FIRST ITALIAN NATIONAL COMMUNICATION TO THE FRAMEWORK CONVENTION ON CLIMATE CHANGE

January 1995

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PREFACE

This Communication, required under the Convention on Climate Change, has been drawn up by the Ministry for the Environment in collaboration with the Ministries of Transport, Industry, Agriculture, Foreign Affairs and Education, and with the help of the Environment and Energy Departments of ENEA (the National Agency for New Technology, Energy and the Environment).

The Interministerial Committee for Economic Programming received the report on 10.1.1995 and authorized the sending of the report to the United Nations and the European Union; it was sent on 16.1.1995.

The report confirms Italy's commitments for the gradual reduction of the emissions of carbon dioxide and other greenhouse gases, already described in the program, and identifies the sectors and options for intervention:

- Greenhouse gas emissions and absorption in 1990;
- National programs in the energy, industrial, transport, waste disposal and reforestation sectors, examined in relation with the reduction of greenhouse gas emissions;
- Vulnerability of the country's environment to the consequences of climate change and the corresponding measures for adaptation;
- International cooperation for the prevention of climate change;
- Systematic research and observation on the climate in Italy and the Mediterranean region;
- Information and training programs.

For the publication of this report, I would like to highlight Italy's constant, coherent fulfilment of the commitments undertaken with the European Community on 29.10.1990 under Italian chairmanship; these commitments have provided the basis for the long negotiation process aimed at the approval of the Convention.

This report will enable Italy to play a significant role in international organizations for the implementation of the Convention, with special reference to the development of technological cooperation and the joint implementation of programs for energy efficiency in the Mediterranean and in Central and Eastern Europe.

It is clear to everyone that the Convention is a significant instrument for the definition and application of global standards for energy efficiency in the industrial and transport sectors, and for the protection and extension of forests throughout the planet.

In this context, Italy can play a major technological and economic role, making available its skills and expertise in the energy sector (among all the industrial countries, Italy has the best industrial energy performance rates) as well as in forestry protection and management.

The first national Communication is not only designed to respect the terms of an international agreement, but also to provide a framework for a model for sustainable development, on the domestic level but suitable for export.

We hope that Italy will be able to take advantage of the cooperation and the globalization of our economy provided under the Convention on Climate Change. This report proposes a new "product" made in Italy, characterized by the high quality of industrial processing and products, new technologies compatible with environment protection and a program for new environment-friendly approaches in agriculture and forestry.

Corrado Clini
Director General
Ministry for the Environment

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1 SUMMARY

1.1 Introduction

The First Italian national Communication to the Framework Convention on Climate Change is the consequence of the commitments which Italy took on under the agreements and conventions signed at Rio de Janeiro during the Earth Summit in June 1992.

Even before Rio de Janeiro, Italy had taken on a major role among the developed countries within the European Community and in the negotiations started by the UN for a global convention on climate change.

The joint declaration by the EEC Councils of Ministers for the Environment and Energy on 29 October, 1990 was promoted and adopted under Italy's chairmanship. In this declaration, the EEC countries acknowledged the joint goal and commitment for preventing climate changes and reducing greenhouse gas emissions, starting with carbon dioxide.

In particular, the commitment adopted on a community level for the stabilization of carbon dioxide emissions at 1990 levels by 2000 requires the individual member States to adopt programs and initiatives for environment-friendly reconversion and energy efficiency in industry, energy production, transport, services and in the non-industrial sector. It also requires the member States to protect and extend carbon dioxide absoprtion, with particular reference to forests.

The contents and commitments of the Community declaration are the main basis for the negotiation for the Framework Convention on Climate Change.

During the negotiations, in order to foster the clarification of the complex environment and energy problems involved, the UN appointed Italy to organize and host in October 1991 an International Symposium on the promotion and transfer of improved technology for energy efficiency and environment compatibility to developing countries and Eastern Europe (ESETT '91). The Symposium was attended by 45 countries from all continents, and the results of this work are an integral part of the final contents of the Framework Convention on Climate Change signed at Rio de Janeiro.

1.2 EEC decisions and the Convention on Climate Change. Italy's committments

The decisions by the EEC Councils of Ministers for the Environment and Energy on 29 October, 1990, reconfirmed in the subsequent joint Councils on 13.12.1991 and 23.4.1993, recalled in the declarations of the member States attached to the Framework Convention on Climate Change ratified by the Italian Parliament on 15.1.1994 and confirmed in the decision by the European Union Council of Ministers for the Environment on 23.3.1993 on the "Mechanism of control of CO_2 emissions and other greenhouse gases in the Community" require the following measures in the short term:

- The formulation and publication of the National Program for the limitation of CO_2 emissions;

- The drawing up of a Report on the emissions of other greenhouse gases not subject to the Montreal Protocol and the corresponding measures for limitation.

Law N. 65 of 15.1.1994 ratifying the Framework Convention for Climate Change calls for an allocation of 1,500 million lire for 1994 and 1995 for monitoring and updating national programs for the stabilization of greenhouse gas emissions, for Italian collaboration with the Intergovernmental Panel on Climate Change, for funding the Aid Fund for Developing Countries and the Fund for running the Convention Secretariat.

1.3 National Program for the reduction of CO_2 emission

The initial draft of the National Program for limiting CO_2 emissions was submitted to the EEC by the Ministry for the Envirnment in May 1992. The final text was approved by the Interministerial Committee for Economic Planning on 25 February, 1994.

This revision enabled a better illustration of the basic data for the estimate of 1990 emissions, an updating of the energy scenario and a more accurate definition of the technological, regulatory and fiscal measures available for the stabilization of emissions in 2000.

1.4 First national Communication on the Framework Convention on Climate Change

The part of the text of the first national Communication on the Framework Convention on climate changes regarding carbon dioxide is based on the information and programs contained in the National Program for limiting CO_2 emissions.

In accordance with the INC guidelines for drawing up the first Communications by the countries in Annex I, it contained the following:

- An estimate of national emissions for 1990 of CO_2, CH_4, NO_2, NO_x, CO, COVNM, and of HFC, CF_4 and C_2F_6;

- A preliminary assessment of the absoprtion of CO_2 from changes in land use and forests in Italy;

- The identification of some measures for the limitation of the emissions of other greenhouse gases not covered by the Montreal Protocol;

- All the information required under the INC guidelines for the description of policies, programs and measures, the estimate of emissions and the absorption of greenhouse gases, the calculation of the effectiveness of the mneasures, the vulnerability of Italian territory to the resulting climatic changes and the measures to be adopted as a consequence, the Italian cooperation initiatives regarding climate changes, research and systematic observation initiatives, information and training programs.

1.5 Italian greenhouse gas emissions in 1990

The estimates of emission rates for the main greenhouse gases (CO_2, CH_4, NO_2) and the precursors (NO_x, CO, NMVOC) presented here are based on the ENEA estimates for the CORINAIR '90 Inventory of the European Union. It has been decided to refer to this inventory in order to ensure the maximum uniformity of the emission data reported by Italy to international bodies. The CONRINAIR Inventory is the basis for the estimates provided by Italy to the European Environment Agency and the EMEP Program of the Geneva Convention on Long Range Trans-Boundary Air Pollution.

The 1990 CO_2 emissions in the energy sector total 400.4 million tons, of which 34.5% come from energy processing and production industries, 23.9% from transport, 22.6% from industry, 10.3% from the residential sector and 6.6%

from the commercial and institutional sector.

This estimate differs from the one reported by Italy to the European Union in the context of Council Decision 93/389/EEC on the "Mechanism for monitoring the emission of CO_2 and other greenhouse gases", totalling 421 million tons of CO_2, for the following reasons.

1) In accordance with the guidelines of the 9th session of the INC, emissions for international bunkering (12.5 Mt CO_2) have been considered separately from the national total (as mentioned in paragraph 2.3);

2) In order to make the estimate match international statistics (like those of the AIE / OECD) corrections had to be made to the lower heat generating power of bitumen and lubricants (with a fall of approximately 5Mt CO_2);

3) The estimates are based on the statistics of the Petroleum Bulletin, which supplies detailed information on the amount and quality of the fuel consumed by the end users, and on the reports for individual facilities, rather than on the fuel flows for the entire economic system contained in the National Energy Budget (the emissions thus fall by a further 2.6 CO_2).

To the energy-related emissions, we should add 27.6 Mt of CO_2 from industrial processes and 3.7 Mt of CO_2 from forest fires; the carbon dioxide absorbed every year by the national forest reserves corresponds to approximately 40.4 Mt of CO_2 absorbed from the atmosphere. Total national emissions are therefore 391 Mt of CO_2.

Emissions of other greenhouse gases and precursors on the basis of the CORINAIR '90 Inventory are: 3,901 kt of CH_4, 120 of NO_2, 2,218 of NO_x, 9,333 of CO and 2401 of COVNM. In 1990, processes for the primary smelting of alluminum released 14 tons of CF_4 and 1.4 tons of C_2F_6 into the atmosphere.

The analysis of national data on energy consumption and CO_2 emissions highlight the fact that Italy, compard to the other OECD countries, has a very low energy level (e.g. in 1991, the consumption of primary per capita sources and per unit of GDP was the lowest of the 7 most industrialized countries). This may be explained by various factors, including the temperate climate, high energy taxes, limited national energy resources and the contribution of energy saving policies over the past 25 years. CO_2 emissions of the energy sector for unit of GDP are also amoung the lowest in the OECD.

Given the lower energy levels, national goals of limiting CO_2 emissions therefore have higher costs than in other countries.

1.6 The scenario forecast for 2000 and the measures already adopted

The basic scenario adopted for energy consumption estimates for 2000 is made on the basis of a constant technology economic analysis. The total forecast primary energy requirement for 2000 is approximately 190 Mtep, of which there are approximately 463 Mt of carbon dioxide emissions.

The economic analysis variable of this scenario consists in the average annual GDP growth rate between 1990 and 2000 of 2%, in constant value lire, corresponding to an average annual growth rate of approximately 3% up to 2000.

Compared to 1990, the range of fuels has been characterized by an increase in natural gas mainly at the expense of coal, and a resulting fall in emissions for the various fuel emission factors.

A number of measures, already provided for in the 1988 National Energy Plan, have already been implemented in order to achieve the rational use of energy; this involves a significant reduction of consumption and emission levels compared to the estimated economic growth rate.

Generally speaking, the measures taken into consideration tend to highlight the opportunities for energy efficiency in the programs and in the interventions for the modification and updating of processing and products, which are in any case required for market factors or for the end of the working life of the plants.

The limitation of carbon dioxide emissions is not an aim which is separate from development policies and programs, but one which is an environmental goal for the efficient use of energy and the improved use of resources as an economic goal included in any growth forecast.

The first set of measures concerns electric power generation: the cogeneration of electric power and heat and separate production of electricity. These measures have already been planned on the basis of economic and industrial evaluation made separately from the goal of stabilizing emissions.

The ENEL programs for thermoelectric power plants, adopted as a basis and revision of PEN 88 (resolution by the Interministerial Committee for Economic Planning of 26.7.1990 and 21.9.1993, and resolutions by the ENEL Board of Directors for the period 1991-1993), provide for the following initiative between 1994 and 2000, apart from the ones already statred between 1990 and

1993:

- The closure of approximately 3,500 MWe of fuel oil and coal power plants with a yield of under 34%;

- The construction of new gas turbine intallations (making them more powerful, converting them into combined cycle plants) for a total of approximately 1,600 MWe and the construction of new combined cycle plants for 1,800 MWE with an average yield of approximately 45-50%;

- The construction of new "traditional"plants for approximately 3,100 MWe, with an average yield of approximately 45-50%.

The ENEL programs already defined involve approximately Lit. 10,000 billion in investments.

Cogeneration and separate production of electricity are another significant contribution to the energy efficiency of industrial systems and the reduction of emissions. Under Law N. 9/91 and subsequent resolution N. 6/92 of the Interministerial Committee for Economic Planning, plants for generating a further 6,000 MWe from renewable or related energy resources should be built by 2000. This production receives incentives from the sale of contracts for energy supplies to the ENEL network. The cogeneration and independent production facilities which have already been approved involve investment of approximately Lit. 9,000 billion.

Compared to the economic forecasting based on constant technology, the results expected from industrial cogeneration and independent power production, there is a fall in energy requirements of approximately 4 Mtep with a CO_2 emission reduction of approximately 22 Mt. These results are due to the improved yield of the plants and the modification of the hypothetical fuel mixture. The specific emission level per KWh of electricity consumed is reduced to approximately 7% compared to 1990.

Under Law N. 10/91, as amended in subsequent budget laws, there are approximately Lit. 2,500 billion in incentive funds to be utilized by 1997. These incentives correspond on average to 30% of the total investment subject to incentives. The total investments available thus corresponde to approximately Lit. 8,300 billion.

On the basis of experience acquired under the implementation of Laws N. 308/82 and 10/91 and of the analyses contained in PEN'88, it is estimated that in order to save an equivalent ton of petroleum per year, an average investment of approximately Lit. 2 million is required.

On the basis of investments started, and with the hypothesis of an average time of 2 years for completing the facilities, the savings expected by 2000 are approximately 4 Mtep, if the investments are started by 1997. Ths estimate has been calculated also considering that about 70% of the savings derive from the industrial sector (on the basis of the incentive quota provided to the sector under La2 N. 10) and the other 30% from the non-industrial sector.

On the basis the subsequent changes and initiatives starteed, it can be estimated that energy consumption in 2000 will show an annual average increase in primary source consumption of between 0.9% and 1.3%, corresponding to a rise in CO_2 emissions of between 0.4 and 0.9%.

1.7 Possible initiatives for further containing CO_2 emissions

The initiatives are as follows:

Regulations with the aim of:

- Defining minimum energy efficiency standards for indsutrial components and processes, and for equipment designed for the domestic and services sectors;

- To adsopt energy efficiency verifications in certification procedures for new motor vehicles and industrial vehicles, with the aim of gradually introducing higher efficiency thresholds; increases in efficiency of electric vehicles, especially underground lines and electric railways;

- Improved use of resources available for meeting the demand for urban transport;

- Promotion of voluntary agreements between authorities and companies for early achievement of efficiency standards in components and processing, by providing proper incentives.

The identifcation of the minimum energy efficiency standards is in accordance w ith the other measures adopted in the European and national plans, for the definition of goals such as the quality of the air, limits on vehicle emissions and ecolabels.

Voluntary agreements, incentives and information. Standards can represent the goal of performance and environmental quality, to be achieved through agreements between industries and the authorities with the support of incentives and funding. In particular, the minimum energy efficiency goals are connected with funding provided to industries, both direct and indirect, for technological

innovation, environmental protection and, more generally speaking, to support employment.

In industry, important effects occur with the recovery of residues from production cycles to be used as secondary material or non-convenional fuel for use in highly efficient installations.

In transport, the basis is formed by the measures set for in the resolution by the Interministerial Committee for Economic Planning dated 7 June 1993 "Guidelines to be adopted for Italian initiatives in the Community with regard to transport" with the following long term aims:

- To ensure the coherence of current Community polices on trans-European railways for high-speed and combined transport;

- To create intermodal railway facilities, especially in the goods sector, and to develop transport systems with lower energy and environment impact;

- Technological improvement of the regional lines providing access to the trans-European networks (TEN) and additional motorway and road links;

- To give priority to new railway crossings over the Alps and to expand the current road crossings.

The following measures are also required:

- In urban areas, policies for the investment in and improvement of underground railways and the integrated management of public and private transport;

- To provide incentives for renewing the stock of cars in circulation which are over 10 years old.

In the non-industrial sector, further energy saving measures could be implemented by identifying standards and technologies aimed at:

- Utilizing highly efficient lighting systems and devices;

- Using highly efficient appliances.

With regard to domestic heating and air conditioning, requalification measures are required in existing systems.

All of the measures must be supported by an information campaign developing

the experience already started by the MICA.

The implementation of these measures could reduce energy consumption and CO_2 emissions to the lowest level stated at the end of the previous section by 2000, and ensure the maintenance of this trend in subsequent years.

1.8 The contribution of Italian emissions to global radiative forcing

The analysis of radiative forcing reductions in national emission levels, assessed by multiplying the emissions of the various gases for their global warming potential (GWP) highlight the following, even considering the considerable uncertainty of the GWP levels:

1) The significant impact of interventions for methane emission reduction, especially over a 20 year period;

2) The significant contribution to radiative forcing of HFC- 134a emissions;

3) The possibility of achieving the goal of reducing the national contribution to global radiative forcing for 2000 within 20 years by implementing all the measures stated for scenario 2a, into a 100 year period also considering most of the measures stated for scenario 2b, and into a 500 year period considering all the measures for scenario 2b.

With respect to the specific goal of stabilizing CO_2 emissions, which are of great importance for the stabilization of long term radiative forcing, the Italian government believes that the efforts required to achieve this goal must be coordinated in the context of international cooperation. Taking this goal into consideration, Italy has recently:

- Reminded the European Union of the need to adopt the burden sharing mechanism provided for by the decisions of the EEC Energy-Environment Council of 29 October, 1990 for achieving the Community goal of stabilizing CO_2 emissions;

- Made a preliminary suggestion to the Interim Secretariat of the Convention for the XI Session of the INC highlighting the fact that limiting the joint implementation mechanism to reducing CO_2 emissions does not take into account the fact that most industrial countries will not be able to keep their emissions in 2000 to 1990 levels. Italy has therefore proposed an examination of the possibility for industrial countries with national energy-related CO_2 emissions less than 3% of total energy emissions to stabilize their emissions through technological cooperation with developing countries

and/or countries in Central and Eastern Europe. This type of technological cooperation could reach important results and lead to major energy savings in industry, power plants, transport systems and services.

2 INVENTORY OF EMISSIONS AND SINKS OF GREENHOUSE GASES FOR 1990

2.1 General

Tables 2.1 and 2.2 show the 1990 emission levels for the main greenhouse gases (CO_2, CH_4 and N_2O) and the precursors (NO_x, CO, NMVOC), which the INC Guidelines suggest be included in the national Communications.

The following estimates have been developed by ENEA in the context of the CORINAIR '90 Inventory of the European Union. It has been decided to refer to this inventory, despite the problems of compatibility in nomenclature with the IPCC/OECD Guidelines, 1994), in order to guarantee the utmost standardization of the data reported internationally by Italy. The CORINAIR Inventory is at the basis of the estimates reported by Italy to the European Environmental Agency and the EMEP program of the Geneva Convention on Long Range Trans-boundary Air Pollution.

Original estimates were made for the two IPCC categories IA3 (Air/marine bunkers) and 5 (Land use change and forestry), not included in CORINAIR '90.

Emissions have been shown in accordance with tables 6A, 6B of the IPCC/OECD Guidelines for reporting inventories of greenhouse gas emissions, showing the categories of emission sources considered in the inventory with two disaggregation levels. It was not considered necessary to submit minimum data tables of the IPCC methodology since the IPCC categories are different from the CORINAIR activities for which the emissions have been estimated.

On the other hand, in order to provide complete, transparent information, the annex shows the CORINAIR inventory regarding the various activities considered in this methodology (Tables A1. 2 and A1. 3) and in Table A1.1 the correspondence between the SNAP/CORINAIR and IPCC nomenclatures.

Table 2.3, in accordance with Table 7A of the IPCC/OECD Guidelines, shows information on quality and on the type of data shown in Tables 2.1 and 2.2 of this Communication.

2.2 Emissions and sinks of greenhouse gases from land-use changes and forests

The calculation of emissions in this IPCC category was somewhat difficult, since some of the IPCC Guidelines are not wholly applicable to our country. This also means that the IPCC should continue to study estimates on emissions in this area.

With regard to managed forests (IPCC 5D), the whole forest is considered to be managed by man. The accumulated carbon is estimated to be 268 million tons, corresponding to an annual 50.8 million tons of CO_2 absorbed by the atmosphere (including absorption by tree-lined roads and windbreaks).

