atmospheric sciences and climate (ISAC), one of most important scientific institute inside CNR (National Council Research), has a staff of around 130 researchers and technicians that follow 4 "Themes" (Dynamic Meteorology, Earth Observations, Atmospheric processes, Climate Change). Here we consider only climate change activities.

The main themes concern the study of the behaviour of the earth climate system with particular focus on the physical processes that define the exchanges of energy between the earth's surface and atmosphere and the processes of interaction of solar radiation and earth radiation with the atmosphere of our planet. In this context, the activities of research are mainly aimed at (1) the study of the various physical processes able to produce variations of noteworthy importance on the balance of energy of the earth climatic system, and particularly cloud and aerosol radioactive forcing and models (physics and chemistry) of aerosols and the other reactive atmospheric constituents on the local and regional scale, and (2) the reconstruction and analysis of historical series of climatic and meteorological data, to obtain accurate information on the climatic changes of the past and draw useful indications on the forecasts of future climate changes.

Training

The Institute give large attention to young researchers training, both internal to the Institute and through a collaboration with Universities. Some typology of activities are pointed here.

Financial support for scholarship

The financial support uses external founds or internal resources. The aim is to create specific professional researchers on environmental sciences and climate.

Universitary courses

ISAC researchers are involved as teachers in more then 20 university courses at different level, in the following Institutes:

- University of Piemonte Orientale, Philosophy faculty
- University of Calabria: Climatology
- University of Tuscia, Climatology
- University of Bologna, Meteorology
- University of Bologna, Climate and cultural heritage
- University of Bologna, Urban pollution
- University of Ferrara, Climatology
- University of Ferrara. Climatology and cultural heritage
- University of Ferrara-Facoltà Microclimate Laboratory
- University of Roma "Tor Vergata":, Atmospheric Laboratory
- University of Roma Tor Vergata, Oceanography
- University of Sassari, Atmospheric Laboratory
- University of Urbino, Atmospheric Laboratory
- University of Urbino,: Atmospheric Chemistry and global change.

Post Graduate Level

The Institute has developed post laurea training in collaboration with the following Universities:

- University of Urbino, Facoltà Scienze Ambientali
- University of Siena, Dipartimento di Scienze della Terra
- University of Sassari
- University of Lecce-Messina-Palermo consortium
- University of Messina
- University of Genova
- University of Basilicata
- University of di Torino
- University of L'Aquila
- University of Siena
- University of Napoli Federico II
- University of Bologna
- University of Camerino
- University of Evora, Dept. of Physics
- University of Ferrara
- Univ. La Sapienza Roma
- University of Siena
- University of Firenze
- University of Trento
- Universitade Federal do Rio Grande do Sul (UFRGS).

National and International Summer schools

- II Edition of Mediterranean School on Mesoscale Meteorology
- Summer School "Processi fondamentali della dinamica dei fluidi geofisici ed ambientali", from 1994.
- International summer school on turbulent diffusion, Campus Universitario de la Mediterrania, UPC Barcelona, 4-8 sept. 2006

Graduation thesis

It is a traditional activity of the Institute to guest students preparing their graduation thesis This activity is developed in collaboration with the above mentioned Universities.

Climate change activities involving NGOs

As in the past also today environmental associations have place climate issues at centre of their activities. The following contains a summary of the most important NGOs initiatives.

