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**COMMUNICATION FROM THE COMMISSION UNDER THE UN
FRAMEWORK CONVENTION ON CLIMATE CHANGE**

Article 4.2. (b) (c) (d) and Article 12

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EXECUTIVE SUMMARY

1. Introduction

- 1.1. The European Community¹ signed the UN Framework Convention on Climate Change (UN FCCC) at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 and ratified it on the 21st of December 1993.
- 1.2. As a Party to the Convention, the European Community has accepted the commitment to adopt policies and take corresponding measures aimed at returning emissions of greenhouse gases to 1990 levels, individually or jointly, by the year 2000. With respect to CO₂, the European Community set itself the objective to stabilise emissions by the year 2000 at 1990 levels, in the terms agreed by the Joint Energy/Environment Council of October 1990.
- 1.3. The present Communication of the European Community under the UN FCCC explicitly describes measures to address climate change which are or will be taken at the Community level in the period 1990-August 1995. Relevant information of Austria, Finland and Sweden, which joined the European Community on 1 January 1995 has been included. The commitments of the European Community are to be reached with complementary Community and national programmes. Since the national programmes have been described in detail in the National Communications under the UN FCCC of the Member States, these programmes have only been summarized in this communication.

2. Specific circumstances in the European Community

- 2.1. The Member States of the European Community vary enormously in size, population, geographical and economic profile. Until 1 January 1995, the European Community consisted of the following Member States: Belgium, Denmark, Germany, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom. Since 1 January 1995, Austria, Sweden and Finland acceded to the European Community.

¹ Throughout the text the term "European Community" is used, since this is the legal name deposited to the United Nations in 1994. The "Commission of the European Communities" is the formal name of the European Commission.

- 2.2. The European Community is relatively modest in size (3 240 153 km²). The total number of inhabitants of the European Community amounts to 370 million inhabitants, i.e. the average population density amounts to 114 inhabitants per km². The territory of the European Community is made up of a wide variety of land of varying quality, almost a quarter of which is arable (28%), approximately a third wooded (35%) and a substantial proportion grassland (18%).
- 2.3. The level of development of the national economies in the European Community varies considerably among the Member States. The GDP per capita of the majority of the Member States lies in between 11 500 ECU and 16 500 ECU (figures for 1992 in 1985 prices and exchange rates). Service sectors are the most important economic sectors in the European Community. Manufacturing industries are the second most important sector. The transport sector in the EC has shown above-average CO₂ emission growth in recent years and is one of the major sources of CO₂ emissions (Green Paper on Transport and Environment; COM (92), 46 final, 20.02.92). The EC is depending on imports for most of its energy provision.

3. The EC emission inventory

- 3.1. The EC inventory for the year 1990 has been compiled based on the inventories of the 15 Member States. Table E.1 provides a summary of greenhouse gas emission estimates in 1990. To estimate total greenhouse gas emissions in the European Community, total greenhouse gas emissions in each one of the Member States were added together. Estimates of emissions in the Member States were primarily taken from national communications prepared by the Member States under the UN FCCC. If these were not available, national programmes under the EC Decision on a Monitoring Mechanism for CO₂ and other greenhouse gases were used. In general, the inventories reported in these national reports followed the IPCC guidelines for national greenhouse gas inventories. If no nationally reported estimates were available, CORINAIR and/or Eurostat figures have been used.
- 3.2. Since nationally reported inventories were not available for all EC Member States, and CORINAIR does not include removals of CO₂, CO₂ emissions and/or removals from Land Use Change have not been quantified in the 1990 EC inventory.
- 3.3. The emission estimates presented in Table E.1 are structured according to the reporting instructions of the IPCC guidelines for greenhouse gas inventories. For reasons of consistency, EUROSTAT estimates have been used for each of the Member States to calculate their feedstock emissions. These have been reported separately in the category "Final Non Energy Consumption (FNEC)".