The CO_2 emitted to cutting wood (IPCC = biomass harvested) is 10.4 million tons. This figure has been calculated on the basis of the amount of wood utilized (national statistics) multiplied by the conversion factor (0.5 tons of dry material per cubic meter of wood) and using 0.45 as the factor for the carbon content. The use of wood as fuel (approximately 50% of the total wood used) is characterized by a low level of wood residue not harvested from the ground; 10% is assumed. Wood for industry (the other 50% used): the biomass expansion factor of 1.90 proposed by the IPCC is used. The result is an average biomass expansion factor of 1.50, taking into account the considerations stated above.

The net carbon accumulated every year by our forests thus corresponds to 40.4 million tons of CO_2.

Emissions attributed to forest fires, even if this item cannot be classified under IPCC 5A forest clearing, has been included in this item and added to the national total. This choice takes into account the basically manmade nature of fires in Italy and relatively long regrowth periods (10-20 years).

The IPCC methodology considers the absorption of CO_2 related to arable land abandonment (5C, abandonment of managed land); this abandonment involves the accumulation of carbon in the soil and topsoil, the amount depending on the type of vegetation reappearing there. In Italy over the past 30 years, there has been an increase in forests due to reforestation and the natural spread of forests due to the abandonment of grazing land and arable land. The absence of data for measuring this phenomenon in various geographical areas of our country has made it impossible to apply the methodology suggested by the IPCC for the assessment of this CO_2 sink, which could have a significant extent.

Table 2.1 Summary report for national greenhouse gas inventories (Gg) is not available electronically

Table 2.3 Short summary report for national greenhouse gas inventories (Gg) is not available electronically

Table 2.3 Overview table for national greenhouse gas inventories is not available electronically

2.3 International bunkers

On the basis of the INC Guidelines for the preparation of the first national communications (INC/FCCC, 1994) emissions due to international bunkers, air and maritime, have not been included in the national total, and have been estimated separately (Table 2.4).

With regard to maritime bunkers, the amounts of fuel oil and diesel fuel shown in a specific item in the National Energy Budget (NEB, 1990) were used. For air bunkers, which are not identified as such in the NEB, the consumption of airplane jet and gasoline fuel shown by the BEN under the air transport item was used, subtracting the amount corresponding to domestic flights (considering consumption for the takeoff and landing phases as well as cruising), with an approximate estimate.

For the emission factors, the values provided by the IPCC/OECD 1994 Guidelines were used.

2.4 Carbon dioxide (CO_2)

Graph 2.1 shows the different contributions to total CO_2 emission. Almost all of it comes from the energy sector, while the land-use change and forests is the only form of absorption.

Graph 2.2 shows the various contributions to CO_2 emission from the energy sector.

With regard to CO_2 emission related to use of biomass as fuel and various waste disposal methods, these have not been included in the national total on the basis of the assumption that their use is sustainable, in accordance with the IPCC Guidelines.

With regard to the category of emissions related to land-use changes and forests, it should be pointed out that no estimates are available on the abandonment of cultivated land; as for managed forests, all Italian forests have been classified as managed.

The estimates of CO_2 emissions by the energy sector shown in this report are based on the statistics of the Oil Bulletin, which supplies detailed information on the quantity and quality of fuel consumed by each of "end uses" and on reporting from individual facilities, rather than the fuel flows within the entire economic system as contained in the National Energy Budget; the bottom-up methodology is the one used in the CORINAIR '90 project, on the basis of which the emissions are assigned by the various economic activities where they originate.

An alternative approach refers to the fuel flows for the whole economic system, a top-down approach. The use of this approach, the only alternative for developing countries with no detailed energy accounting, is also recommended as a verification of data calculated with bottom-up systems. In the latter there is a considerable probability of double counting related to the overlapping of various economic activities and industries. This can be avoided by checking overall fuel consumptions and the corresponding emissions.

In order to make this verification possible, Italian CO_2 emissions from the use of fossil fuels have been estimated on the basis of energy consumption figures in the National Energy Budget and the methodology developed by the OECD (The IPCC Reference Approach: Detailed Fuels, IPCC/OECD, 1992). The same methodology has been used to estimate the emissions from the energy system for 2000, shown in Chapter 4.

The top-down approach provides for a complete survey of primary fuel products, both imported and exported, including changes in stocks. The production of secondary fuels products must not be considered in the estimates for carbon emissions, since the carbon in these fuels has already been considered under primary fuels.

Once the emission factors have been determined for the various fossil fuels and other energy sources which may produce CO_2 emissions in some part of their cycle, these factors are applied to primary energy consumption, with caution regarding the quota of energy products utilized as raw materials for industrial processing.

With regard to non-energy uses, the amount of carbon released into the air is obviously a fraction of this total, ranging from 0% in bitumen, to 20% in fuel oil and LPG used as a raw material, 50% in lubricants and 67% in natural gas used as a raw material. In coke, it can generally be assumed that 6% of the total carbon is transformed into oil and tar, and 75% of this amount is collected in the processing subproducts. With respect to the standard layout, the petcoke item has also been added.

According to this approach, fuels used as raw materials in the production of non-energy products is not taken into account where they do not undergo immediate partial or complete oxidation (such as in plastics and in tar for road asphalt); these products are considere to be fixed carbon with the standard proportions mentioned above.

No corrective factor has been considered for the carbon non oxidized or only partially oxidized and then emitted in the form of VOCs (volatile organic compounds) or CO (carbon monoxide). This fraction, which is very low compared to the overall carbon content in primary fuels, around 1% of total emissions, nevertheless varies according to the type of fuel and the sector where it is used (e.g. it is very high in transport). With regard to the estimates shown here, the emission factors available in literature have been adapted to the Italian situation - with the comparison of the different methodologies - taking into account the data and information available on the chemical composition and the energy contents of the fuel products.

This leads to a 1990 estimate of 403.5 $MtCO_2$, approximately 2.15 $MtCO_2$ higher than the data estimated on the basis of the CORINAIR '90 inventory, as shown from the comparison with the data in Table 2.5 with the data in Tables 2.1 and 2.2. The following observations can be made on the reasons for this slight difference between the top-down and the bottom-up methods (0.54%):

a) The top-down method uses numerous default values for emission factors, while the bottom-up method, based on actual consumption, can count on more accurate data (the Italian estimate, in particular, is heavily influenced by the assumptions regarding the emission factor of crude oil);

b) The estimates of the CORINAIR '90 inventory are based on the statistics of the Oil Bulletin, supplying detailed information on the quantity and quality of the fuel consumed by each of the "end uses" and, with regard to the sources, on the reports from the individual facilities, rather than on the fuel flows for the entire economic system contained in the National Energy Budget.

The top-down estimate in Table 2.5 also differs from the one contained in the communication sent by Italy to the European Union under Council Decision 93/389/EEC on the "Monitoring mechanism for CO_2 and other greenhouse gas emissions", totalling 421 million tons of CO_2, for the following reasons.

1) In accordance with the Guidelines of the 9th session of the INC, emissions for international bunkers (12.5 Mt CO_2) have been considered separately from the national total (as mentioned in paragraph 2.3);

2) In order to make the estimate match international statistics (like those of the IEA / OECD) corrections had to be made to the lower heat value of bitumen and lubricants (with a fall of approximately 5 Mt CO_2).

The top-down approach has also been used to calculate the CO_2 emission trends in the energy sector in recent years. The estimates show that the rising trend has declined (see Table 2.6). The last available data (for 1993) is 1.1% lower than in 1990.

Table 2.4 Greenhouse gas emission from bunkers is not available electronically

Graph 2.1 CO_2 emission and Sinks (Mt) is not available electronically

Graph 2.2 CO_2 emission from fuel combustion

2.5 Methane (CH_4)

The estimate for emissions from landfills (IPCC 6A) contained in the CORINAIR '90 inventory has been reviewed, adding the emissions deriving from the disposal in landfills of sludges from sewage treatment and the decomposition - mainly anaerobic - of organic industrial waste.

The emissions under IPCC/OECD item 6B for the treatment of sewage has also been considered. Given the lack of information on industrial waste, only methane emission from urban sewage treatment plants has been taken into consideration. Emissions were calculated as 33.6 Gg on the basis of the simplified methodology contained in the IPCC/OECD Guidelines and assuming for statistical purposes that the number of inhabitants covered by sewage treatment plants in 55,886,000 (RSA, 1993).

Graph 2.3 shows the contributions of the various categories of emission sources: the most significant contribution is from farming, with over half the total emission. Graph 2.4 shows the subdivision of emissions in agriculture.

2.6 Nitrous oxide (N_2O)

Graph 2.5 shows the contributions of the different categories of emission sources. The main one - about 50% - is from agriculture, especially from the use of fertilizers.

2.7 Emissions of precursor gases (NO_x, CO, NMVOC)

The estimates shown here are the ones shown in the European Union CORINAIR '90 inventory. The data in table 2.1 shows that for these three gases, transport is the most important source (45.7% for NO_X, 60.5% for CO, 41.5% for NMVOC).

Table 2.5 CO_2 emission estimate from energy: top-down approach (1990) is not available electronically

2.8 Other greenhouse gas emissions

On the basis of the INC indications (INC, 1994), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) have been taken into account. Tetrafluoromethane (CF_4, also known as perfluoromethane, carbon tetrafluoride and CFC-14) and hexafluoroethane (C_2F_6, also known as perfluoroethane) are extremely potent greenhouse gases, with global warming

potentials amounting respectively to 6,300 and 12,500 time CO_2 over a period of 100 years, and with an average life of over 50,000 years.

The only significant currently known source of CF_4 and C_2F_6 is primary aluminium smelting, responsible for most if not all global emissions.

Other possible anthropogenic sources are the production of CFCs, steel and uranium. There could also be small natural emissions of CF_4.

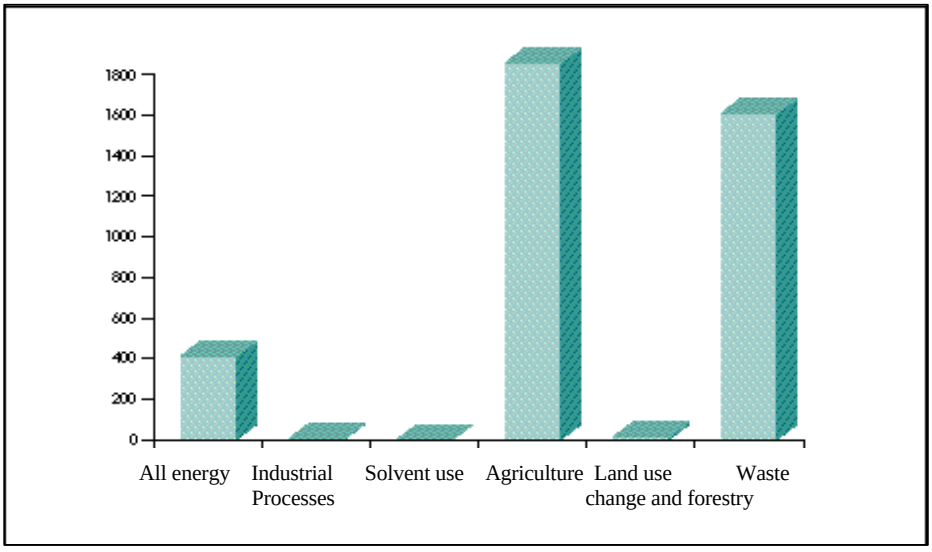
The specific emissions are highly uncertain, and depend closely on the technology utilized. Italian facilities, recently refurbished (1992) utilize prebake technology with point feeders for adding alumina, characterized by a lower emission rate. For this type of plant, some recent measurements at French and Norwegian plants have shown rates of 0.06 kg CF_4 per ton of aluminium produced. C_2F_6 emissions are generally about ten times lower, and the emission factor may be assumed to be 0.006 kg C_2F_6 per ton of aluminium produced. With a national production of 232,000 tons in 1990, approximately 14 tons of CF_4 and 1.4 tons of C_2F_6 were released into the atmosphere.

Emissions of hydrofluorocarbons (HFCs) will increase in Italy since these compounds will replace chlorofluorocarbons (CFCs, chlorofluorobromocarbons (halons) and hydrochlorofluorocarbons (HCFCs) controlled by the Montreal Protocol and subsequent London and Copenhagen amendments. It is estimated that HFCs will mainly be used in refrigerators, air conditioners, fire-fighting equipment and as aerosols. In 1990, however, these applications and the corresponding emissions were negligible. HFC-23 can be emitted into the air as a subproduct of HCFC-22 production. Since 1990, emissions from the only Italian plant have been subjected to incineration treatment.

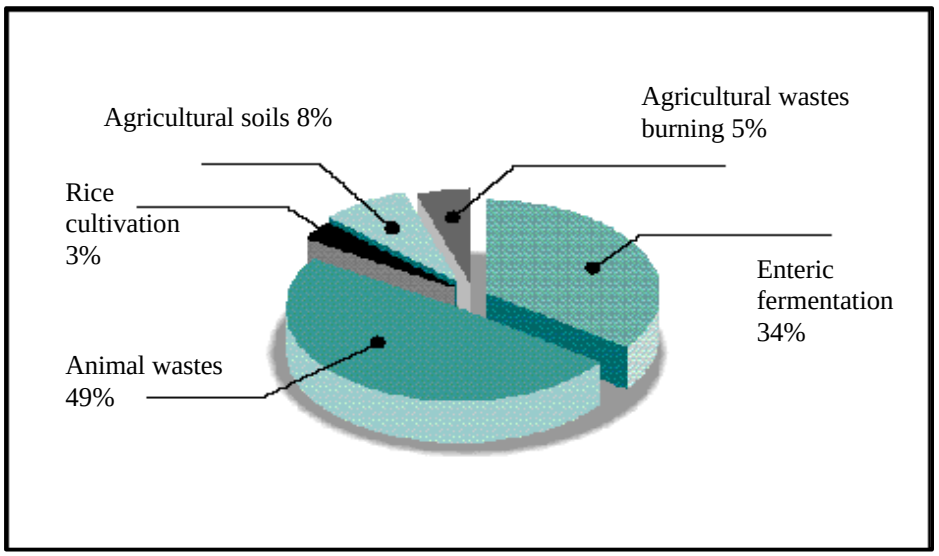
Sulphur hexafluoride (SF_6) is another powerful greenhouse gas with a global warming potential of 24,900 over a 100 year period. Its use will increase, especially in high voltage transformers and in fire-fighting equipment, together with the replacement of halon products in the HCFC and HFC families. Given the confidential nature of production data and the lack of detailed information on end use, no attempt has been made to assess these emissions.

Table 2.6 CO_2 emissions from energy (1988-93) is not available electronically

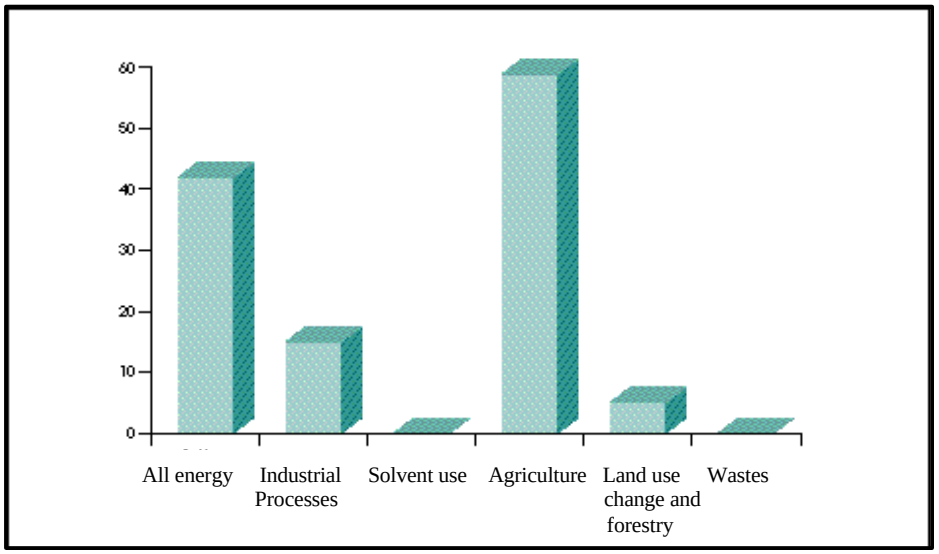
Graph 2.3 – CH_4 emissions (kt)



Graph 2.4 – CH_4 emissions from Agriculture



Graph 2.5 – N_2O emissions (kt)



2.9 National circumstances having an impact on greenhouse gas emissions

Table 2.7 shows emission data in terms of summary indicators on specific Italian characteristics.

Table 2.7 - National circumstances (1990)

	Unit	Total CO_2	Net CO_2	CH_4	N_2O
Per capita emissions	kg/cap	7421,1	6823,1	60,3	2,05
Emissions by national area	t/sq.km	1440,9	1324,8	11,7	0,40
Emissions by GDP	t/GLit	330,9	304,2	2,69	0,09

Table 2.8 shows how, with respect to other OECD countries, Italy has a very low energy intensity (for example, in 1991 primary energy consumption on a per capita and GDP basis was the lowest of the seven most industrialized countries. This may be explained by various factors such as the temperate climate, high energy taxes, limited domestic energy resources and the contribution of energy saving policies adopted over the past 25 years. CO_2 emissions from the energy sector per unit of GDP are also among the lowest in the OECD. Because of the low energy intensity, national goals of limiting CO_2 emissions are more costly than in other countries.

Table 2.8 - Energy indicators and CO_2 emission indicators for the most industrialized countries (1991)

	Per capita energy consumptions (primary sources) (toe/cap)	GDP Energy consumptions (primary sources) (toe/1000 $US)	Per capita CO_2 emissions from the energy system (t/cap)	CO_2 emissions from the energy system by GDP (t/1000 $US)
Canada	7,8	0,40	16,1	0,83
France	4,1	0,22	7,1	0,39
Germany	4,4	0,26	12,0	0,71
Japan	3,5	0,19	8,7	0,46
Italy	2,7	0,16	7,2	0,43
UK	3,8	0,24	10,6	0,67
US	7,7	0,34	19,9	0,88
OECD Europe	3,3	0,23	-	0,57
OECD	4,8	0,27	12,1	0,69

(1) GDP at 1991 prices with purchasing power parity
Source: OECD, 1994

3. DESCRIPTION OF POLICIES, PROGRAMS AND MEASURES

3.1 National planning in the energy sector with an impact on greenhouse gas emission reduction

National energy plans

Over the period characterized by high oil prices (1973- 1985), the energy policies followed by Italy as well as most of the developed countries was aimed at reducing the economic cost of the energy system. Planning was mainly aimed at regulating the growth of the energy supply system. Three types of response were developed: organizational, economic and financial, scientific and technical.

From the organizational point of view, the countries with the highest energy consumption agreed to set up the International Energy Agency in order to deal with the oil producers' cartel (OPEC). They set up a committee in this Agency to provide a coordinated response to any sudden cutoff of oil supplies, a second committee to keep demand under control over the medium term and a third committee to provide coordinated long term strategies, especially in research and development. On the national level, the various governments have collaborated with the most important energy-related organizations to draw up a series of national energy plans designed to modify the structure of the national energy system to reduce dependence on other countries.

In the context of the national energy plans, various economic and financial measures have been taken in order to reduce demand (e.g. higher energy taxes and internal inflation), to diversify the supply options (with the development of non-OPEC oil sources, non-oil sources, non- fossil fuels) and to diversify the geopolitical sources of energy products.

From the technical and scientific point of view, both national and international, governments have fostered the researh, development and commercial demonstration of new, more efficient energy technologies (such as nuclear and renewable ones). Studies have also started on national and local energy systems, with the collection of standardized statistical data and the application of economic modelling techniques to the energy sector in order to better understand the major processes under way.