Organization		Title	Description
Alleanza per il clima	Training	**Bussola del clima**	Training for local authorities and local notables. The purpose is to furnish tools for implementing local strategies to fight climate change
Alleanza per il clima	Public awareness	**Climate star**	Conference program involving local administration in order to promote good practices at local level to contrast climate change
Alleanza per il clima	Public awareness	**Clarity**	Using CDRom the campaign want to furnish information on climate change knowledge in order to promote public awareness
Amici della terra	Information campaign for schools	**La sCO2messa – la grande campagna in favore del clima**	**Sensitisation** of students in order to promote awareness on climate change
Amici della terra	Education campaign	**Che cosa è l'energia**	The aim is the involvement of students in ten Italian towns. An educative kit, including booklet, schedulas and CDRom is distributed to pupils and teachers. The program gives particular attention environmental impact of fossil energy
ICLEI	Public awareness	**Cities for climate protection campain**	The aim of the campaign **is** to promote local strategies for mitigation of climate change effects. A certain numbers of municipalities are enclose in ICLEI network. ICLEI guarantee to these cities scientific support for implementing mitigation program
Kyoto club	Education campaign	**Scuole per Kyoto**	The **program's** purpose is to promote actions on energy save and diffusion of solar energy inside school buildings. The program is developed through a training operated by professional in the sector of alternative energies

Kyoto club	Technical training	**Corsi Kyoto club**	Technical training has been proposed to different local actors, i.e. local authorities, professionals and associations
Kyoto club	Information campaign	**Azzero CO2**	Public awareness for citizens and local authorities
Legambiente	Information campaign	**Meno consumi più energia pulita per salvare il pianeta**	**This information** campaign includes the following actions: 1.A net of municipalities climate friends 2.A net of schools climate friends 3.A national centre for promoting renewable sources 4.Energy ecobox for local authorities and public administration 5.Collaboration with Kyoto club campaign Azzero CO2
Legambiente	Education campaign	**www.laccendiamo.com**	Educative program using a **on line** play on energy
WWF	Public training and information campaign	**Generazione clima**	**Generazione clima** is an initiative to increase public awareness **through** information on sustainability of **citizens'** housing. The tool is the distribution of informative kit to citizens in order to meliorate energy efficiency inside house. The campaign is developed on line too

Conclusion

Non-institutional companies and organisations play a relevant role in developing information on climate change.

Some work have to be undertaken to completely remove obstacles to the diffusion of activities on training, education and public awareness, as well as the “distance” between Institutions and citizens. Priority of Italian Government 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. In order to realise this objective the Italian Ministry of Environment, Land and Sea and the Ministry of Scientific Research could improve their relationship with national research agencies and educational system.

At the same time, initiatives designed to supply the public with information on climate change should be sponsored on a more regularly based in order to complement the work done by environmental associations and municipal agencies operating at local level.

Notwithstanding the strong increment of educational activities inside schools, the lack of coordination between scholastic activities and scientific community make it difficult to test such activities. Nevertheless 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.

The role of the regions, provinces, municipalities and the so-called intermediate bodies (mountain communities, park authorities and water-basin authorities) is relevant thanks to their nearest to the citizens, to favourite a wide participation in decision making processes which influence emissions of greenhouse gases at a local level. Such role could envisage proposals for changes of lifestyle and the introduction of economic activities, which are best suited to the territorial focus of these bodies, which should be familiar with such issues also creating a synergy between the general objective of greenhouse reduction and the contribute of cities 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 development at EU level of participation methodologies. To promote greater awareness of environmental risks, the future challenge will be to further develop such methodologies in order to address not only specific topic such as deforestation, as it is currently being done, but also global topics, such as climate change.