When the problem of the financial cost of the national energy system returned to levels which were more sustainable by the country's economy, attention focused on the rising environmental cost of energy. With the emission of combustion gas, the energy system modifies the chemical equilibrium of the atmosphere, with danger to human health in polluted cities, danger to flora and inland waterways due to the acidity of deposition within countries and in cross-border

processes; the mechanisms regulating the earth's climate are also threatened.

The 1988 National Energy Plan

Following the rejection of nuclear energy in the 1987 referendum, the government approved a new National Energy Plan (NEP '88) in August 1988. The point of departure of this plan was the energy situation in Italy at that time, considered to be highly critical because of the country's vunerability to energy crises and environment pressure.

Five priority goals were identified:

- Energy saving;
- Protection of the environment and human health;
- Development of domestic resources;
- Diversification of energy sources and suppliers;
- International competition.

Under NEP '88, energy saving should be "understood not as the limitation of development but as the efficient use of energy to reduce overall energy requirements, and thus have obvious positive effects on our energy dependency and therefore out vulnerability...as well as on the environment."

Protection of the environment should be understood not as a limitation, but as a goal of energy policy: "the anticipation approach is adopted, both to avoid harm to the environment before it arises and, where possible, to replace current production processes and technologies with new, lower impact solutions."

With regard to atmospheric emissions, NEP '88 aims ar the gradual reduction of air pollution from the energy sector, but does not have any goal of containing carbon dioxide emissions, which would actually rise (+13% in 2000 as compared to 1987).

National Plan for Sustainable Development Implementing Agenda 21

According to Agenda 21, "governments...should adopt a national strategy for sustainable development. This strategy should be set up by utilizing and harmonizing the policies in the various sectors. The aim is to ensure economic development which is responsable towards society, protecting both the basic resources and the environment to the benefit of future generations. The national strategies for sustainable development should be developed through the

broadest possible participation and the most comlete evalution of the current situation and initiative."

In 40 chapters, Agenda 21 deals with all fields (energy, industry, agriculture, transport, tourism, waste) requiring the integration between environment and development, stressing the following needs:

- To integrate the environmental aspects in all the central and local government structures in order to ensure the coherence of policy in the various sectors;

- A system of planning, control and management in order to support this integrations;

- To encourage the participation of the public and the relevant organizations, which requires full access to information.

The energy problem is crucial for Agenda 21; "the need to limit the emission of greenhouse gas and other gases and substances into the atmosphere requires increasingly efficent production, transmission, distribution and consumption of energy, as well as the growing use of energy systems which are sustainable from the environmental point of view, especially new and renwable energy sources.

In Italy, the National Plan for Sustainable Development to Implement Agenda 21, drawn up by the commission for the Global environment of the Ministry of the environment, was approved by the Interministerial Committee for Economic Planning on 28.12.93. The document is full of information and useful items. It is divided into chapters on energy, industry, agriculture, transport, tourism, waste management and international cooperation for sustainable development.

In the energy sector, the plan confirms the commitment to contain carbon dioxide emissions to 1990 levels by 2000, "first of all exploiting the potentials offered by low or zero cost interventions in energy production and use, taking advantge of the possibility of implementing no regret options, i.e. measures which are useful and produce no regrets even if scientific discoveries should lead to a siginficant reduction of the threat of climate change." These measures, besides leading to the reduction of the main greenhoue emissions, would also help counter urban pollution and acid dopsition, reduce the energy bills of households and industries, and reduce the heavy burden on the national economy of importing energy supplies. The wide range of goals also justifies costs which would otherwise be too high compared to the benefits expected - and not only in the energy sector.

Numerous means can be utilized or have been proposed in Italy in order to promote energy saving initiatives for the production and use of energy and the

increase in renewable sources. Instruments to promote investments include Laws N. 9/91, N. 10/91 and Interministerial Price Committee Resolution N. 6/92, energy auditing, capital account and interest funding, third party financing, guarantee funds, incentives / disincentives, fiscal policy, volunatry planning agreements. The instruments for the qualification of devices for the end use of energy include ecolableling, energy saving labelling, the European union energy label, the comparative list of appliance energy consumption, product certification, minimum compulsory enrgy efficiency. The instruments for changing behavior and accelerating product acceptance include information, training, progressive tariffs for metered utilities, demand side management, tax benefits, public contracting of energy services, regional energy planning.

Despite the variety of technological options and political measures, the way towards sustainable development in the energy sector has not yet been identified on the worldwide or national level. The technology exists but is not currently compatible with economic development, since it requires an excessive use of resources at the expense of the other sectors.

National Program for Limiting Carbon-related Emissions to 1990 levels by 2000

Parliament has approved Italy's agreement to the Framework Convention on Climate Change (FCCC) by Law N. 65 of 15.1.94. The National Program for Limiting Carbon-related Emissions to 1990 levels by 2000, submitted jointly by the Ministry of the Environment and the Ministry for Industry, Trade and Crafts, was approved by the Interministerial Committee for Economic Planning in the session of 25.2.94.

The National Program approved by the Committee also sets energy system carbon dioxide emissions - totalling 421 $MtCO_2$ in 1990 - to approximately 430 $MtCO_2$ in 2000, i.e. 40-60 $MtCO_2$ less than the values forecast if national energy consumption grew at the previously estimated rates. This is possible if a primary requirement target of 179 Mtep is set for the energy sector for the year 2000.

3.2 Policies, programs and measures for power generation

The first set of measures concerns electric power generation: the cogeneration of electric power and heat and electricity generation from independent producers. These measures have already been planned on the basis of economic and industrial policy options made separately from the goal of stabilizing emissions.

The ENEL (national generation, transmission and distribution utility) programs for thermoelectric power plants, adopted as a basis and revision of NEP 88

(resolution by the Interministerial Committee for Economic Planning of 26.7.1990 and 21.9.1993 and resolutions by the ENEL Board of Directors for the period 1991-1993), provide for the following initiative between 1994 and 20000, apart from the ones already started between 1990 and 1993:

- The closure of approximately 3,500 MWe of fuel oil and coal power plants with a yield of under 34%;
- The construction of new gas turbine installations, converting some existing plants into combined cycle plants, for 1,800 MWe with and average yield of approximately 45-50%;
- The construction of new "conventional" plants for approximaately 3,100 MWe, with an average yield of approximately 40%.

The ENEL programs already defined involve approximately Lit. 10,000 billion in investments.

Cogeneration and electricity generation from independent producers are another significant contribution to the energy efficiency of industrial systems and the reduction of emissions. Under Law N. 9/91 and subsequent resolution N. 6/92 of the Interministerial Committee for Economic Planning, plants for generating a further 6,000 Mwe from renewable or related energy resources should be built by 2000. This production receives incentives from energy supply contracts to the ENEL network. The cogeneration and independent production facilities which have already been approved involve investment of approximately Lit. 9,000 billion.

3.3 Policies, programs and measures for industry

For industries with high energy absorption, there are many technologies for considerably reducing the specific energy consumption per product unit produced. The diffusion of information in this area is generally adequate, and the failure to adopt new technology is more due to industrial policy choices and/or lack of capital than to lack of technological information.

For an analysis of the policy measures promoting the adoption of this technology, we have made a subdivision of three major categories of technology: processing technology with an approximate breakeven time of less than 3 years; technology with a longer breakeven time and, in this class, a sub-group of technology increasing the efficiency of electric power use.

In the first group of technologies, the economic and financial advantages should favor the "spontaneous" adoption when existing plant is changed; the most effective measure is considered to be agreements with Category Associations because:

- The increase in energy cost by taxation, considering its effect on production costs, could penalize industries already in a poor condition with respect to international competition, unless EEC and/or OECD coordination could be agreed;

- The introduction of new technology to reduce porduction costs is, in any case, the only way to avoid the rapid obsolescence of the industries themselves.

The second group of measures, given the lower profitability, would undoubtedly be favored by suitable incentive policies and/or risk-taking by third partioes (financial companies and merchant banks).

The subgroup of technology targeted towards enhanced efficiency of electricity use (high performance light bulbs, high performance and/or variable speed engines) has a relatively long breakeven time but has virtually no industrial risk; legislation can therefore be used, togwther with third party financing, with the aim of promoting the development of a market for these more efficient devices and to encourage the market to replace the previous models.

In the industrial sectors with low-medium energy consumption, the costs of energy do not have a significant impact on production costs, and this leads both to a relative absence of energy cost impact as well as a widespread ignorance of energy saving option. Energy auditing and better information are therefore essential for promoting energy saving policies.

Here, to, agreements with Category Associations are the best way to promote the adoption of processing technologies with breakeven times of less than three years, while for technology with longer breakeven time, incentives and/or significant manipulation of energy prices seem to be the only feasible solutions.

3.4 Policies, programs and measures for the residential sector

The options for intervention in this sector are based on the building standards for new homes and on the refurbishing projects for existing buildings, mainly promoted under Law N. 10/91 and the related implementation regulations.

With regard to electricity consumption, measures are oriented towards the introduction of more efficient appliances and equipment on the market.

In this sector, the measures and policies required can be implemented by 2000, but as in the transport sector, their effect on consumption will only been

perceived subsequently. It is ofrecast that consumption levels in the various sectors will increase up to 2000 and remain stable or fall slightly in subsequent years.

3.5 Policies, programs and measures for transport

The measures required for a better distribution in transport flows between road and rail traffic and to increase the efficiency of the vehicles themselves are rather complex, and difficult to implement by 2000. The CIPE Resolution dates 7 June, 1993, entitled "Guidelines to be adopted for Italian initiatives in the Community with regard to transport problems" and has the following long term aims:

- To ensure the coherence of current Community policies on trans-European railways for high speed and combined transport;
- To implement intermodular railway schemes especially for goods traffic, and to develop transport systems with low energy and environment impact;
- Technology improvement of the regional lines providing access lines to the Trans-European Networks (TEN) and additional motorway and road links;
- To give priority to new Alpine rail crossings and to expand current road crossings.

The following measures are also required:

- In urban areas, policies for the investment in and improvement of underground railways and the integrated management of public and private transport;
- To provide incentives for renewing the stock of cars in circulation which are over 10 years old.

With regard to enhancing energy efficiency of road vehicles, which will in any case remain highly important, the most effective measures are as follows:

- The introduction of energy performance monitoring in vehicle certification, with the aim of providing minimum performance standards;
- The introduction of incentives for renewing the stock of cars in circulation which are over 10 years old.

3.6 Policies, programs and measures for waste management

National programs for waste management include general goals which are internationally accepted and planned on the European level, in particular:

- Reduction of waste disposal risks;

- Limiting the amount and danger of waste.

Some of the interventions provided for in these programs were significant for the reduction of CH_4 emissions; these measures were not considered in the case of CO_2, since on the basis of the IPCC Guidelines these emissions have been initially considered as being of organic origin and have not been included in national totals.

Reduction of risks related to disposal

The main action for achieving this goal is to increase and improve waste disposal on the supply side, both for urban and industrial waste. Current suppliers are inadequate with respect to requirements and their geographical distribution is such that there are higher risks related to waste transport.

For solid urban waste, Italian legislation (starting from Presidential Decree N. 915/82) requires that all waste disposal facilities be equipped with systems for the capture and combustion of the biogas produced. In 1990, the percentage of biogas captured was 13%, and has risen following the completion of plants financed under the agreements signed by the Ministry for the Environment and the Regional authorities in 1991, and under the 1989-1991 3- Year Program for Environmental Protection. The exploitation of the energy potential of biogas could speed up the completion of systems for capturing gas from urban waste. The incentives made available under CIPE REsolution N. 6/92 may provide for the installation of biogas-powered installations with an overall power of approximately 100 MWe, corresponding to a methane emission reduction of about 300,000 t. It has been assumed that thanks to these interventions, the percentage of gas captured by 2000 should approach the technological potential of 50%.

Dependence upon waste disposal facilities should therefore fall over the coming years from the current level of 90% to no more than 42% in 2000, according to the forecasts under the regional plans currently in force.

With regard to industrial waste disposal, the most recent initiatives tend to

provide incentive through regulations and to finance self-disposal of waste products by producers. This is the aim of waste regulations in line with EC Directive N. 91/156, and Decree Law N. 619 of 7 November, 1994 aimed at monitoring possible violations with regulations for re-use for production purposes.

It is thought that the implementation of this law would enable up to 30% of industrial waste porduced to be subtracted from the disposal process for re-use. With regard to the exploitation of these residues, efforts will be made to apply Law N. 10/91 for the implementation of the National Energy Plan. The law promotes energy exploitation of waste and provided financial incentives for initiatives aimed at the rational use of energy, the limitation of energy consumption in the production and use of manufactured goods and the use of renewable energy sources.

The Ministry for the Environment and the Ministry of Industry have drawn up regulations to classify products which can be recovered for energy exploitation purposes. This rule has recently been re-issued as a Decree of the Minister of the Environment dated 4.1.1995, entitled "Technical regulations for the re-use as energy sources of residues deriving from production or consumption cycles." The rule also defines the general characteristics of treatment cycles, as well as the technologies to be used, and the threshold levels of the resulting air pollutants. The Decree has the "energy goal" of installing 2000 MW in electric power plants by 2000.

Reduction of the amount and danger of waste

The second goal is being pursued through measures in the industrial production sector, the consumption sector and in urban waste disposal.

With regard to industrial waste, Community programs provide for the introduction of cleaner technologies in all the stages of the production cycle. With regard to urban solid waste, priority intervention is focused on packaging material, which in 1990 accounted for approximately 37%. The European Union goals proivde for the following within 10 years:

- The compulsory removal of 90% of the weight of discarded packaging from waste disposal facilities;

- The compulsory recycling of at least 60% of the weight of each material.

Within 5 years after the approval of the packaging directive by the Council, Italy must achieve the goal of removing 50- 60% of the weight of packaging waste to be recovered (by recycling or for energy use) and of this 25-45% must be recycled.

For some types of waste, Italian rules have already provided for the creation of consortia for recovery for recycling of glass, plastic and aluminum containers for liquid, dead lead batteries, lead waste and used oil. The minimum goals of these consortia must be defined in accordance with European goals.

As a result of measures for the production, marketing and use of packaging and for the expansion and increase of differentiated waste collection, Italy should be able to stabilize waste production to a per capita level of approximately 300 kg, as provided for under the "5th Community Action Program for Environmental Protection."

3.7 Policies, programs and measures for agriculture and changes in land use

The relative lack of arable land providing an adequate economic return has favored the development of intensive agriculture in Italy with a significant environmental impact. The same consideration can be made with regard to animal breeding, which is also carried out on an intensive scale in some areas of the Po valley, thus resulting in one of the country's major environmental emergencies. It is estimated that approximately 50% of national animal production takes place in this area. The trend towards intensive exploitation has been further encouraged by the Common Agricultural Policy (CAP), characterized by a number of problems such as surplus production, high storage costs for these products, uncompetitive pricing and a significant environmental impact deriving from the production techniques.

Proposals for a major revision of this policy have been made only recently. In the context of the "5th Community Action Program for Environmental Protection" the European Union has identified agriculture as one of the five sectors of the economy requiring intervention, proposing the gradual reconversion of the sector to sustainable agriculture.

The reform of the CAP contained in the so-called McSharry Plan lays down a series of conditions / goals which can be summarized as follows:

- Containment of production and abolition of price subsidies;
- Extensivation of farming and animal breeding (including letting set aside land remain fallow);
- Development of environment-friendly agriculture;
- Safeguarding and restoring the natural environment;

- Conversion of arable land into forests;

- Retirement of the older age group farmers.

In this context, some regulations known as measures accompanying the CAP reform have been drawn up; they appear to be particularly significant also with regard to the goal of limiting greenhouse gas emission and the improvement of sinks. EU Regulation N. 2079/92 sets up a financial aid scheme to promote the adoption of farming methods compatible with environment protection, while EU Regulation N. 2080/92 provides for aid for converting arable land into forests. Although not included in the regulations, we should cite EU Directive N. 91/676 on the protection of water from nitrate pollution from agricultural sources, and EU Regulation N. 2092 on the production method of biological agriculture.

The following priority goals identified on the national level can be identified in the context of EU Regulations N. 2078/92 and 2080/92:

1) Reduction of nitrate depostion in the soil from animal breeding or fertilizer, as well as other potential pollutants;

2) Reduction of the concentration of animals on a unit / land area basis;

3) Withdrawal of arable land from production and earmarking this land, and marginal land areas, for reforestation.

With regard to the first point, fertilizer consumption has reached nearly 20 million tons, with an average of approximately 160 kg per hectare, rising to 700-800 kg in some provinces of the Po valley. According to reliable estimates, a reduction of 3.4-4 million tons of fertilizer consumption is considered possible, i.e. about 20% of the current figure. This reduction requires the rationalization of fertilizer use, the partial reintroduction of land rotation and green fertilizer, the use of animal waste after suitable treatment and of food industry sibproducts, and above all the abolition of subsidies to agriculture for the purchase of fertilizer, which is in contrast with the goal of reducing the amount of chemicals.

With regard to the instruments available for the reduction of nitrate fertilizer, it should be recalled that EU Directive 91/676 regarding the protection of water from nitrate pollution from agricultural sources calls upon member States to draw up codes of good conduct in agriculture, to be applied by farmers throughout the country. The code of good conduct in agriculture provides guidelines and suggestions to farmers for a more careful management of the nitrogen levels in their farming methods. It could be used as a set of basic

standards for the use of products and subproduct (especially fertilizers and manure) under which producers should not go, since these standards, without implying any reduction of production yields, lead to better protection of the environment.

Interventions for the reduction of nitrogen fertilizer are the only measures considered in rice farming. The possibility of changing the rice production system with new technology is highly unlikely, considering that rice is the basic food porduct for 3 billion people, and any change in the production system to reduce methane emissions would have catastrophic effects, especially on the populations of the third world.

With regard to animal breeding, and especially pig breeding, regional regulations on the disposal of the waste material are being revised in some areas of the Po valley, making it compulsory for the breeders to respect specific waste disposal plans for the agricultural land, taking into account the characteristics of the waste, the type of crops and the degree of vulnerability of the soil. The maximum animal population allowed. four tons of live animals per hectare under current Italian regulations, is therefore reduced in accordance with the agronomic and soil situation, so that waste disposal could be prohibited in vulnerable areas. For example, in the field of initiative for vulnerable areas, the limitations on animal breeding are quite clear: the amount of waste matter which can be spread on the land is 170 kg/ha in terms of nitrogen, which means a considerable reduction of live animal weight per hectare.

In order to reduce methane emissions in animal breeding, new technology should be acquired for the recovery of gas prodcued by breeding for energy purposes, so that the environmental impact can be reduced without affecting productivity, and even trying to maintain productivity at current levels. A further step could be the reduction of breeding facilities without land and the extension of facilities over larger areas. A continuation of current trends would lead to further damage to the environment and of resources such as the air.

With regard to land use, it should be stated that over the past 30 years forests have been increasing in Italy, both due to reforestation and to the natural spread of forests due to the abandonment of grazing land and arable land. It is hard to determine to what extent regulations N. 797/85 and 1272/88 regarding the application of set-aside policy have affected the evolution of Italian agriculture. An analysis of partial data shows that the set-aside policy has involved a slight percentage of the overall arable land area, and a type of farm which is not in line with average figures with regard to size. It is even harder to say what effects regulations N. 2078/92 and 2080/92 may have by 2000. According to ENEL estimates, the incentives to be applied in Italy over the next 10 years for the conversion of coppices with smaller trees into forests, planting poplars, commercially valuable wood and urban parks, which should lead to an estimated

10% increase in the wood mass. On the basis of studies by the University of Florence, setting the overall carbon in forests at 268 Mt, the amount of CO_2 removed from the atmosphere would be approximately 10 Mt.

The Italian forestry policy

The interventions under current Italian forestry policy are based on the National Forestry Plan, approved by the CIPE resolution of 2.12.1987

The Plan was created when the forests were decreasing and worsening in quality throughout the world. The forest ecosystem, manipulated by man, has been considerably weakened due to continuous, increasing deforestation with the resulting erosion of the soil and desertification, with negative effects on agriculture, on the conservation of animal and plant species and on climate change.

In Italy, the forests are mainly coppices, abandoned, in poor condition, highly fragmented, with low productivity, subject to forest fires and diease. Reforestation is rare, and the incresing abandonment of arable land has resulted in soil erosion and the lost of both the protective and the conservation functions.

The goals of the Plan basically regard the development of the functions of the forest, to protect and improve the forests, with a policy aimed at economic and functional enhancement.

The basic measures provided for under the Forestry Plan, for which Lit. 500 billion was allocated over a 5-year period (1988-1992) under Law N. 752/86, were as follows:

a) Maintenance and improvement of existing forests, with regard to the ecological and vegetation status, the defence of the hydrogeological resources, the maintenance and development of productivity and the technological characteristics of wood products;

b) Providing incentives to reforestation both on abandoned and wasteland and on fertile land abandoned by agriculture, encouraging valuable native species sich as cherry, walnut, cheestnut and cork oak trees;

c) The consolidation and development of efficient forestry for wood harvesting with poplarrs and other rapid growth species;

d) The improvement of forestry management, the development of mechanization, training, reseatch and promotional activities for Italian wood and wood products;

e) The promotion of forest and brushwood products, the development and improvement of parkland in and around cities.

The philosophy underlying the Forestry Plan is basically to achieve a balance between rational incentives and the management of forestry resources and respect for the forest ecosystem by measures to recover and improve forests and the environment in general.

On the Community level, Italian forestry policy is related to the application of regulations issued by the Council, basically regarding the reforestation of arable land, the exploitation of forests in rural areas and the improvement and marketing of forestry products, the proection of forests in rural areas and a system of forestry subsidies in the agricultural sector (respectively: CIPE Regulation N. 1609/89, N. 1610/89, N. 1612/89, N. 1614/89, N. 2080/92).

3.8 Types of options

The emission of manmade greenhouse gas can be reduced with many changes being made in human activities. Taking the national energy system into account, these changes can be divided into the following categories:

- Population reduction;
- Reduction of per capita economic development;
- Reduction of the demand for high emission services (e.g. energy services) under the same economic development rate by consumersa and producers (restructuring by reducing the demand for some services;
- Reduction of the amount of high emission goods (e.g. energy) which serve to satisfy the demand for services (e.g. energy saving by end users and the improvement of energy production efficiency);
- The shift of the supply of goods (e.g. energy) to lower (e.g. natural gas) or nil (e.g. renewable energy) forms of emission.

With some generalizations being made, these categories can be applied to the reduction of emission levels of all greenhouse gases in any sector.

The reduction of emissions has a duration depending on the category involved. When there is a reduction of economic development of in the demand in some sectors with taxation, there is an artifical reduction in emissions. As soon as the economy resumes growth, emission also rise again. The most long-lasting options are the ones involving the improvement of capital equipment, with

lower unit emissions for the good or service produced.

There follow some considerations of the technological options for the reduction of greenhouse gas emissions; Annex 5 shows a more detailed list of the options and a quantification of their economic potential for reduction.

Carbon dioxide

There are medium term technological options for CO_2 reductions in energy production (thermoelecrticity and hydrocarbon processing), end use of energy in industry (high and medium-low energy consumption) and in services (trade, services and transport), as well as household energy consumption (road transport and residential).

Within each sector, technological options are considered to be those technologies leading to a reduction of CO_2 emission for the same energy service provided. In general, technologies existing on the market are already developed have been considered; they number nearly 400, and refer mainly to industry and households. The technical potential of organization in transport is generally considered to be equivalent to technological options.

The technical potential for the reduction of CO_2 emissions is much higher in the end use of energy, accounting for three quarters of national energy consumption, as compared to production and processing. Annex 5 examines the sectors and technologies which seem to have the greatest technical and economic potential for energy reduction.

Methane

There are many technological options for the reduction of methane emissions in the energy system, although there is not yet a single standard for evaluating their cost and reduction potential.

The main parties working in the sector are conducting research projects to measure the real value of the losses and potential of the technology available for limiting methane emissions from components and sections of sample networks, i.e. primary and distribution networks. The results of this work will not be available till 1996. Until this time, information and figures on technical factors and related costs are not sufficient for assessing the technical potential, costs and policies for loss reduction, apart from current work on updating and reburbishing the oldest parts of the cast iron urban gas distribution networks.

Most of the distribution netowkr is new, and on the international level no

specific technology has been identified for improving the performance of modern networks, apart from some procedures to be carried outr in network maintenance. However, the refurbishing of the remaining 10% of the cast iron network - especially in urban areas - should lead to significant results by 2000 without significantly higher costs with respect to the ordinary renewal of capital equipment. Potential reductions of methane (and NMVOC) emissions can also be achieved with the diffusion of catalytic exhaust control, already provided for by existing regulations.

There seem to be more options for methane reduction in non- energy sectors, although the potentials and costs are equally or more uncertain.

Nitrous oxide

The options for the reduction of nitrous oxide are almost entirely related to agriculture. The evaluation of their potential (and emissions) is highly uncertain, and among the various farming practices affecting N_2O emissions from farmland and rice paddies we have only quantified the reduction deriving from the use of less nitrogen-based fertilizer.

3.9 List of measures adopted, due to be adopted or taken into consideration

Table 3.1: Regulations with effects on various sectors

Law N. 10/1991 and implementation decrees	The law is entitled "Regulations for the implementation of the National Energy Plan with regard to the rational use of energy, energy saving and the development of renewable energy sources. It is a complex law innovating Italian legislation by introducing a framework for sector regulations aimed at the efficient use of energy resources in all the end use sectors including the specific redution of energy consumption in porduction processes, and especially in buildings and heating plants. The rational use of energy is introduced as a criterion for the assigning of contracts for the supply of goods. The law provides for tax relief and the payment by local authorities of incentives to favor the adopting of the most efficient technological solutions.
CIPE Resolution 26.11.1991	"First guidelines for the coordination of public instruments in energy saving and the use of renewable energy sources"
ENEA-Ministry of Industry Agreement	Guidelines for research and development activity and technoligcal innocation in the energy sector, also providing instruments for a more in-depth analysis of national development strategy and the diffusion of more efficient energy technology.
Revision of the guidelines for new combustion plants (planned)	Introduction of environmental constraints requiring specific and/or lower emission rates, favoring new plants with high energy efficiency.
Regulations on the sulphur content of liquid and solid fuel (partly implemented and partly planned)	In order to implement Community directives, the minimum sulphur content in liquid and solid fuel is gradually being lowered. Besides reducing emissions of acid rain precursors, they make it possible to achieve higher efficiency in existing plants.

Table 3.2 - Energy supply sector

Law N. 9/1991 and corresponding implementation decrees	The law is entitled "Regulations for the implementation of the new National Energy Plan: institutional aspects, hydroelectric plants and power lines, hydrocarbons and geothermal plants, self-production and fiscal rules." The main innovations regard the liberalization of energy production from renewable and similar energy sources, especially with incentive to the production of energy from renewable sources, hiogh efficiency plants and the combined production of electricity and heat. The category of "independent producers" - absent in previous laws - was also introduced
CIP Resolution N. 6/92 and related measures e.g. Ministry Decree 4.8.94	This is one of the main implementation regulations of Law N. 9. It provides incentives for electricity porduction from renewable and similar energy sources such as highly efficient cogeneration of electricity and heat, by setting the concession prices to ENEL. In 1994 the concession of over 6000 MWe in new plant capacity was authorized.
CIPE Resolutions N. 26.7.909 and 21.9.93 (ENEL plans)	Authorization for the construction of new high performance power plants, both traditional and combined cycle, amounting to about 2400 MWe. Authorization of retrofitting for converting plants which are not yet obsolete into combined cycle systems, totalling 5000 MWe (including Montalto).
Decree of the Minister of the Environment of 8.5.89: Limit on nitrous oxide and sulphur from major combustion plants	Strict limits on NOx and SOx emissions for existing combustion plants exceeding 50 MW, with deadlines for the refurbishing.

Implementation of Art. 24 Law N. 10/91, plan for methane gas supply to Southern Italy, Ministry Decree N. 209 of 11.6.91 and CIPE resolutions of 20.7.91, 12,8,92 and 7.4.93.	A number of decrees and resolutions were issued to regulate national and Community subsidies to methane gas diffusion in areas prevously lacking this network, especially South- Central Italy. The overall extension of the transport and distribution network rose from 100,000 in 1985 to about 140,000 in '90 and over 155,000 in '93.
Decree of the Minister of Industry of 7.5.92 and subsequent implementation rules	In order to implement Art. 14 of Law N. 9/91, rules were issued for the granting of capital account contributions for initiatives for the reactivations, construction and expansion of hydroelectric plants.

Table 3.3 - Energy demand in the residential and commercial sector

Presidential Decree N. 412 of 26.8.93 (implementation of Law N. 10/91)	Regulations for limiting energy consumption with special reference to the design, installation, running and maintenance of heating plants. Verification and certification of energy performance rates of buildings are provided.
Implementation regulations: Ministry Decree 7.10.91 and 6.8.94	Revisions of minimum energy efficiency standards of the shell of newly constructed buildings, residential and non- residential, and the introduction of rules and methods of calculation for determining the seasonal energy consumption of buildings.
Ministry Decree 13.12.93	Approval of the forms for submitting the technical report stated in Art. 28, Law N. 10/91, confirming the respect of rules for limiting energy consumption of buildings.

Table 3.4 - Energy demand in industry

Presidential Decree N. 203/1988 of limiting the emissions of industrial plants and implementation decrees (Ministry Decree 9/10.7.94)	With reference to greenhouse gas emissions, regulations on limitation favor the use of primary sources with lower sulphur content leading to improved efficiency.
Circular of the Ministry of Industry N. 219/F of 2.3.92 and 226/F of 3.3.92 on the person in charge of rational energy use	In order to implemnt Art. 19 of Law N. 10/91, regulations have been issued on the compulsory appointment by companies with high energy consumption of an expert in charge of the conservation and rational use of energy.
Decree Law N. 619 of 7.11.94	Implementation of EEC Directive N. 91/156 and regulation of the re-use of industrial residue for productive purposes, with obvious benefits in terms of reducing the use of primary fossil fuels.
Decree of the Minister of the Environment of 29.9.94 "Technical regulations for the re-use of the residues of production or consumption cycles as a source of energy	Classification of products which are recoverable for energy purposes, definition of the general characteristics of the treatment cycles, the technologies to be utilized and the ceilings for the emission of air pollutants.
Decree of the Minister of Industry to implement Art. 12, Law N. 10/91	Implementation of the article providing for the granting of contributions for particularly efficient and innovative demonstration projects for the rational use of energy, with the "general classification of the applications allowable for consideration for the granting of contributions for the design and construction of plants with innovative characteristics in the sector of the rational use of energy and renewbale sources."

EEC Council Regulation N. 1836/93 on the voluntary membership of industrial enterprises of a Community scheme for co-management and auditing	A voluntary system is set up to enable industries to introduce and implement policies, programs and systems for environment management for their sites, for the systematic, objective and periodical assessment of the efficiency of these elements and for public information on environment efficiency.

Table 3.5 - Energy demand in transport

Expansion of the railway network and the construction of high speed lines	The implementation of a complex investment plan for improving the network, amounting to Lit. 88,000 billion by 200, of which approximately Lit. 39,000 is already covered up to 1998.
Integration with European transport infrastructures	Participation in the European program for major infrastructure netowkrs, intermodal services and systems, modal readjustment of demand between passenger and goods traffic via road and rail, intermodal goods traffic with the development of the railway combination. The completion of new Alpine tunnels is particularly important for Italy.
Expansion of the urban underground railway network	Construction of aboubt 25 km of new urban underground railway networks, the improvement of the existing lines and the construction of 1,250 km of light urban railways.
Definition and development of policy in the fuel sector	In the context of policies aimed at using alternative fuels such as methane or vegetable oil in urban areas for environmental reasons, a pilot program is under way on an industrial scale in order to supply limited amounts of fuel to urban transport systems. The product is cheap due to tax exemptions. The promotion of fuels reformulated with low aromatic hydrocarbon (especiallly benzene) contents.
Planned: Promotion of the replacement of the automobile stock with catalytic vehicles	Approximately Lit. 8-10,000 billion for purchasing catalytic exhaust treatment technology.

Planned: Drawing up of a policy for intermodal private- public transport and the protection of areas devoted to transport infrastructures	In the first case, verification is under way on the economic and social feasibility and the human factors involved; in the second case, measures for passive (building regulation and Highway Coe) and active (urban design) protection are being studied.
Planned: Definition of industrial support policy for planning mass transport, low emission vehicles	Support to environment-friendly redesigning of multimodal or hybrid mass transport systems, i.e. tramways, electric and other buses.

Table 3.6 - Waste management

1991 Agreements between the Ministry for the Environment and the regional authorities and the 1989-1991 3-Year Envirinmental Protection Program	Financing is provided for constructing disposal facilities for solid urban waste and for promoting differentiated waste collection. Thanks to these measures, the percentage of gas collected from disposal facilities could reach 50% by 2000. The availability of complex treatment technology should also increase, thus reducing dependence on disposal facilities from the current level of 90% to no more than 42% in 2000
Law N. 10/91 implementing the National Energy Plan	Promotion of the exploitation of the energy potential of waste materials.
CIP Resolution N. 6/92 and related measures	The incentives under the CIP Resolution will promote the installation of plants powered by biogas from waste disposal.
Protocol of agreement betweeen the Ministry for the Environment and FIAT (June 1993)	Provides for the recovery and recycling of automoble parts at the end of their life cycle.
Decree Law N. 619 of 7.11.94	Implementation of EEC Directive N. 91/156 and regulation of the re-use of industrial residue for productive purposes, with obvious benefits in terms of reducing the use of primary fossil fuels.

Decree of the Minister of the Environment of 29.9.94 "Technical regulations for the re-use of the residues of production or consumption cycles as a source of energy	Classification of products which are recoverable for energy purposes, definition of the general characteristics of the treatment cycles, the technologies to be utilized and the ceilings for the emission of air pollutants.
EU Directive on packaging	the Directive provides for the compulsory removal of 90% of the weight of discarded packaging from waste disposal facilities and recycling of at least 60% of the weight of each material. Within 5 years after the approval of the packaging directive by the Council, Italy must achieve the goal of removing 50-60% of the weight of packaging waste to be recovered (by recycling or for energy use) and of this 25-45% must be recycled.

Table 3.7 - Agriculture, forestry, change in land use

National Forestry Plan, approved by the CIPE resolution of 2.12.1987	The basic measures provided for under the Forestry Plan, for which Lit. 500 billion was allocated over a 5-year period (1988-1992) under Law N. 752/86, were as follows: maintenance and improvement of existing forests; providing incentives to reforestation, the consolidation and development of efficient forestry activities; the improvement of forestry management, the development of mechanization, training, reseatch and promotional activities for Italian wood and wood products; the development and improvement of parkland in and around cities.
EU Directive N. 91/676	Protection of water from nitrate pollution from agriculture by the reduction of nitrogen-based fertilizers.
EU Regulation N. 2078/92	Financial aid to let arable land lie fallow, reduction of fertilizer use.
EU Regulation N. 2080/92	Financial aid to reforestation in the agricultural sector.

Table 3.8 - Ratification of international treaties

Convention on long distance cross-border pollution	Ratified on 16.3.1983.
Protocol to the convention on the monitoring and evaluation program (EMEP) (Geneva, 1984)	Ratified on 28.1.1988.
Protocol to the convention for sulphur emission reduction (Helsinki, 1985)	Ratified on 2.9.1987).
Protocol to the convention on the reduction of nitrous oxide emissions or cross-border flows (Sofia, 1988)	Ratified on 19.5.1992.
Protocol on the COV convention (Geneva, 1991)	Awaiting ratification
Second protocol on the convention for the reduction of sulphur emissions (Oslo, 1994)	Awaiting ratification
Convention on the protection of the ozone layer in the stratosphere (Vienna, 1985)	Ratified on 1.1.1989
Protocol on the convention on substances damaging the ozone layer (Montreal, 1987)	Ratified on 1.1.1989.
Amendment to the Montreal protocol on substances damaging the ozone layer (London, 1990)	Ratified on 21.2.1992

Framework Convention on Climate Change (Rio, 1992)	Ratified under Law N. 65 of 15.1.1994, allocating Lit. 1,500 million in 1994 and 1995 for monitoring and updating national programs for stabilizing greenhouse has emission, as well as Italian collaboration in the IPCC, financing of the aid fund for developing countries and the fund for the operation of the Convention Secretariat.

4. ESTIMATES OF EMISSIONS AND ABSORPTION OF GREEENHOUSE GASES AND IDENTIFICATION OF THE IMPACT OF MEASURES

4.1 Economic estimates; energy estimates and uncertainty

The possible trend in the market and in energy consumption, rwhich accounts for over 50% of greenhouse gas emissions, has been assessed by using both a top-down and a bottom-up approach. The top-down scenario has been utilized to assess the global economic compatibility of the development of the Italian energy system. The bottom-up approach, basically using exponential models based on the trends over the previous decade to assess the trends in each of the sub- sectors of energy consumption, was used to verify the physical compatibility of production and consumption, especially in the electricity, industrial and transport sectors.

In order to estimate the trends, the bottom-up scenario trends are brought within the variable and macroeconomic compatibiliity highlighted in the top-down analysis, using a mixed approach.

4.2 Estimated scenario without measures

Top-down economic estimate

Energy consumption trends in this report have been caluclated using simple models making forecasts up to 2000 on the basis of the most recent trends in the energy system. The value of these forecasts basically depends on the type of development hypothesized for the basic independent variables, as well as on the estimated economic relationship between energy and economic variables.

In calculating the updated forecast scenario, we have postulated macroeconomic development and price trends which are an average of the numerous estimates contained in literature (see Table 4.1). With regard to the previous forecast in early 1994 (See Ministry for the Environemnt - Ministry of Industry "Progamma nazionale per la limitazione delle emissioni di anidride carbonica nel 2000 al valore del 1990", February 1994) the forecasts have basically been confirmed for all the sectors except transport, and therefore in oil refining, given the sharp rise in traffic from 1990 to 1993.

The hypothesis of a scenario for forecasting national energy consumption within the overall updated scenario (using an economic analysis model developed by the Enrico Mattei Foundation, ENI) takes into account the real trends in the

1988-93 5-year period in population (decrease), income (+2%), prices and technology.

Some of the variables shown in the table have a considerable impact on energy consumption levels (GDP, crude oil prices), and others have less impact (e.g. transport activity variables, generally parallel to GDP). Technology has less weight in the energy consumption forecasts, and is not included. The updated forecast scenario does not take into account the fact that laws, decrees and grants for the improvement of energy efficiency have reduced consumption while the other variable increase.

Table 4.1 - Hypothetical scenario

QUANTITY	**1990**		**2000**
	unit	values	trend
Population	millions	58.5	58
GDP (a)	L'90*10^12	1312	+2.0%
	billions ECU	862	-0.7%
Transport activites (a)			+2.2%
- Passengers	Pass.km*10^9	729	+2.4%
- Goods (b)	t.km*10^9	212	+2.0%
- Consumption			
International prices	ECU/barrel	18.1	14.8
- Crude oil	ECU/t	45	45
- Coal	ECU/Mbtu	1.8	1.8
- Methane			

a) Percentage of average annual increase in the period starting from the reference year (1990)
b) Excluding coasting trade

The growth hypotheses for the economic figures are shown both in Italian lire and in ECU. The values in constant lire reflect the forecast trends provided by the major statistical sources. Constant ECU values have risen much less since the lira has been devalued by approximately 23% between 1990 (1522 Lit/ECU) and the end of 1994 (1985 Lit/ECU); the latter figure is extrapolated up to 2000. Domestic energy prices in 1990 refer to residential contracts up to 3KW and 1800 KWh, and industrial contracts up to 60 GWh/year and 10 MW / 100-200 KV, derived from AIE/OECD statistics on Energy Prices and Taxes, 1992.