Annex: List of acronyms

ACRONYM	ENGLISH	ITALIAN
APAT	Environmental Protection and Technical services Agency	Agenzia per la Protezione dell’Ambiente e per i servizi Tecnici
ARPA	Regional Agency Prevention and Environment	Agenzia Regionale Prevenzione e Ambiente
ARPA SIM	Emilia-Romagna Regional Agency Prevention and Environment, HydroMeteorological Service	Agenzia Regionale Prevenzione e Ambiente della Regione Emilia-Romagna, Servizio IdroMeteorologico
ASI	Italian Space Agency	Agenzia Spaziale Italiana
C.F.S.	Italian Forest Department	Corpo Forestale dello Stato
C.G.I.	Italian Glaciological Committee	Comitato Glaciologico Italiano
C.I.P.E.	Interministerial Committee for Economic Planning	Comitato Interministeriale per la Programmazione Economica
CCS	Carbon Capture and Storage	
CESI	Italian Experimental Electrotechnical Centre	Centro Elettrotecnico Sperimentale Italiano
CFCs	Chlorofluorocarbons	
CINFAI	National Consortium of Universities for Atmospheric and Hydrospheric Physics	Consorzio Interuniversitario Nazionale per la Fisica delle Atmosfere e delle Idrosfere
CIRA	Italian Centre for Aerospace Research	Centro Italiano Ricerche Aerospaziali
CISMA	Centre of Engineering and Development of Models for the Environment	Centro di Ingegneria e Sviluppo di Modelli per l’Ambiente
CMA CRA former UCEA	Research unit for Climatology and Meteorology applied to Agriculture of the Agricultural Research Council, former Central Office of Agriculture Ecology	Unità di ricerca per la Climatologia e la Meteorologia applicata all’Agricoltura del Consiglio per la Ricerca e la sperimentazione in Agricoltura, ex UCEA
CMCC	Euro-Mediterranean Centre for Climate Change	Centro Euro-Mediterraneo per i Cambiamenti Climatici
CNMCA	National Centre of Meteorology and Aeronautical Climatology of the Italian Air Force (National Meteorological Service)	Centro Nazionale di Meteorologia e Climatologia Aeronautica dell’Aeronautica Militare (Servizio Meteorologico Nazionale)
CNR	National Research Council	Consiglio Nazionale delle Ricerche
CoNISMA	National Interuniversity Consortium	Consorzio Nazionale Interuniversitario per le

	for Marine Sciences	Scienze del Mare
CRA	Agricultural Research Council	Consiglio per la Ricerca e la sperimentazione in Agricoltura
CRSA	Council for Research and Experimentation in Agriculture	Consiglio per la Ricerca e la Sperimentazione Agricola
CVR	Venice Research Consortium	Consorzio Venezia Ricerche
D.P.E.F.	Document of Economic and Financial Planning	Documento di Programmazione Economico-Finanziaria
DISAFRI	Department of Forest Resources and Environment of University of Tuscia	Università della Tuscia, DISAFRI - Dipartimento di Scienze dell'Ambiente Forestale e delle sue Risorse
DiSTeBA	Department of Biological and Environmental Sciences and Technologies of University of Salento	Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali dell'Università del Salento
EC	European Commission	European Commission (EC)
EEA	European Environment Agency (EEA)	
EMEP	Long-range Transmission of Air Pollutants in Europe	
ENAV	National Agency for Aviation Aids	Ente Nazionale per l'Assistenza al Volo
ENEA	Italian National Agency for New Technologies, Energy and Environment	Ente per le Nuove Tecnologie, l'Energia e l'Ambiente
ENEL	National Company for Electric Power	Ente Nazionale per l'Energia eLettrica
ESA	European Space Agency	
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites	
FEEM	ENI Enrico Mattei Foundation	Fondazione ENI Enrico Mattei
FIRB	Fund for Investments in Basic research	Fondo per gli Investimenti della Ricerca di Base
FISR	Integrated Special Fund for Research	Fondo Integrativo Speciale per la Ricerca
FP	Framework Programme	
GAW	Global Atmosphere Watch	
GCOS	Global Climate Observing System	
GHGs	GreenHouse Gases	
GOOS	Global Ocean Observing System	
GSN	GCOS Surface Network	
GTOS	Global Terrestrial Observation System	