The values for transport activities in 1990, for which specialized literature does not provide standardized figures, are taken here from the "Conto Nazionale dei Trasporti", ed. 1994.

The population of Italy in 1990 included 840,000 foreigners (according the the hypothesis made at the National Conference on Immigration, 1990. It is assumed that the taxation level to be attributed to domestic energy price trends will grow at the same rate as average inflation.

Bottom-up analysis

Industry

In this sector, the approach followed was based on a relatively simple concept, aimed above all at identifying the trend underlying the market for finished and semi- finished products requiring high energy use. These products alone represent nearly 50% of consumption in the industrial sector, and about 60% in terms of primary energy consumption. For the other sectors, including the mechanical and textile industry, which are especially important for our economy, the trends in the individual product sectors have been assessed.

With regard to the high energy use products, energy consumption trends have been surveyed from 1985 to today for about 20 different finsihed or semi-finished products on the basis of energy consumption data for the sector and on the basis of the physical amount of products. Assuming the constant use of the main technologies used in 1990, market trends have then been forecast up to 2000/2005. For sectors where a direct link between product and energy cannot be identified, sales figures between 1985 and 1993 have been extrapolated on a constant technology basis. On the basis of technological information and historical trends, fossil fuel consumption has been kept constant, while electricity consumption has been increased in many sectors at an annual rate of 0.5-1% according to the current situation.

Total consumption in industry in this scenario is mostly in agreement with the overall macroeconomic estimates, and has been used as the basis for classifying consumption and the estimation of the technical potential for increased efficiency.

Transport: traffic and consumption

This sector has been studied at the POC General Directorate of the Ministry of Transport (which supplied the database created for the "Conto Nazionale dei Trasporti", ed. 1994, and other reports on specific sectors such as "Radiografia delle Ferrovie dello Stato". It provided coordination with the other General DIrectorates of the Ministry, the MCTC General Directorate and Civil Aviation.

Other organizations provided data for their own sectors: FS S.p.A., ACI, AISCAT and Alitalia.

The demand for goods and passenger traffic has been reconstructed on the basis of periodical studies performed by the POC and other statistical research (ISTAT, AISCAT, ANAS). Among the most important data used, special reference was made to energy consumption for transport. It should be recalled that total traffic data derived from all the sources quoted above should be considered as describing trends.

The analysis of historical data in the sector, and especially the most recent data, has shown a significant characteristic: the continuing growth of traffic even during the recent slowdown in the economy. In specific terms, while goods mobility has at least partly been affected by the economic crisis with constant levels in the 1991-1993 period, passenger traffic continued to rise, though at a slower rate than in the previous decade.

The increase in traffic is concentrated in the road sector, especially in urban areas, although there has been some recovery in rail traffic, especially for goods transport.

The historical analysis of passenger traffic shows that trends are not closely linked to the GDP, with a rate less than or equal to the 1973-1982 period (annual average traffic +2.9%, average annual GDP +2.8%, average annual real gasoline prices +3.0%) and a trend higher than in the 1983- 1992 period (annual average traffic +4.6%, average annual GDP +2.1%, average annual real gasoline prices -4.2%). It should be stressed that the analysis of the National Transport Statistics shows that the trend in passenger traffic is more closely related to household consumption and less statistically related to the GDP.

An important factor for explaining these different trends is the real price of gasoline, increasing in the first period and falling in the second period. In the first period, the expectations of the public were undoubtedly affected by the prospect of an immenent oil shortage. It should also be pointed out that in the same period ('73-'82) there has been a considerable improvement in the average efficiency of vehicles, whose influence on the total stock was not felt until the second period.

In accordance with the macroeconomic forecasts for the period 1990-2000-2005, with a trend towards a slight fall in real gasoline prices, a sharp increase in consumption is forecast for the period 1990-1995 (average annual +3%), already partly confirmed by the accounts. For the trends between 1995 and 100/2005, highly prudent percentage increases were considered, with an average annual growth rate of 1.3% in the period 1995-2000 and 1.6% in the period 2000-2005.

Goods traffic and its modal distribution was estimated separately for the road, railway, maritime and pipeline systems. Average annual growth rates basically correspond to the GDP trends, and estimated at 1.1% in 1990/95, 2.6% in 1990/2000 and 3% in 2000/2005.

In a recent study by the EU Commission - GD VII "EC Motorway network Perspectives, 2010 Horizon", 1992, forecasts are made for the increase in goods and passenger road traffic for all the EU countries including Italy. With an economic growth rate of 1.5% in the "low" scenario and 2.5% in the "high" scenario, average annual road traffic increases are estimated respectively at 2.4% and 4% between 1990 and 2010. As we can see, the goods traffic rate in the "low" scenario corresponds with the levels considered in this report, excpet for the recent slowdown in the economy. For passengers, the estimated growth rates correspond with the "high" scenario, despite the economic slowdown. Despite these estimates, it has been decided to maintain the passenger traffic growth rate already stated, and for the same reasons; the forecast of different real gasoline price trends compared to the previous decade, possible saturation of infrastructures - especially in the urban context - and the awareness that higher growth rates would lead to primary energy requirements which would be unrealistic and basically incompatible with with the amount which households could spend on transport.

Energy consumption forecasts

The updated forecasts involve consumption rates differeing from the NEP '88 "high" scenario from the quality point of view only, although in the 5-year period that part of the economy depending on external factors showed a different trend from the forecast one (see Table 4.1). On the one hand, the country's GDP growth rate was different; it is unlikely that the 1990-2000 GDP growth rate will exceed 2%, thus leading to a reduction in energy requirements in 2000.

The forecast price of oil for 2000 is approximately $15 per barrel. The total estimated electricity requirement is approximately 290 TWh (320 in 2005) and the primary energy requirement is estimated at 190 Mtep (196 in 2005).

According to the updated forecast, the end user energy requirement seems to have increased by approximately 5 Mtep, especially in order to satisfy the rising transportation demand. The forecast energy requirement for industry and energy production will fall by the same amount. As compared to 1990, the energy requirement in 2000 assuming constant technology would increase by 24% for road transport, 38% in services, 11% in residential uses and with a slight fall in industry due to structural changes in the sector.

The postulated primary energy requirements on a business as usual scenario is harder to determine, and could differ from the NEP '88 figures, especially with regard to the rise in methane supplies and the fall in coal consumption.

The amount of primary energy supplied by non-fossil fuels, both in this scenario in in the subsequent ones, must be seen from the aggregate point of view. It simply tends to confirm the hypotheses of NEP '88, without going into the details of the individual sources of non-fossil fuels. In any case, it seems likely that in 2000 electricity imports can compensate for any lower production from renewable sources.

Emissions from the energy system

Carbon dioxide

With the rise in energy requirements, the amount of carbon dioxide emissions from the energy system have also risen in the forecast of trends for 2000, on a constant technology basis. In order to distinguish the following considerations from the emission level chosen for the reference year (see the chapter on inventories for further discussion of the conventional standards adopted for the 1990 carbon dioxide estimates), reference will be made exclusively to the amount and percentage of growth.

According to the NEP '88 forecasts, CO_2 emissions in 2000 could rise by 65 Mt CO_2 per year compared to 1990 (approximately +16%), especially because it was thought that there would be a massive return to coal in traditional thermoelctric power plants. The updated scenario, although with constant technology, provides for a slower rise in CO_2 emissions - around 60 MtCO_2 per year (approximately +14%) - and for a more realistic growth rate for coal and a faster expansion of methane.

Electricity sector

On the basis of the 1990 situation, the increase in efficiency provided for under ENEL plans and automobile producers using new plants, already completed, under construction or planned for the near future. Further forecasts are also made for the period after 2000 on the basis of ENEL plans and current technologies. The average net yeild of fossil fuel facilities would rise from 27.8% in 1990 to approximately 39% in 2000, and could rise subsequently to approximately 40% if all the new plants are completed and the less efficeint facilities closed. Specific emissions per kWh consumed would fall from about 150 grams of C to about 145 (-6.5%) in 2000, and should stay constant after that date if the programs which have already been planned are implemented.

The primary sources for covering the fuel requirements are fuel oil, natural gas and coal, with a trend which should lead to the balance of the market share between the various sources if current energy priice trends persist on international markets. In any case, the main national producer has substantial facilities designed to utilize different primary fuel sources.

Finally, with reference to the average CO_2 emissions per kWh consumed, it should be pointed out that the latter are calculated with a nil emission estimate for imported electricity, coming mostly from France and Switzerland and produced by hydroelectric or nuclear facilities. According to the information available to the authors of this report, the contracts for th supply of this power do not extend beyond 2002, and the possibility that all the power now imported may be produced by the exisitng Italian facilities and using fossil fule. In this case, estimates for 1990 figures should have theoretically used additional fossil fuels, evenly distributed over those actually used, with an additional emission of approximately 25 $MtCO_2$. By 2000/2005, there would be additional emissions of about 17/16 CO_2 for the imported electricity, thanks to the greater efficiency of the facilities and the estimated higher percentage of methane. Average emissions per kWh consumed would rise from the figure of 145 g of C per kWh mentioned above to approximately 160.

Refinery sector

Forecasting in the refinery sector is complicated bnecause of its close link with transport and the current uncertainties on the type (diesel / gasoline) and environmental quality of the fuel required in 2000 / 2005. Generally speaking, total fuel consumption should rise together with emissions, since even if requirements are more or less stable between 1990 and 2000, consumption and specific emissions should rise considerably due to the probable need to produce clean or at least partially reformulated fiels, together with the percentage fall in fuel oil use.

Industrial sector

The trends in overall consumption and emission in this sector should fall slightly (approximately -1% in terms of final energy; emissions including electricity, -2%) with an incresing influence due tro electricity consumption. This situation arises from a low increase, and in some cases stability and/or reduction in physical porduction in energy- intensive sectors such as steel, chemicals and cement, more than compensated by the forecast growth in other sectors such as the textile and mechanical industry.

The main finished and/or semi-finished products, current specific energy

consumption, the most efficient technology now on th market and any other possible improvements have been identified for each subsector in order to define the "technical potential for higher energy efficiency." Wherever possible, the investments required to exploit the efficiency increase identified have been calculated, although due to the average working life of current plants it is not realistic to forecast the use of all the facilities available up to 2000. A realistic level of energy savings by 2000 is considered to be approximately 2 Mtep on an end user basis and approximately 6 $MtCO_2$ in corresponding emission reductions will be possible subsequently if measures are continued to promote the combined generation of heat and electricity and the introduction of more efficient processing equipment.

Civil sector

Final energy consumption (including electricity) is expected to rise by about 18% and emissions be about 20%. The rise in electricity consumption mopre than compensates for the considerable expansion of domestic methane (nearly 50% more) as a primary source for heating to replace fuel oil.

Options for intervention in this sector are based on regulations concerning the building standards for new homes and the refurbishing of existing buildings, largely promoted by Law N. 10/91 and the implementation laws.

With regard to electricity consumption, the trend is to introduce more efficient applicances and other equipment on the market.

In this sector, the required measures and policies can be implemented by 2000, but as in the transport sector, their effect on consumption will be apparent only in the subsequent period. According to forecasts, consumption in the individual sectors will rise up to 2000 and remain constant or fall slightly in the following years.

Transport sector

Both consumption (final energy) and emissions in this sector should increase significantly between 1990 and 2000 by 21% and 24% respectively. The reasons for this rise have been discussed in paragraph 4.2 in the section on estimated consumption trends, and are basically linked to the constant rise in goods and passenger traffic demand, mainly satisifed by road transport.

Intervention to restore balance to transport flows by ropad and rail and for the increase in the specific efficiency of the means of transport is unlikely to be completed by 2000. Paragraph 3.4 already provides a summary of the measures required for long term transport changes, providing for a system which is improved with regard to the consumption and use of resources.

An examination of the measures provided shows than most of them are long term, beyond 2000 in terms of implementation, and effects on consumption could occur even later (e.g. the renewal of the autombile stock). Measures could be possible by 2000 resulting in the saving of approximately 3 Mtep and 10 $MtCO_2$ by the renewal of the automobile stock, the promotion of goods transport by rail and measures for managing urban traffic.

Methane

Methane gas is the most relevant gas from the climatic point of view after carbon dioxide and exists in the atmosphere in much smaller amounts. It is also the main componnet (usually over 90%) of natural gas, which among all the fossil fuels is the most efficient from the energy point of view and with the lowest CO_2 emissions with respect to the final energy produced. For this and other reasons, it is forecast that methane use will expand considerably in the near future.

With regard to methane emissions in the atmosphere, losses from the energy system represent a significant source (9% of total emissions in 1990 according to CORINAIR). Given the importance of this gas from the climatic point of view, studies have been made on the major sources and time scale of these emissions.

It should first of all be recalled that the amount of greenhouse gases other than carbon dioxide emitted in Italy in 1990 have been identified with much less precision than CO_2 from energy sources; with reference to methane, uncertainty levels of up to 100% are common in the estimates of individual items and in aggregate figures. Given this fact, current estimates on methane emissions in Italy only give an approximate idea of the amounts involved (see Tables 2.1, 2.2, 2.3). Methane emissions from the energy cycle can be classified as direct and indirect. The former regard the release of gas from oil and gas wells and the transport and distribution of natural gas, and the latter mostly derivce from the incomlete???? combustion of the major fossil fuels.

There is still uncertainty in the value of direct losses from the natural gas energy cycle, estimated at over 90% in the transport and distribution stage and only 10% at the gasfields and in primary supplies. Data from the National Energy Budget 1988-1993, with additional data from the Ministry of Industry (1988-1993) leads to an estimate of the amount of gas unaccounted for between the inlet and outlet points in the medium-high pressure primary networks. TO this gas we should add the amount from urban distribution networks, not shown in the National Energy Budget - Ministry of Industry reports but existing in official statistics. Only part of the gas "unaccounted for" is actually a loss; the rest is

due to measurement differences.

Total 1990 losses can be estimated by the CORINAIR methodology at about 340 kt, of which 15% is due to the tapping of natural gas and oil pumping, 15% to the primary network and 70% to the low pressure distribution networks. According to other estimates (International Gas Union, IGU, Milan, June 1994) and real emissions due to the distribution networks accounted for about 140 kt in 1990.

Indirect emissions were estimated at 56 kt for 1990, mainly in transport (50%) and 20% in the residential sector.

Overall scenario

Tables 4.2 and 4.3 show the effects on CO_2, CH_4 and N_2O emissions for waste disposal, agriculture, changes in land use and forestry for the measures already examined in chapter 3. Tables 4.4 and 4.5 show estimates of these emissions for the reference year 1990 and for 200. For 2000, all the measures for reducing emissions from the non-energy sector have been taken into account (as stated in chapter 3), while the emissions for the energy system refer to the updated forecasts without any intervention (business as usual).

Table 4.2 – Projections of greenhouse gas emission from waste management (Gg)

IPCC category		**Year**	**CO_2***	**CH_4**	**N_2O**
6A	Landfills	1990	5096.2	1526.4	0.0
		2000	7026.0	909.6	0.0
6B	Wastewater	1990	0.0	33.6	0.0
		2000	0.0	49.6	0.0
6C	Other	1990	2185.4	51.4	0.1
		2000	9536.1	57.0	0.2
6	**Total**	**1990**	**7281.6**	**1611.3**	**0.1**
		2000	**16562.1**	**1016.2**	**0.2**

* CO_2 emissions regarding organic waste disposal are not included in the national total in accordance with IPCC/OECD, 1994 guidelines

Table 4.3 – Projections of emission and sinks of greenhouse gases from

agriculture, from land use change and from forestry (Gg)

	IPCC Category	Year	CO2 *	CH4	N2O
4A	Enteric fermentation	1990 2000	0.0 0.0	654.0 648.4	0.0 0.0
4B	Animal waste	1990 2000	0.0 0.0	887.0 879.4	0.0 0.0
4C	Rice cultivation	1990 2000	0.0 0.0	64.2 64.2	0.6 0.5
4D	Agricultural soils	1990 2000	0.0 0.0	157.5 157.5	56.6 45.3
4E	Agricultural waste burning	1990 2000	0.0 0.0	97.4 97.4	1.5 1.5
4	**Agriculture**	**1990** **2000**	**0.0** **0.0**	**1860.1** **1846.9**	**58.7** **47.2**
5A	Forest clearing	1990 2000	3670.0 3670.0	61.6 61.6	0.5 0.5
5B	Conversion of grasslands to cultivated lands	1990 2000	NE NE		
5C	Abandonment of managed land	1990 2000			
5D	Managed forests	1990 2000	-4040.0 -5040.0		
5	**Land use change and forestry**	**1990** **2000**	**-3673.0** **-4673.0**		

Table 4.4 – 1990 greenhouse gases emissions based on BEN (Gg)

Greenhouse Gas Source and Sink Categories	**CO_2**	**CH_4**	**N_2O**
Total (Net) National Emission	**387046**	**3900.2**	**123.6**
Total greenhouse gas source	**427446**	**3900.2**	**123.6**
Total sinks	**-40400**	**0.0**	**0.0**
1. All Energy (Fuel Combustion + Fugutive)	**402799**	**414.8**	**24.6**
A Fuel Combustion	402799	67.4	24.6
Energy & Transformation Industries	141383	4.8	5.5
Industry (ISIC)	85954	3.2	1.4
Transport	96570	28.4	8.7
Commercial/Institutional	13695	6.5	3.2
Residential	56580	10.7	5.0
Agricultural/Forestry	8112	3.4	0.4
Other	505	0.1	
Biomass Burned for Energy	2560	10.3	0.4
B Fugutive Fuel Emission	0	347.5	0.0
Oil and Natural Gas Systems		337.1	
Coal Mining		10.4	
2 Industrial Processes	**20977**	**2.0**	**35.2**
A Iron and Steel	0	1.2	
B Non-ferrous metal	0		
C Inorganic chemicals	0	0.0	
D Organic chemicals	4	0.4	35.2
E Non-metallic mineral products	20972	0.3	
F Other	0		
3 Solvent use			
A Paint application			
B Degreasing and dry cleaning			
C Chemical products manufacture/processing			
D Other			
4 Agriculture		**1860.1**	**58.7**
A Enteric Fermentation		654.0	
B Animal Wastes		887.0	
C Rice cultivation		64.2	0.6
D Agricultural Soils		157.5	56.6
E Agricultural waste burning		97.4	1.5
F Savannah burning			

5 Land Use Change & Forestry	**- 36730**	**12.0**	**5.0**
A Forest Clearing & on-site burning of cleared forests	3670	12.0	5.0
B Grassland conversion			
C Abandonment of managed lands			
D Managed Forests	- 40400		
6 Waste	**13630**	**1611.3**	**0.1**
A Landfills	5096	1526.4	
B Wastewater		33.6	
C Other	8534	51.4	0.1

Table 4.5 - Greenhouse gas emissions in 2000 on the business as usual basis (Gg)

Greenhouse Gas Source and Sink Categories	**CO_2**	**CH_4**	**N_2O**
Total (Net) National Emission **Total greenhouse gas source** **Total sinks**	**435710** **486110** **-50400**	**3300,8** **3300,8** **0,0**	**119.4** **119.4** **0,0**
1. All Energy (Fuel Combustion + Fugutive)	**463408**	**423,8**	**31,7**
A Fuel Combustion	463408	76,4	31,7
Energy & Transformation Industries	176187	4,6	8,2
Industry (ISIC)	82010	3,1	1,2
Transport	119031	35,0	12,0
Commercial/Institutional	18921	4,7	2,3
Residential	58641	15,3	7,1
Agricultural/Forestry	8112	3,4	0,4
Other	505	0,1	0,0
Biomass Burned for Energy	2560	10,3	0,4
B Fugutive Fuel Emission	0	347,5	0,0
Oil and Natural Gas Systems		337,1	
Coal Mining		10,4	
2 Industrial Processes	**19033**	**1,8**	**35,2**
A Iron and Steel	0	1,1	
B Non-ferrous metal	0		
C Inorganic chemicals	0	0,0	
D Organic chemicals	1	0,4	35,2
E Non-metallic mineral products	19031	0,3	
F Other	0		

3 Solvent use			
A Paint application			
B Degreasing and dry cleaning			
C Chemical products manufacture/processing			
D Other			
4 Agriculture		**1847,0**	**47,3**
A Enteric Fermentation		648,4	
B Animal Wastes		879,4	
C Rice cultivation		64,2	0,5
D Agricultural Soils		157,5	45,3
E Agricultural waste burning		97,4	1,5
F Savannah burning			
5 Land Use Change & Forestry	**-46730**	**12,0**	**5,0**
A Forest Clearing & on-site burning of cleared forests	3670	12,0	5,0
B Grassland conversion			
C Abandonment of managed lands			
D Managed Forests	-50400		
6 Waste	**20692**	**1016,2**	**0,2**
A Landfills	4651	909,6	
B Wastewater		49,6	
C Other	16041	57,0	0,2

Table 4.6 – Annual grow rate forecasts of energy consumptions and emission between 1990 and 2000 (1) (2)

Scenario / Measures	Development forecast 1990-2000	
	Energetic consumption	CO_2 emissions
1 Updated forecast trends	1.5%	1.4%
2a Supply side intervention	1.3%	0.9%
2b Demand side intervention	0.9%	0.4%

(1) Energy consumption reflects the overall primary requirement
(2) Emissions are net of bunkering, biomass and "non-energy uses"

4.3 Scenarios with the measures already implemented

Hypothetical scenario

The hypothetical scewnario for the two options examined in the document (see Table 4.6) are not shown, since energy consumption has not been calculated on an economic model, but rather by subtracting energy savings achievable by the use of more energy efficient technology from the consumption levels of the updated forecast trends. In any case, the two scenarios should not involve a different national and sector situation, since the only technologies taken into consideration are those with a current postive net value at the interest rates considered here (4% in real terms). Differences of only a few percentage points are forecast for the ratio between the expense for final energy consumption purchase and the expense for durable goods (the more efficient plants cost more in order to allow for lower energy consumption) and in the ratio between domestic energy prices as compared to the overall consumer price index (due to a lower factor of exploitation of production facilities).

Methodology

As already mentioned, the scenarios with inteventions have been set up using the bottom-up method, subtracting the effects up to 2000 of the technological options and policies being implemented from the forecast consumption and emission trends. Figures are on a half-yearly basis on order to ensure the interal correlation of consumption and emission in the scenarios with interventions.
Alternative scenarios can, if necessary, be created. It would only be necessary to identify the technologies and political measures concerned, calculate the aggregates of the corresponding energy savings and subtract them from the scenario which most resembles them and where they have not yet been included.

4.4 Estimates of the emissions of other greenhouse gases

As already stated in paragraph 2.8, the specific emission of CF_4 and C_2F_6 from Italian facilities for primary alluminum smelting are very low, since these plants, which have been recently restructured (1992) utilize prebake technology with point feeders for adding allumina, characterized by lower emission factors. National emission rates should also be further decreased due to the trend to shift energy intensive production to developing countries. On the basis of this trend, the primary smelting of alluminium has already fallen in Italy in recent years. According to estimates by producers, it should be stable up to 1997-1998 and then fall, stabilizing at around 120,000 tons in 2005.

The following table shows the production data assumed as the basis of CF_4 and

C_2F_6 emission estimates from primary alluminum smelting plants on the basis of the previous considerations.

Table 4.7 - Primary alluminum production and CF_4 and C_2F_6 emissions in 1995 and 2000

Year	**1995**	**2000**
Production (t)	160,000	140,000
CF_4 emissions (kg)	9,600	8,400
C_2F_6 emissions (kg)	960	840

Forecasts are much more uncertain for HFC for two reasons:

a) The European and national regulations on CFCs and HCFCs, which will determine HFC use, are still being drawn up;
b) Sufficient information is not yet available on the characterization of the procedures for releasing the products into the atmosphere in relation to the varous uses.

In order to assess HFC emissions into the air in 2000, a survey has been conducted at the main Italian users of these materials in order to identify the amounts used for producing goods and services, the percentage used on the Italian market, the average product life, emissions from production processes and emissions in the life cycle of the products.

On the basis of this survey, emissions in 2000 for HFC-134a only have been estimated at 1,923 t, of which 52% refers to its use in aerosols, 42.5% in refrigeration, 3% in air conditioning and 2% in fire-fighting equipment.

4.5 Contribution of national emissions to radiative forcing

In order to assess the overall effectiveness of the measures surveyed thus far, to compare the effectiveness of the measures for the various greenhouse gases and to identify the priorities for any future intervention, the emission rates of the gases studied in the scenarios stated above have been multipled by their global warming potential (GWP), utilizing the figures supplied in the recent IPCC report entitled "Radiative Forcing of Climate Change" (IPCC, 1994). The

results obtained are shown in Table 4.8

The non-energy emissions shown in the table take into account all the measures for reduction taken into consideration in chapter 3, with the effects surveyed in Tables 4.2, 4.3 and 4.5. With regard to CO_2 emissions from the energy sector in 2000, reference has been made to scenarios 2a (supply-side interventon) and 2b (demand-side intervention), illustrated in Table 4.6, rather than to the forecast trends without intervention.

While taking into account the highly uncertain nature of GWP factors (generally +/- 35%), the table shows some obvious results:

1) The significant impact of interventions for the reduction of methan emissions, especially over a 20 - year period;

2) The significant impact on increasing radiative forceing by HFC-134a emissions;

3) The possibility of achieving the goal of limiting the national contribution to global radiative forcing in 2000 over a 20-year period by implementing all the measures stated in scenario 2a, over 100 years with most of the measures in scenario 2b and in 500 years consiereding all the measures stated in scenario 2b.

Table 4.8 - Contribution of national emissions to radiative forcing *is not electronically available*

Note: Global warming potential rates are supplied in "Radiative Forcing of Climate Change - The 1994 Report of the Scientific Assessment Working Group of IPCC"

5. VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

5.1 Introduction

The earth's climate is a constantly changing system according to different astronomical, physical and chemical factors. It is only over the past 100 years that human activities have been so extensive as to have a direct impact on the climate. Emissions of combustion products into the atmosphere have caused a change in the earth's radiative characteristics.

The temperature of the air, rainfall, and all the weather- related environmental parameters may vary, through a complex set of interactions, according to the earth's radiative characteristics.

Temperature measurements, which go back several decades and in some cases to the beginning of the century, show an average global temperature rise of 0.3-0.6xC over the past 80-100 year and the occurence of one of the century's hottest years in the last decade. The temperature rise cannot, however, be attributed in a statistically significant way to the hypothesis of climate change caused by man. Temperature changes are still within the range of fluctuation which cna be attributed to natural climate changes. It is thought that no experimental evidence on global climate change will be available before the end of the century or, according to the effectiveness of any measures for the reduction of emissions, before the middle of the next century.

5.2 Global climate changes

In 1990, the Intergovernmental Panel on Climate Change (IPCC) published its first report entitled "Climate Change - The IPCC Scientific Assessment" providing four hypothetical scenarios for the emission of the major greenhouse gases on the basis of diferent economic, technological and population growth assumptions. In 1992 the IPCC pubished a second report entitled "The IPCC Supplement Report" which updated and partially modified the scenarios on the basis of more recent data. These scenarios are still the main point of reference for the assessment of future atmospheric emission levels up to the year 2100.

The main scenario is the one often called "business as usual" in which energy consumption up to 2100 is forecast without any emission controls.

The climate change modelling shown by the IPCC in the 1990 report and in the 1992 updating is mainly based on two working hypotheses:

1) Imminent doubling of the CO_2 rates in the atmosphere;

2) Gradual increase of the amount in the atmosphere at an annual rate of 1%.

Modelling of climate change in the first case utilizes general circulation models (GCM) of the atmosphere, while the second scenario utilizes combined general circulation models of the atmosphere and the ocean.

All the simulations performed by different models agree in showing a trend towards the warming of the lower layers of the atmosphere and a resulting worldwide increase of rainfall and evaporation.

Average global estimates for temperature increases under the first two hypotheses, once an equilibrium has been reached, are between 1.5xC and 4.5xC with an estimated average level of 2.5xc. Applying this result to a real year is highly uncertain, and depends on the scenario which is assumed. According to the "business as usual" scenario, the doubling of CO_2 would occur in about 2020, and it is therefore realistic to hypothesize that the estimated increase under these conditions could represent the conditions which would occur at least a decade after this date.

Modeling carried out under the second hypothesis with combined atmospheric and ocean circulation models shows a more realistic climate pattern, though it introduces further assumptions and doubts. The results nevertheless confirm the trend towards global warming, with 60% of the forecast warming level with a doubling of CO_2 when a balance is reached. The lower warming level is due to an improved modeling of the effect of the thermal inertia of the oceans, which would not reach an equilibrium at the same time as atmospheric CO_2 doubling.

The 1992 IPCC report thus confirms the trend towards average global atmospheric warming, without, however, being able to provide sufficiently reliable paramaters as to the extent to which this global warming will occur.

Although climate modeling systems are highly complex and require supercomputers to run them, they are still based on highly simplified with respect to the real world they try to describe with mathematical models. This is why the results of climate modeling must not be taken as "forecasts" but rather as possible scenarios, i.e. descriptions which are internally consistent and physically coherent with possible future climate scenarios.

5.3 The Italian situation

Italy has a temperate climate with heavier rainfall in the winter (triple cycle) than in the summer; local climatic conditions depend closely on the topography. The sharp contrast between winter and summer rainfall also affects all the seasonal weather cycle variable. Since the Italian peninsula extends for a considerable distance from North to South, the North has lower temperatures and higher rainfall levels than the South, which has a warm, dry climate.

Rainfall is mainly associated with the transit of Atlantic storm fronts, which are significantly affected by orographic features.

The Mediterranean climate is therefore partly determined by large-scale atmospheric circulation, and partly by interactions due to local effects. Climate changes due to greater amounts of greenhouse gases will affect atmospheric flows, though their effect depends closely on local conditions. Since the circulation models have a low geographical resolution, and cannot provide a realistic picture of regional characteristics, the model of the Mediterranean - and therefore of the the Italian - economy is inadequate.

Despite all the limits of the current state of the art in climate modeling, the following conclusions can be drawn from the data currently available for the period 2025-2030:

I) The Mediterranean basin will undergo a warming process over all the months of the year of between 1.2 and 3.5xC;

II) The outlook for the rainfall scenarios is less consistent than the one for the temperatures. In general, it can be said that summer rainfall will decrease throughout Italy, while winter rainfall will increase in the North and be stationary or lower in the South. The range which can be realistically estimated is +/- 30%.

III) In accordance with global estimates, the expected change in the Mediterranean sea level is 12-18 cm.

5.4 Vulnerability

A possible climate change scenario, little studied up to now, could combine a slow, gradual change in average values, reflected in the rise in the frequency and intensity of extreme weather phenomena.

Environmental vulnerability of Italy's various climatic areas varies according to current environmental and socio- economic features. For example, possible

climate changes could affect the following sectors:

- Water resources (for fresh water supplies);
- Agriculture (soil humidity due to lower rainfall and higher evaporation rates;
- Public health (a rise in respiratory disease);
- Fishery resources (possible changes in fishery resources);
- Forestry resources (higher forest fire risks).

Currently, no quantity forecasts can be made in these sectors, but the risk factor is high.

Although it would be arbitrary to cite one scenario only, paragraph 5.5 highlights the fact that the South and the Islands would be more vulnerable to environmental changes involving a drier climate or phenomena such as rising sea levels. While in the South the risks affect agriculture and the water supply, the North is less vulnerable to climate change but more vulnerable to specific risks such as in the Venice Lagoon, coastal tourist areas or areas with particular environmental degradation.

5.5 The impact on Italy of the hypothetical climate changes

Climate changes triggered by the doubling of CO_2 in the atmosphere, suggested in the scenarios obtained by the development of climate models (see paragraph 5.2) woulf have an impact on Litaly. This impact, though clear from the quality point of view, cannot be defined from the quantity point of view with the scenarios currently used.

These climate change scenarios in the case of the doubling of CO_2 show an average annual global temperature increase of between 1.5 and 4.5xC, while the increase in Italy would be between 1 and 3xC. Rainfall would decrease in South-Central Italy and rise in the North. Generally speaking, rainfall would be more variable both in the amount and the frequency.

The consequences and extent of the impact of these changes on Italy appear to depend on both national factors such as the country's physical and geographical characteristics, and on the type of land use and human activities.

The rise in sea levels appears to be the most immediate consequence of the temperature increase; it is thought that sea levels may rise between 12-18 cm

over the next 30-40 years, mainly due to the thermal expansion of the seawater. The rise in sea levels would therfore produce effects on coastal areas.

Changes in rainfall and temperature affect the hydrological balance, and therefore water resources and soil characteristics, and the consequences could be felt throughout the country.

Impact on coastal areas

A rise of around 20 cm in the sea level would lead to the flooding of very low coastal areas and coastal marshes, accelerate coastal erosion, increase salinity in estuaries and deltas and produce a higher infiltration of salt water in the coastal groundwater.

Low coatal areas would be more subject to flooding in the case of weather producing unusually high waves; the outflow of rivers into the sea would be impeded, thus increasing the chances of overflows and flooding in case of high waters.

The results of these changes can be summarized as follows:

- The flooding of coastal areas by seawater could lead to the loss of fresh water and saline marshes, which are important for fishing, and could also reduce arable land areas. Considering that the lowest coastal areas are mainly river deltas, the heaviest impact would be in the following areas: the lowest part of the Po valley in the Veneto region from Romagna to Firuli, the northern and southern coasts of Tuscany, the Tiber delta and the Pontine area of Lazio, the lower Volturno Plain in Campania;

- The infiltration of seawater into groundwater, besides the areas mentioned above, could also affect the entire coastline where there are fresh water reserves interacting with salt and briny water;

- Accelerated coastal erosion would lead to the loss of significant beach areas for leisure purposes and damage to tourist and residential facilities near or on the beaches themsevles;

- Barriers in coastal and reclaimed areas, near or under sea level, will require modification and adaptation.

The impact on the coast could be even more serious if a decrease in rainfall, a decrease in river flow volumes and an increase of inflitration in coastal groundwater all occurred at the same time.

It should also be pointed out that the rise in sea level of about 20 cm on a

worldwide level could be higher or lower in particular coastal areas due to local factors. Some areas are subsiding due to natural or human causes, while other may rise due to tectonic and isostatic factors.

In areas subject to subsiding, the rise in sea levels could be much higher than the estimated levels due to the sinking of coastal land. Areas subject to subsiding generally include low coastal plains and in particular the lowest parts of the Po valley in the Veneto region from Romagna to Friuli.

In rising areas, the fall in sea levels could be much lower.

Impact on environmental degradation and on the hydrological situation

The effects of the climate changes hypothesized here on environmental degradation and on the hydrological balance appears to be easy to define. The assessment of the relaibaility of the hypothetical scenarios cannot be discussed in detail. However, the main expected effects could be highlighted, with the conclusion that the impact of changes in temperature and rainfall could be much more significant in Central and Southern Italy and the Islands than in Northern Italy. The extent of the effects on a loca level also depends on the geology and geomorphology, the characteristics and use of the soil etc.

The hypothetical reduction of rainfall in Central and Southern Italy and the Islands, associated with a significant rise in average temperatures, would seem likely to trigger aridification. These processes, whose extent cannot currently be estimated, will produce effects varying in degree according to the location as a result of local morphology, lithology and pedology.

The main effects of aridification on soil and water resources are as follows:

(1) Greater soil degradation due to the effects on organic substances and soluble salts, and to the lack of humidity;

(2) Heavier soil erosion due to their lower absorption capacity;

(3) Heavier erosion on slopes, especially with unusually heavy rainfall;

(4) Heavier erosion in streams;

(5) Greater sedimentation and lower flow volumes in larger rivers;

(6) The fall in solid transport rate in the larger rivers;

(7) Changes in riverbeds;

(8) Deposition of new alluvial sediment or the alteration of existing deposits;

(9) A fall in the avergae flow rate of rivers, with some seasonal streams becoming ephemeral;

(10) A fall in the replenishment of groundwater supplies;

(11) An increase in the concentration of substances harmful to health in rivers or groundwater due to less dilution and to a general worsening of water quality.

This survey of the effects on the soil and on the hydorlogical balance in areas subject to aridification highlights how serious the impact could be on agricultural production, hydraulic works, the vulnerability of human settlements to flooding, the impact on water resources and energy production etc.

The impact of the changes hypothesized here could be reduced in various ways, undertaking preventive structural measures and planning changes in the exploitation of land and water resources. Nevertheless, the changes could produce damage which it would be hard to control.

With regard to Northern Italy, the scenarios invole a possible rise in rainfall or the stability of current levels, as well as a rise in temperature. Rainfall, however, could be more variable, with more frequent heavy storms. One of the possible climate change scenarios involves a possible rise in rainfall in the winter and a lower fainfall in the summer.

Maintaining or increaseing rainfall to a level higher than the current one, but with higher temperatures, could also lead to losses in water supplies due to lower soil humidity. Even if this did not occur, the changes in the intensity and the seasonal patterns of rainfall could trigger effects similar to aridification, though not as serious. In particular, the changes discussed in these scenarios could have the following effects:

(1) Lighter snowfalls and faster melting of moutain snow;

(2) Shrinkage of glaciers;

(3) Heavier river flows in the winter and lighter flows in the summer;

(4) Summer drainage of groundwater due to rivers;

(5) Lowering of water quality;

(6) Soil degradation.

Problems would arise due to the more frequent occurence of serious flooding, problems for agriculture, energy production and perhaps for winter tourism. The possible effects would, in any case, occur to varying extents in environments with differing geological, morphological and pedological characteristics.

River plains not subject to flooding could be less affected by these changes due to their greater geomorphological stability. Since groundwater is constantly replenished even though rainfall is mainly concentrated in the winter, lower water levels in irrigation canals due to the fall of river flows in the summer could be partially compensated by groundwater seepage.

On the whole, in the scenarios proposed here, Northern Italy would be less affected by climate change than Southern and Central Italy, and it can be assumed that these consequences could be dealt with by taking suitable measures in agriculture and for hydraulic works.

Impact on earth ecosystems

Following a probable climate change due to the greenhouse effect induced by man, the scenarios include a rise in the average air temperature which would have less impact on the ecosystems in Northern Italy (the Central European region) than in Central and Southern Italy and in the islands (Mediterranean region). In the Mediterranean region, it can be forecast that given the altitude factors, the biotic community in the Mediterranean region would not be directly affected, since the plant specieis are highly adapted to water shortage.

In the Central European and Sub-Atlantic biotic community, a degeneration is forecast in native species with the invasion of heliophyte and xerophyte species such as Quercus ilex, Quercus pubescens etc.

Eight biotic communities have been identified which are considered to be especially vulnerable to climate change, almost all of them in the Mediterranean - high mountain area, the Alpine area, forests in plain areas with Quercus robur and Carpinus betulus, river bank and stream basin forests with Alnus glutinosa and Fraxinus oxycarpa, marsh vegetation and moor vegetation. The survival of these habitats depends on the presence of surface water, and a fall in average humidity and a rise in evaporation triggered by the rise in average temperatures would lead to the rapid reduction of these biotic communities and their possible disappearence.