GTS	Global Telecommunication System	
GUAN	GCOS Upper Air Network	
IBAF CNR	Institute of Agro-environmental and Forest Biology of the National Research Council	Istituto di Biologia Agroambientale e Forestale del Consiglio Nazionale delle Ricerche
IBIMET CNR	Institute of Biometeorology of the National Research Council	Istituto di Biometeorologia del Consiglio Nazionale delle Ricerche
ICAO	International Civil Aviation Organization	
ICOS	Integrated Carbon Observation System	
ICRAM	Central Institute for scientific and technological Research Applied to the Sea	Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare
ICTP	Abdus Salam International Centre for Theoretical Physics	Abdus Salam International Centre for Theoretical Physics
IGOSS	Integrated Global Ocean Services System	
IIA CNR	Institute for Atmospheric Pollution of the National Research Council	Istituto sull'Inquinamento Atmosferico del Consiglio Nazionale delle Ricerche
IMC	International Marine Centre	Fondazione IMC - Centro Marino Internazionale - Onlus
INGV	National Institute of Geophysics and Volcanology	Istituto Nazionale di Geofisica e Vulcanologia
IOC	Intergovernmental Oceanographic Commission	
IP	Integrated Project	
IPASS	Consortium Engineering for Environment and Sustainable Development	Ingegneria Per l'Ambiente e lo Sviluppo Sostenibile
IPCC	Intergovernmental Panel on Climate Change	
IRSA CNR	Water Research Institute of the National Research Council	Istituto di Ricerca Sulle Acque del Consiglio Nazionale delle Ricerche
ISA CRA	Agronomical Research Institute of the Agricultural Research Council	Istituto Sperimentale Agronomico del Consiglio per la Ricerca e la sperimentazione in Agricoltura
ISAC CNR	Institute of Atmospheric Sciences and Climate of the National Research Council	Istituto di Scienze dell'Atmosfera e del Clima del Consiglio Nazionale delle Ricerche

ISCI CRA	Experimental Institute for Industrial Cultivars of the Agricultural Research Council	Istituto Sperimentale Colture Industriali del Consiglio per la Ricerca e la sperimentazione in Agricoltura
ISMAR CNR	Institute of Marine Sciences of the National Research Council	Istituto di Scienze Marine del Consiglio Nazionale delle Ricerche
ISNP CRA	Experimental Institute for Plant Nutrition of the Agricultural Research Council	Istituto Sperimentale per la Nutrizione delle Piante del Consiglio per la Ricerca e la sperimentazione in Agricoltura
ISRIM	High Institute for Research and Education on Special Materials for Advanced Technologies and for Environment	Istituto Superiore di Ricerca e Formazione sui Materiali Speciali per le Tecnologie Avanzate e per l'Ambiente
ITM CNR	Institute for Membrane Technology of the National Research Council	Istituto per la Tecnologia delle Membrane del Consiglio Nazionale delle Ricerche
JRC	Joint Research Centre	
MAE	Italian Ministry of Foreign Affaires	Ministero degli Affari Esteri
MATTM	Ministry of Environment, Land and Sea	Ministero dell'Ambiente e della Tutela del Territorio e del Mare
MEF	Ministry for Economy and Finance	Ministero dell'Economia e delle Finanze
MeteoAM	National Meteorological Service of the Italian Air Force	Servizio Meteorologico Nazionale dell'Aeronautica Militare
MIPAAF	Ministry of Agriculture Food and Forestry Policies	Ministero delle Politiche Agricole Alimentari e Forestali
MSG	Meteosat Second Generation	
MUR	Ministry for University and Research	Ministero dell'Università e della Ricerca
NoE	Network of Excellence	
OGS	National Institute of Experimental Oceanography and Geophysics	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
PNR	National Research Programme	Programma Nazionale della Ricerca
PRIN	Research Programmes with Relevance at the National level	Progetti di Rilevante Interesse Nazionale
SAR	Synthetic Aperture Radar	
SODAR	Sonic Detection and Ranging	
STREP	Specific Targeted Research Project	
UCEA	Central Office of Agriculture Ecology	Ufficio Centrale di Ecologia Agraria
UNFCCC	United Nations Framework Convention on Climate Change	

USAM	General Office for Air Space and Meteorology of the the Italian Air Force (Meteorological Service)	Ufficio Generale Spazio Aereo e Meteorologia dell'Aeronautica Militare (Servizio Meteorologico Nazionale)
WCRP	World Climate Research Programme	
WDCGG	World Data Centre for Greenhouse Gases	
WMO	World Meteorological Organization	
WWW	World Weather Watch Programme	

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