Pinus mugo and Vaccinium myrtillus shrubland in the Appennines, Sesleria tenuifolia high meadows in the Central Appennines, high meadows in Mediterranean mountain area, Silene acaulis and Kobresia myosuroides Alpine tundra in the Central Appenines are characteristic of cold weather areas with

very low winter temperatures. A rise in average temperatures would threaten these habitats, which would undergo the invasion of species adapted to higher temperatures, more competitive compared to the original ones (see Annex 4).

Conclusion

The assessment of the impact of climate changes surveyed in the scenarios considered here highlights the fact that negative effects are likely in Italy, and would be more extensive in Central and Southern Italy. Currently, the extent of the numerous phenomena which would be triggered and which are described above cannot be assessed. The only certainty is that if the rise in global sea levels and the other hypothetical scenarios occur, the main consequences will be the ones described here.

The effects of the rise in sea levels have already been verified in subsiding areas. The effects of aridity, similar to the ones that could affect Southern Italy, are quite clear in many countries in the Mediterranean area.

Paleo-climate studies on Italy show that, in the recent geological past, periods of greater dryness and/or more irregular distribution of rainfall have occurred, and have produced effects similar to the ones which could occur after future climate changes.

5.6 Implications of climate changes for the Po Delta and the Venice Lagoon

Considerable attention has been devoted by IPCC studies to the rise in sea levels and the related impact. In particular, Working Groups I and II, together with Working Group III, have dealt with the following areas:

- The increase of the scientific understanding of the phenomenon;

- The identification and assessment of the adaptation strategies most suited to dealing with the problems which would occur.

The main problem regarding the coastal regions is their gradual degradation, associated now more than ever with a greater economic development and increasing population pressure.

Threats from frequent flooding, coastal erosion and pollution have not slowed down the process of development and building up of coastal areas. The benefits from the use of the numerous marine resources continue to attract individuals and groups, with obvious, serious consequences for the coastal environment. In particular, human activities at river deltas such as the construction of dams or

the continuous pumping of water and oil lead to problems of erosion, subsidence and the infiltration of salt water.

Potential sea level increases could make these critical situations even worse and add further problems to the ones affecting coastal areas. The scientists of the IPCC WOrking Group I have forecast a rise in sea levels of 12-18 cm by the year 2030. These changes would be partly due to the melting of land glaciers and partly to the thermal expansion of sea water.

The most significant effects would be a rise in more frequent and more serious flooding, with a negative impact on human safety and the coastal environment. The phenomenon would be extremely serious in the smaller islands, low-lying coastal plains and river deltas. In these areas, of which there are many in Italy, flooding would make many areas which are now heavily populated uninhabitable.

Given the importance of the coastal areas in terms of environemntal, social and economic significance, the IPCC has stressed the importance of measures targeted towards improving planning strategies in these areas.

Some major goals have been identified, such as better information on the physical processes involved in the phenomenon, the development of global, national and regional monitoring systems and consequently the identification of the threatened island and coastal areas. The reports also propose the coordination of efforts for the joint, integrated adminsitration of resources through studies conducted on the local level.

Other basic points regard training to promote awareness of the problem among the public; the availability of technical and financial tools for research; the implementation of protection plans taking into account the different requirements and different financial potentials of each country; the allocation of international funds to developing countries and the adoption of a common Convention and the setting up of an international organization to coordinate and facilitate these tasks.

With regard to Italy, the importance of coastal areas is reflected by their extent: 7,500 km of coastline of which 3,250 km in beaches. Particular attention should have been paid to these areas, subject to the natural vulnerability of land-sea interaction; instead, they have undergone intensive, uncontrolled development.

Between 1951 and 1990, the population of coastal towns in Italy rose by 4,600,000 people, increasing from 26.7% to 30% of the population. Population pressure is then coupled with the seasonal rise in population and the physical pressure of the increase in building for residential and tourist use.

Coastal erosion in Italy is significant (just under 50% of the total coastline, according to estimates by the Department of Earth Sciences of the University of Rome). The most significant man-made factors are the gradual change in the coastal environment by the massive "paving" of widespread areas and the reduction of the silt carried by rivers due to canalization and similar measures.

As stated in the previous paragraph, the most vulnerable area in Italy is the Northern Adriatic seacoast, extending for 845 km. Despite the many river deltas, the coastline has teneded to receed over this century. This process has been aggravated by drainage and the removal of gravel from riverbeds in alluvial areas near the coast. In this context, we will refer breifly to the Po Delta and the city of Venice, which represent the most serious aspects of the crisis in the Northern Adriatic environment.

The Po Delta is characterized more by the low energy level of the river flow than by the silt it carries. Starting from the 1950s, the increase in the amount of water, liquids and natural gas pumped for agricultural, urban and industrial use in the Po Delta has led to the acceleraton of natural subsidence in this area. Land levels fell by an average of 54 cm between 1959 and 1975, so than most of the Po Delta is under sea level.

The impact will be assessed in terms of environmental problems such as the significant change in rainfall and river flows, the problems related to overflow and subsidence, and saline infiltration of coastal groundwater. Together with all this there are the other serious problems such as intensive urban development, the existence of ports with seagoing traffic and agricultural and industrial activities which should be relocated.

With regard to the Upper Adriatic, including areas of great economic, industrial and commercial importance such as Porto Marghera, Ravenna and Chioggia as well as a city of incomparable historical and artistic value such as Venice, precautionary measures should be taken despite the scientific uncertainty as to the sea level rise; these measures have been started but are far from being completed.

Over the centuries, natural subsidence and rising have occurred. The impact of various human activities has been added to these natural processed over the centuried, including intervention in the Venice Lagoon starting in the 1950s, often based on wrong development policies for the entire lagoon area. The petroleum and chemical industry dates back to that time, and eliminated increasingly large areas of living marsh areas for the expansion of tides. In order to build industries, inlets and inland navigable canals were excavated up to depths of 15-20 meters in order to allow for maritime transport of raw materials and freight. The industries led to increasingly serious pollution and, up to the 1970s, to the increasing pumping of groundwater resources (up to 300,000 per

day) in order to meet the rising demand for water.

The combination of these measures has lead to the sinking of the whole city by approximately 25 cm, as has been confirmed by the extensive, accurate geological research conducted from the 1950s to the present by the CNR Laborator for the Dynamics of Large Masses in Venice. These studies have shown that in some areas such as the Venice Lido the ground level is sinking by 8 mm per year, a level higher than the rise in sea levels forecast by WGI of the IPCC.

Despite this data, the problem of saving Venice was highlighted after the flood of November 4th, 1966. Since then, with the pressure of public opinion, scientists and politicians have been trying to determine how to protect the city and the lagoon from rising seawater.

Two goals have been pursued since then:

- Defending Venice from "high water";
- Respecting the ecological and environmental equilibrium of the Venice Lagoon.

A number of solutions have been studied since then.

The first law on Venice dates back to 1973, but the government commission of experts for the protection of the lagoon was not appointed until 1981. A project was then proposed and approved for installing pontoons to control flow rates at the three tidal inlets to the lagoon.

In 1984, another law for Venice was approved, and the "Consorzio per Venezia Nuova" was set up. In October 1989, this Consortium launched the REA Project (restoration of environmental balance) to conduct reseatch on the defence of Venice and the lagoon environment. The study provided for basic theoretical analyses based on simulation and mathematical and physical modelling, with the aim of:

- Safeguarding the inhabited area and the art treasures;
- Controlling changes in sea level;
- Safeguarding the ecosystems.

Since then, there have been more studies and proposals made by experts, but the 1981 project has not been basically modified.

It is hoped that the impact due to a possible rise in the sea level can be overcome by Venice. Much depends on the future development of the city in terms of popuation pressure, since while the resident population has fallen by 50% - from 130,000 to 73,000 over the past 25 years - there gas been a rise in tourist flows which has affected the structures of the lagoon.

The international community has also been involved in safeguarding Venice, through the cooperation protocol for safeguarding the Mediterranean, signed in Rome in Ocober, 1992. The aim is to develop measures for the protection of the Italian coastlines, the Venice Lagoon and the lagoon ports in the context of initiatives for safeguarding the Mediterranean.

On the national and local level, public and private organizations and universities have been involved in studies on Venice. Awareness of the problem should, however, be increased through educational programs on the safeguarding of the sea and the coast, and by overcoming political mistrusts and bureaucratic obstacles.

Italy believes that in both of the cases analyzed here - the Po Delta and the Venice Lagoon - the following reseatrch projects and working proposals are required:

- Monitoring at different levels to record the most important climate and oceanographical data;

- Collection of reliable, updated socio-economic data which can be correlated with existing data;

- The analysis and quantification of the impact of climate chane on coastal areas through analysis and modelling;

- The analysis of the various adaptation strategies required to minimize damage caused by the sea.

6. TECHNOLOGY AND FUNDING

6.1 Introduction

International cooperation is essential for implementing the Framework Convention on Climate Change. The commitment of individual countries is important, though not enough for achieving the goals of the Convention. Italy is involved in a number of activities through bilateral, multilateral and multi-bilateral agreements aimed at strengthening international cooperation on climate change. These activities are aimed mainly at aiding public and private institutions in developing countries to create or improve their productive, scientific and technological infrastructures and human resources in order to facilitate the introduction of innovative technology targeted towards the promotion of long term sustainable development, thus implementing Agenda 21.

As part of these goals, Italy will also make a contribution to assist developing countries to meet their commitments under the Convention, consistent with their national priorities.

Within international cooperation, Italy strongly favors a coordinated approach among the various multilateral and bilateral efforts. Italian cooperation efforts are in fact strongly linked to those of the European Union and of other multilateral organizations active in climate change progams.

6.2 Bilateral cooperation

Italian's bilateral assistance to developing countries amounted to approximately $2,430,450,000 in 1992 (of which $1,265,470,000 in grants and $1,164,980,000 in aid loans) and $1,930,120,000 in 1993 (of which $1,368,150,000 in grants and $561,970,000 in aid loans).

Projects and programs with an environmental dimension have been progressively included into Italian bilateral cooperation programs and projects over the last several years. Additional attention has been given to environmental concerns in preparation and follow-up to UNCED 1992. In fact, a methodology for environmental impact assessment of development projects has also been set up by the Italian Ministry for Foreign Affairs with particular reference to energy projects and their global environmental effects.

In 1992/1993 several projects and programs incorporating environmental concerns relevant to climate change have been launched and others are in the pipeline.

Precise and detailed information is rather difficult to gather and analyze given

the cross-cutting nature of environmental and climate change activities, which are often built into other project categories. Agreed upon classifications are necessary, particularly for inter-country comparisons.

Energy sector

Energy has been a priority area for Italian development cooperation over recent year. In the 1992-1993 2-year period, Italian government aid in this sector totalled $273,300,000 (of which $28,260,000 in grants and $245,040,000 in aid lonas) according to official OECD-DAC data.

A considerable number of these projects covers the development and application of renewable energy technologies, energy efficiency and energy training thus contributing to the reduction of overall gas emissions through the substitution of fossil fuels with renewable energy sources.

Besides the numerous, important initiative of Italian industries, we should cite some of the pilot or research and development projects regarding renewable energy:

- Development of gassification plants for agro-industrial residue in China in order to reduce fossil fuel consumption and avoid harm to the environment from untreated residues;

- Development of renewable energy programs for isolated communities in Egypt;

- Planning for the introduction of renewable energy sources and personnel training in Albania;

- Development of small hydroelectric power plants in Peru and Argentina and geothermal plants in Indonesia;

- Measures for the improvement power plant efficiency in Bangladesh, Syria, Guinea, Peru, Morocco and Zimbabwe;

- Regional and national training courses and specialized seminars on renewable energy sources and techniques for rational energy use in the food, agricultural and industrial sectors in developing countries and, more recently, in Eastern European countries.

Afforestation and forestry management

In the field of forest management, Italy is committed to promoting sound

natural resource management to limit deofrestation, to improve land use practices thus reducing carbon emissions. In this area Italy cooperates with several countries.

Examples are:

- Forest management and wood production in Argentina;

- Support to local communities for the conservation and management of natural resources in the Peruvian Amazon forest by reearch activity for identifying the procedures for the rational use, processing and trade in forest resources compatible with safeguarding the environment;

- Multi-sector programs for agricultural and forestry services to assist farming organizations in Bolivia;

- Pilot project for integrated agro-forestry development in Costa Rica;

- Agro-forestry programs in numerous villages in Nicaragua.

Environment planning

With regard to environmental cooperation in fields that influence climat change mitigation and adaptation, such as pollution monitoring and control support for natural resource management and planning, natural hazards prevention and control, Italy is providing assistance to several countries.

Besides the numerous, important initiatives of Italian industry, we should cite some examples of the pilot or research and development activities:

- set up of an air pollution monitoring and control system for the city of Manila;

- assistance to local populations in the region of Lake Rukwa, Tanzania for the conservation and rational use of agricultural, land, game and fishing resources to mitigate existing environmental and socio-economic pressure and prevent future ones;

- water and soil conservation in Burkina Faso;

- Technical assistance to the Ministry of the Environment in Tunisia and to the Ministry of Agriculture on management of land resources;

- support to Albanian Environment Centre for Administration and Technology;

- water emergency aid to Uganda;

- draught emergency aid in Mozambico;

- biological agricultural promotion in Nicaragua;

- support to the implmentation of the National Environment Plan in Egypt, coordinated by the World Bank and the local government with particular reference tree-planting and the rational use of water resources in agriculture;

- environment programs in the Amazonian region. Approximately $24 million are targeted to the classification and monitoring of environmental and economic resources and their utilization in Brazil, Ecaudor and Peru. Approximately the same amount is devoted to scientific and technological activities aimed at making resource inventories and to manage and conserve the territory in Brazil, Columbia, Ecuador and Peru. About $34 million are devoted to the development of indigenous communities in the Amazonia region and some cover specifically resource conservation and management.

6.3 Multilateral cooperation

Global Environment Facility

Italy contributed Lit. 105 billion to the Pilot Phase of the Global Environment Facility (GEF) for the 3-year period from July 1991 to July 1994. Italy will contribute an additional 160 billion lire to the restructured and replenished GEF for the period July 1994-June 1997, still subject to Parliament approval. This ranks Italy the sixth largest contributor to the Fund

Other multilateral organizations

Besides the GEF, Italy allocated approximately $2,616,000,000 to multilateral and regional organizations such as the IBRD, regional development banks, UN Agencies such as UNDP, FAO, UNEP, INIDO, UNESCO, ECE and the European Union, all organizations which finance programs and projects contributing to the achievement of the goals of the Convention on Climate Change in developing countries (for a detailed description of the Italian contribution to these organizations, see the table below).

Particular reference should be made to the Keita project in Nigeria implemented by FAO. About $70 million, of which 85% was provided by Italy, has been used to solve the serous problems of aridity and desertification in the region by a

massive involvement of the local population. Until now, 34,000 hectares of arable and grazing land have been recovered, 3,000 hectares of dunes reforested, 10 million trees planted, 50 wells dug and 12,000 people provided with training courses.

Cooperation with countries in Central and Eastern Europe, the former Yugoslavia and the Republics of the former Soviet Union.

Italy provides aid to countries in Central and Eastern Europe, the former Yugoslavia and the Republics of the former Soviet Union through bilateral, multilateral and multi-bilateral programs aimed specifically or partially at solving environment problems.

Special Trust Funds have been set up for these countries over the past two years at the World Bank and the European Bank fo Reconstruction and Development. These funds may be used to finance environment and energy programs with an impact on the global climate.

It should be pointed out that an Italian Special Trust Fund managed by the World Bank is financing an energy and environment auditing program in Bielorussia.

Through its quota in the European Union, Italy contributes to the PHARE and TACIS programs, providing energy assistance to the countries in Central and *Eastern Europe, with positive effects on climate change.*
Other contributions

In addition to the afore-mentioned bilateral and multillateral initiatives, Italy has sponsored the following international Conventions, Conferences and Project as well as Special Trust Funds for climate change:

- Secretariat of the Intergovernmental Negotiation Committee for the Framework Convention on CLimate Change (INC-FCCC) with a contribution of Lit. 200 million for the organization of the 11th negotiation session;

- Intergovernmental Panel on Climate Change (IPCC) with a voluntary contribution of Lit. 100 million for the participation of developing countries in IPCC activities;

- Project with FAO to support the Tropical Forests Action Program, jointly managed by the World Bank, FAO, UNDP and the World Resources Institute with the aim of fostering the development and conservation of tropical and sub-tropical forests. In 1991-1993, Italy contributed $2 million;

- Project with the University of the United Nations on the feasibility study for the creation of a network of international quoality centers for the diffusion of renewable energy to developing countries, with a contribution of about $450,000;

- The Energy Efficiency 2000 Project of the ECE (UN European Economic Commission). Through the ENEA (National Institute for New Technologies, Energy and the Environment), Italy has contributed Lit. 345 million for the 1991-1993 period to the targeted project for the promotion of technology and management methodologies in order to improve energy efficiency in the countries in Central,Eastern and Southern Europe;

- Contribution of approximately Lit. 1 billion to the activities of the IIASA (International Institue for the Analysis of Applied Systems) and the ENEA. These activities also concerned global environmental change, economic and technological change and methods for analyzing global changes.

6.4 Technology transfer

Introduction

The Convention on Climate Change highlights the role of low environmental impact energy technology and the role of technological cooperation for reducing greenhouse gas emissions. The transfer of technology for energy efficiency and for all non-polluting technologies to the developing countries, the countries in Central and Eastern Europe, the former Yugoslavia and the Republics of the former Soviet Union is therefore important and urgent.

Italy supports various activities for facilitating access to technolgies which could help reduce greenhouse gas emissions. In addition to the aid programs already mentioned which Italy funds through bilateral and multilateral channels, a number of Italian research institutes such as the CNR and the ENEA provide further direct aid to developing countries, mainly through initiaitves aimed at strengthening their technological and scientific capabilities. These initiatives include: specialized training courses in Italian laboratories, the organization of seminars in Italy and in the developing countries, and technical aid for the drawing up of research, development and pilot projects. The main aim of these activities is to familiarize the experts of these countries with the most advanced Italian technology in the environment sector, including greenhouse gas reduction, such as the most promising technologies for renwable energy sources and energy saving.

In order to facilitate the exchange of information on technology transfer, the Italian Institute for Foreign Trade (ICE) allocates funds to firms in Italy and in

developing countries, countries in Central and Eastern Europe the Republics of the former Soviet Union to promote joint- ventures in low environment impact technologies.

Specialized institutes such as the ENEA and the Confindustria Institute for the Environment also participate actively with their own resources in programs for environmental conservation such as the International Cleaner Product Program of the UNEP. This program is aimed at promoting the exchange of in information and the transfer of clean technology.

Italy is actively involved in the participation in the GREENTIE program (exchange of technology for limiting greenhouse gas emission) promoted by the OECD/AIE to supply information on technology for limiting greenhouse gas emission, specially targeted towards developing countries.

Joint implementation and technology transfer

In order to contain emissions with a good cost/benefits ratio, interventions in the energy sector (efficiency, savings, fuel switching, renewable energy) and forestation in the countries of Eastern Europe are of particular interest. The Framework Convention therefore takes into consideration the joint implementation (JI) mechanism . This type of technological cooperation could reach major results in terms of lower emission levels and bring about major energy savings in industry, transport and services.

The debate on this subject within the INC has come to a halt due to ethical objections (fairness and historical responsibility) and management difficulties (definition of transaction costs, identification of baseline energy scenarios and quantifications of the reduction goals of the individual projects).

The application of JI could also regard technology transfer and could therefore reinforce the usual international cooperation channels. The existing technology transfer mechanisms could be inadequate for achieving the goal of global CO_2 emission reduction.

Italy has therefore submitted a preliminary suggestion to the Acting Secretariat for the IX Session of the INC in which it highlights that the joint implementation mechanism for limiting CO_2 emissions does not take into account the fact that most of the industrial countries will be unable to stabilize their own CO_2 emissions to 1990 levels by 2000.

Italy therefore proposes that possibility of having industrial countries with national CO_2 energy emission under 3% of overall energy emissions stabilize their own emissions through technological cooperation with developing

countries and countries in Central and Eastern Europe.

From the operational point of view for Italy, this technology transfer through JI could involve a quota of emissions corresponding to the surplus in 2000 with respect to 1990 (between 37 $MtCO_2$ in scenario 2a and 16 $MtCO_2$ in scenario 2b). The corresponding costs would obviously vary according to the type of intervention, the country where the measure would be implemented (e.g. in a developing country in the Mediterranean area or in a country in Eastern Europe), and the amount of the planned reduction.

Table 6.1 Official development assistance (ODA); Italian disbursements to multilateral organizations in 1992 is not electronically available
and
Table 6.2 Official development assistance (ODA); Italian disbursements to multilateral organizations in 1993 is not electronically available

7. RESEARCH AND SYSTEMATIC OBSERVATIONS

7.1 Current research activity

Major research areas

Research on the climate and climate change in Italy has not been organized up to now on the basis of an official national program. Nevertheless, these activities are carried out with the operational coordination between the various Italian research organizations and institutions involved in the climate change problem through joint activities or framework conventions regarding the numerous environment research programs. These activities are generally developed with an interdisciplinary approach reflecting the complex, integrated nature of the problems involved in climate change.

The scientific sectors most directly involved in this context are the ones related to atmospheric and oceanographical science, but research is also carried out in other sectors such as the ecological and global system including the bio-goechemical cycles of carbon and water, as well as interactions between human activity and the climate.

The basic lines of research can be divided into four major topics:

a) Climate models

b) Applied experimental research

c) Climate measures and monitoring

d) Human factors and interaction

a) Climate models

Research activity in Italy has focused mainly on regional analysis and climat change forecasting in the Mediterranean area. In order to develop better regional forecasting capability, considerable efforts are required to increase the accuracy of the general circulation models (GCM), inclduing complex interactions of the climatic system and using special mathematical techniques such as model nesting or other techniques being tested. The GCMs generally used by Italian researchers have been developed in the US by the NCAR (National Center for Atmospheric Research, Boulder, COlorado) and in Europe by the Max-Planck Institut (Hamburg).

b) Applied experimental research

In this area the numerous Italian experiments are conducted by participaton in the European Community research programs (especially MAST and EPOCH) and through the National Program for Antarctic Research. Tis reseach basically regards ocean circulation, ocean / atmosphere flows of rare element gases and interactions between the ocean, atmosphere and criosphere. Other activities regard paleoclimatic research, climatic reconstruction for the Mediterranean area and Italy's climatic history on the basis of a long series of meteorological data available in Italy.

In this context we should also cite the program for intensive and continuous monitoring of forest ecosystems (EU Regulation N. 1091/94). Under this program, the Ministry for Agricultural, Food and Forestry Resources - General Directorate for Forestry, Mountain and Water Resources - has started an integrated national project to study structural and functional changes in ecosystems in relation to possible sources of air pollution or other large scale interference factors. Twenty permanent areas will be involved, cincluding the major forest biotic communities (forests with Picea abies, Fagus sylvatica, Quercus cerris, Q. ilex, Q. petraea, Q. robur.

Seventeen types of scientific research will be conductied in this area, including the 2nd level research provided for under EU Regulation N. 1091/94, and a series of 3rd level research projects, especially those using bioindicators (lichen, fungi, briophytes) and the observation of some basic indicators of the condition of the biotic community (insects life, plant phenology etc.).

One of the goals of the research is to study the carbon balance in forest ecosystems by the analysis of the gas exchange in flows of carbon dioxide and aqueous vapor between the plants and the atmosphere. The following results are expected:

- Quantification and description of trends in the exchange of carbon dioxide and aqueous vapor between the forest ecosystem and the atmosphere;

- Quantification of the global carbon balance;

- Setting parameters for the main physiological processes through the definition of functional relationships typical of different plants;

- Definition and testing of bioclimatic models designed to estimate the main correlations between biological and atmospheric parameters in relation to changes in the global climate.

c) Climate measures and monitoring

Measurements and monitoring of climate parameters are condcuted in three major areas. The first one is the Italian wealther/climatic network of the National Meteorological Service and other regional services for acquiring and processing data and databases. The second one includes sensors controlled from the ground and from satellites for specific research activities and for the development of specialized databases. The third one regard the monitoring of greenhouse gases in the atmosphere, especially carbon dioxide, methan and ozone (tropospheric and stratospheric). Other greenhouse gases will be monitored in the near future.

d) Human factors and interaction

The most important acitvities in this sector regard the estimates of Italian greenhouse gas emissions and the assessment of future emission scenarios related to various social and economic activities, on the basis of different economic development hypotheses and forecasts of the gross domestic product. These activities are carried out in collaboration with international organizations such as the OECD, IPCC and the European Commission. With regard to the assessment of the impact of climate change on the Mediterranean area, studies have only just begun.

Organization and coordination activities

Research on the climate and climate change in Italy has not been organized on the basis of an official national program. The Ministries for Foreign Affaris and for the Environment provide general coordination on the institutional basis to promote Italian participation in intergovernmental and international meetings on climate change problems. Operational coordination in research is carried out by the research institutes which participate directly in this activity.

There follow the major Italian organizations which are responsible for programs or activities regarding climte change:

- ENEA (National Institute for New Technologies, Energy and the Environment) with research activity covering various sectors in science and in the climatic system;

- CNE (National Research Council) conducting activities in various sectors in collaboration with the ENEA for climate research;

- Italian Universities such as L'Aquila, Rome, Bologna, Camerino and others with activities focusing on specific aspects of climate research;

- Italian Meteorological Service and other weather and climate monitoring

organizations which mainly collect and process data and exchange information;

- ASI (Italian Space Agency) which is directly involved in data acquisition and the development of data satellite data analysis and remote sensing.

Finally, other Italian climate research is conducted in collaboration with various international institutions or within international programs.

7.2 Contribution to the World Climate Program

Contribution to climate services for sustainable development

The organizations monitoring the weather and the climate provide information for different purposes according to the nature and organization of the various networks. The basic information is targeted towards the weather analysis and forecasting. Better future integration between the organizations and research institutes could enable Italy to provide a more effective contribution on the international level.

Contribution to new frontiers of science and climate forecasting

Italian efforts are currently devoted to three areas:

a) Historical studies and research on ancient climate conditions in the Italian and Mediterranean regon;

b) Experimental research on atmospheric interaction and marine processes;

c) Regional climate models to forecast climate trends in the Mediterranean area and develop the capacity for forecasting future climate trends in relation to the rise in greenhouse gas emissions and the interaction between human activities and the climate.

In this regard, Italy participates in the IGBP (JGOFS, PAGES, IGAC projects); in the European Union projects (MAST and EPOCH); in internaitonal climate modelling and the intercomparison promoted under the leadership of various American organizations (NCAR, UCAR, LLL); in some international assessment exercises promoted by the OECD, IPCC and the European Union; in the activities of METEOSTAT and ERS-1.

Contribution to observations dedicated to the climate system

Specific observation centers for the basic greenhouse gasses are managed on a regular basis. In the future, these centers will extend their activities to other greenhouse gases such as CFCs. Some greenhouse gases are also monitored in Antarctica (the Italian base in Terranova Bay). The remote sensiing monitoring of climate parameters will also be developed, particularly using MST radar and Lidars.

Contribution to the study and evaluation of the impact of climate change and on response strategies

Italy is heavily dependent on fossil fuels for its energy resources, and its economy is closely linked with natural and environment resources. On the other hand, the MEditerranean is characterized by particular environmental factors affecting the Italian climate, as well as the other Mediterranean countries. Studies on environmental impact are therefore of prime importance. These studies have only just begun. In the future, they must be planned in detail and implemented in relation to the development of regional forecasting capacity. Apart from this type of initiative, studies on the response strategies based on some possible scenarios are now being developed, while the Italian strategy for limiting CO_2 emissions and for the more efficient use of energy in Italy has already been drawn up, and its integration with the EU and OECD countries is now being discussed.

8. PROGRAMS FOR INFORMATION AND TRAINING

8.1 Introduction

Education is a very imortant part of the Convention on Climate Change. This topic is covered by an entire article of the Convention, as well as being present in Commitment in Article 4, where point i) commits all the parties to "promoting and cooperating in education, training and the development of public awareness in relaton to climate change, and encouraging the most widespread participation in this process, also involving non-governmental organizations."

This statement of principle is echoed in Article 6 of the Convention, entitled Education, training and public awareness. With an explicit reference to the Commitment of Article 4, the signatories agree to a series of national and international measures in the field of education and participation of the public.

The points of Article 6, which it is useful to repeat here, refer to point a). After referring to the geographical divisions defined in the Convention as national, regional and sub-regional, and after stressing the laws and regulation and the capacity of each country, the Convention covers fours activities:

- The development and implementation of education programs and participation regarding climate change and its effects;
- Public access to information on climate change and its effects;
- Public participation in political initiative regarding climate change and its effects, and in the formulation of a suitable response;
- Training of scientific, technical and management personnel.

Article 6 contains three major points.

1) The Convention does not state to whom the educational programs are specifically targeted, mentioning only the national population as a whole.

2) It relies on the laws and regulations existing in the individual countries and their capacity to implement educational rporgams.

3) It explicitly calls for the active involvement of the public, a goal which could be achieved by providing information on a large scale.

Information thus appears to the the means rather than the end of the educational program.

Attention should be paid to the importance attributed to any obsernations made by the public. These observations must be included in the national program, and this reinforces the working hypothesis, stated in the previous paragraph, according to which information is the means for public participation rather than the end.

With regard to this, the opportunity provided by the Convention for education and information can be exploited in two ways:

1) With a basic program of exclusively "popular" education on climate change, a set of one-way initiatives such as non-specialist pamphlets, articles, local congresses, exhibits etc., while still fulfilling international requirements;

2) With a more complete, complex program with a 2-way information flow in which for every message sent, the sender is willing to review his project in relation to the response. In this case there is the participation of the citizens and their representative, institutional and otherwise, which undoubtedly has advantages in the subsequent stage when words are translated into action.

In the second option, the final goal which an educational program on climate change must have is to create a creative cycle in which these topics can be inserted and developed. The aim is to ensure that the subject of climate change is included in the programs of the government and the Ministries having jurisdiction to undertake action in this area, of industry for production activities, of the schools for educational activities, of local authorities for the representation of the public, of the media for information. Information plays a key role for achieving this result.

The various groups to whom these activities are targeted should define the goals of an educational and information plan in order to promtoe (according to the initiative to be undertaken:

a) The acceptance of collective responsibilities;

b) The acceptance of individual responsibilities.

The choice of the possible instruments depends on the identification of the target for information and education. Generally speaking, considering that the national community as a whole is concerned with information, initiatives should be defined for each specific target group.

Initially, various target groups in society could be identified for educational and training programs:

a) On the international level training in "ecodiplomacy" is required, to train people qualified to negotiate on the topic of global climate change in a context beyond the national level in relation to the international commitments of the program. This type of diplomacy should be able to ensure the negotiation of our country's international commitments with the UN in legal and scientific terms;

b) On the nationallevel there is a need to act on the basis of information and other insturments promoting the participation of local communities. An organization could be set up at the Ministry for the Environment to provide guidelines in this respect, leaving the local organizations to manage the programs according to their characteristics and capacity. There should also be support acitivity related to global change for the existing organizations such as the parliamentary commissions, which have the task of proposing and guiding legislation on the environment;

c) With regard to local structures and organizations, non-governmental organizations, schools, industrial associations and other organizations in our country, therre should be activities to promote participation and awareness of the problem, including the subject of climate change in existing activities wherever possible.

The measures to be undertaken should be on the grasroots level and this have a good response in term of participation in the groups stated above.

There are 4 sectors in which this activity could take place:

1 - Production: Agriculture and industry
2 - Education: All types of universities and schools;
3 - Local authorities: Mainly municipalities;
4 - The media: Newspapers and television.

This classification reflects the principle in Art. 6 of the Convention stating that information and education should not only be on the natiopnal but also on the local level in order to reach most of the population.

8.2 Production sectors: primary sector and industry

The primary sector including agriculture and animal breeding has only recently been providied with the means to include environment protection in the planning processes.

The environmental movements have concentrated their attention first of all on the conservation of nature, then on industry and on the urbanenvironment, with less attention being paid to agriculture. This shortfall seems to have been ended; the problems of environmental degradation related to agriculture, though improving considerably ove the past 10- 15 years, cannot be ignored, in the interests of both producers and consumers. The need for intervention in dangerous farming practices and to monitor environmental compatibility has this become part of government policy.

The erosion and exhaustion of the soil, climate change, acid rain, desertification are all the most obvious aspects of the environmental crisis related with agriculture. As shown in paragraph 3.5, rules for compatibility with agriculture can be made which take into account the limitations of environmental factors on development.

With regard to Italy, farming activities are highly fragmented and this makes it difficult to provide education and information. A program to ensure greater environment compatibility of farming should take lace on the local level with local structures (consortia, category associations) in order to implement innovative measures to modify production systems with negative environment impact and especially atmospheric emissions.

With regard to industry, there are already tools such as EIS (Environmental Impact Assessment) and the Seveso Directive, which involve industry more closely in environemnt protection. There are also new regulations, now on a volunatry basis, such as eco-auditing and the eco- label, which will soon become part of legislation and can include climate change among the effects of industrial activities on the environment.

Over the past decades the concept of management has developed form both the practical and ethical point of view. It was originally understood an a mainly economic function, the rational handling of the financial resources available. The includion of social goals in management and economic activities has modified the management outlook, making it more environmentally aware.

These points are the basis for the goal of E.E.: to promote responsible, critical behaviour and proposals regarding the natural and man-made environment.

The topic of climate change could therefore be developed within training and

updating courses for teachers with the aim of introducing E.E. in school curricula with an interdisciplinary, broad approach.

In order to do this, the Ministry of Education intends to renew its agreement with the Ministry for the Environment. This agreement also provides for the following three year (1995-1997):

- On the job training and updating courses for teachersz at local, regional and national facilities;
- Promoting European networks of centers, schools and projects for national and European E.E. promotion providing for:

    a) Residential courses for teachers and students
    b) Teacher training
    c) Exchange of information, experience, methodology research and didactic support;

- The promotion of publications and conferences to ensure constant contact between national, regional and local structures and between the latter and the corresponding European structures;
- The diffusion of E.E. in all types of schools also using E.E. centers and laboratories related to the networks promoted by the two Ministers.

8.3 Education: university and schools at all levels

With regard to university training, research on climate change should be promoted in order to give more emphasis to interpretation and the identification of specific research topics with an international impact. Identifying research topics should not be limited to individual disciplines, since global climate change requires a multidisciplinary approach, while taking the individual specializations into account. This is the same for any environemnt studies. In the future approach, climate change should include major research topics and promote the creation of new groups genuinely interested in facing the problems rather than remaining closed in their own areas. In order to reach this goal, the universities, in agreement with the Ministry for Universities and Scientific Research should set up scholarships and fellowships in this area for young graduates.

In order to ensure widespread information and therefore certain participation and interest, environent information in the schools should first of all be oriented towards the teachers through updating and training courses, and subsequently scholastic activities integrated in exchange and cooperation programs on the national and European level.

In order to achieve the goals of environment education (E.E.) on climate

change, the following measures are required:

1. To improve training for all teachers in all types of schools regarding the concept of E.E. oriented towards sustainable, lasting development. This new concept can be implemented in E.E. projects in schools, and required the identification of adequate taining processes in 3 stages: teacher training (school staff for E.E:), then the training of all the teachers interested, who will then convey the contents and projects to the students through school curriculum,

2. To face and solve the educational problem on the European level in all EU countries since the environment, and especially climate change, is global, cross-border and international in nature.

3. To ensure on-going education activities by teachers.

Environmental information given by the media is stronly affected by the emergency approach. This means that environmental problems are dealt with mainly or even exclusively when there ar4e natural or man-made environmental disasters. Even in these cases little space is given to the understanding of the phenomena producing the damage to the environment. Most of this information is simply given in news reports.

With regard to climate change, the fact that the possible effects are not immediately quantifiable and visible leads the media to give little attention to them. The goal here is to provide the public with the opportunity and the means to have information on this topic with the aim of providing awareness and prevention of environment risks linked with climate change.

Global climate change is involved in this area. The AIGA (Italian Association of Journalists for Environment), a specialized group in the FNSI (National Federation of the Italian Press) has often called for the need for more correct and complete information (especially during environmental disasters). It has also called for greater quality, frequency and expertise in dealing with environment news. The AIGA believes that environmental information should become a tool to educate the public to adopt environment-friendly behovior.

With regard to the quantity aspect, there should be more information regarding the envrionment, especially in the newspapers and television in order to ensure greater social awareness of environmental problems and climate change. This implies the constant involvement of management within the media. This should be undertaken also by taking into account the interest and newsworthiness of information targeted towards the non-specialized public.

A better quality level could be achieved by more cooperation between

journalists and technical and scientific experts (as called for by the AIGA) in order to ensure that the public has the right to information as stated in Article 6 of the Convention, indispensable for real public participation in the choices regarding environmental policy related to climate change.

In order to achieve these two points, more journalists are required in the environmental sector. In particular, the closer cooperation between journalists, technicians and scientists, as stated above, is the basis for specific environment training, using courses, scholarships and other methods to enable young journalists to deal with and provide information on climate change.

8.4 Local authorities (mainly municipalities)

The decision to involve local authorities as much as possible is in agreement with Article 6 of the climate change Convention. The assumption is that in order to be effective, any educational and training activity must take into account the needs of the public. In the Italian political system, the local, and in particular municipal authorities, are the best representatives of these interests, and may be the bodies which can best interpret these needs. Their involvement is therefore indispensable for ensuring both information on the problem and the involvement of the publics.

In order to be able to adopt measures for reducing greenhouse gas emissions, the ANCI (Association of Italian Municipalities) will undertake promotional initiviative with the municipal authorities. This Association, already involved in enivronment-related subjects in a joint program with the CISPEL (Italian Confederation of Local Authority Public Services) and Legambients, will include the reduction of CO_2 emissions among the goals to be pursued in municipal policy. The "triangular" approach if the ANCI program, based on attributing responsibility to the local authorities, specialized services and the pubnlic in behaving in accordance with environmental needs and the safeguarding of natural resources, is in line with the methodology laid down in Agenda 21 and may be a useful opportunity to test this approach.

8.5 Mass communications: newspapers and television

Another basic point is the use of the media. It is not only a matter of providing information, but rather of creating a direct or indirect relationship with the media, identifying key figures as a point of reference for this activity.

The main environmental goals of management are as follows:

- Inserting the company in a general environmental context;

- The demand from the public to be involved and informed on production processes and their impact on the environment;
- The change in the concept of the quality of life and the arising of new neds not simply linded to mere survival;
- The development of international and national legislation with greater emphasis on the environment;
- The awareness of the risks inherent in the development of new thechnology;
- The awareness of the limits of exploitation of natural resources.

A program for information and education on climate change targeted to industries should find it easier since Italy is also moving towards change in industry culture.

In order to include climate change in the environment problems already dealt with by companies, the goal is to promote agreements with various major industries; measures for small and medium size industries will be on the local level with course and Chamber of Commerce initiatives to involve the varous local enterprises.

REFERENCES

The list of references is not available electronically

ANNEX 1 – 5

The annexes are not available electronically