Table E.1. EC inventory of greenhouse gas emissions. 1990. (Gg). Short Summary Table. Provisional estimates¹.
Estimates of greenhouse gases in European Community (EUR-15) - 1990 (Gg).

| | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|------------------------------------|-----------------|-----------------|------------------|-----------------|--------------|--------------|
| 1 All energy | 3153200 | 5587 | 157 | 13332 | 46184 | 8422 |
| 1a Fuel combustion | 3145700 | 793 | 157 | 13243 | 46092 | 7697 |
| 1b Fugitive fuel | 7700 | 4795 | 1 | 88 | 92 | 726 |
| 2 Industrial processes | 148300 | 42 | 353 | 154 | 2811 | 1077 |
| 3 Solvent use | 300 | 0 | 6 | 0 | 0 | 4043 |
| 4 Agriculture | 500 | 10349 | 385 | 50 | 2763 | 738 |
| 5 Land use change | NE ² | | | | | |
| 6 Waste | 25850 | 8681 | 20 | 71 | 327 | 93 |
| Total emissions³ | 3328350 | 24660 | 922 | 13606 | 52085 | 14374 |

Marine bunkers 113600

Aviation bunkers 56500

FNEC³ 243600

(FNEC = Final Non-Energy Consumption)

NE = Not Estimated

Notes:

¹ Estimates of greenhouse gas emissions in the European Community are based on estimates of emissions in the Member States, updated up to June 1995.

² CO₂ emissions and/or removals from Land Use Change are not known for many countries and hence have not been included in this table. Non-CO₂ greenhouse gas emissions from Land Use Change have also not been estimated.

³ Emissions from Final Non Energy Consumption (including feedstocks) have not been included in total emissions. Therefore, total emissions are underestimated in comparison with the IPCC methodology. Emissions from Final Non Energy Consumption (FNEC) are based on the total carbon contained in the related products. The addition of energy emissions and emissions from FNEC would therefore produce an overestimation compared to the IPCC methodology.

3.4. Following the decisions taken at ninth session of the Intergovernmental Negotiating Committee on a Framework Convention on Climate Change (INC-9), emissions from bunkers are not included in the total emissions in summary Table E.1. Since only a few Member States provided estimates of bunker emissions, emission estimates from maritime bunkers are based on Eurostat figures. Aviation bunker emissions have been estimated by reconciling non-road transport figures from Eurostat against estimates reported in CORINAIR and/or country reports.

3.5. The uncertainty in the emission estimates has not been quantified, since quantitative estimates of the uncertainty would be highly unreliable. Estimates for CO₂ emissions from fuel combustion activities (based on energy balance figures) are rather reliable and are likely to be least uncertain (within about +/- 3%). The uncertainty in emission estimates from non-CO₂ gases is increasing in the following order: CO < NO_x < CH₄ < NMVOC < N₂O, with uncertainties increasing to several orders of magnitude (several hundreds of percent).

4. Programmes, policies and measures

4.1. In October 1991, the Commission presented an overall strategy to limit CO₂ emissions and improve energy efficiency, with the objective of stabilising CO₂ emissions in the Community in the year 2000 at the 1990 level. The Community strategy rests on four pillars:

- The EC energy conservation and energy technology programmes.

The THERMIE I programme (1990-1994) aimed at the demonstration and dissemination of cleaner and more efficient energy techniques. The JOULE II programme (1991-1995) is relative to the R&D in the same area; it also concerns the elaboration of the RTD strategy and addresses the Energy-Economy- Environment dimensions of the Climate Change issue. SAVE (1991-1995) is a programme of energy efficiency legislation and financial support for the creation of energy efficiency infrastructure in the Member States. ALTENER (1993-1997) provides financial support for activities contributing to the application of renewable energy technologies, and envisages standardization measures for renewable energy equipment.

- Fiscal measures.

In June 1992, the Commission proposed a draft Council Directive for a tax on fossil fuels whose tax base will be to 50% the energy content and to 50% the carbon content of the energy product. In December 1994, the Council agreed on the need to implement a Community framework for the Member States for the application of national CO₂/energy taxation. An amended proposal has been adopted by the Commission on 10 May 1995. The main change proposed is that the implementation of a harmonised tax will be preceded by a transitional period during which the Member States, while respecting a harmonised tax structure, are free to set the tax rates product by product provided that the Community objectives of limiting CO₂ emissions through improvement of energy efficiency and fuel switching towards low -no carbon fuels is fully reflected in the structure of the rates applied.

- A monitoring mechanism.

The monitoring mechanism surveys the Community and Member State actions aimed at reaching the Community CO₂ stabilisation target for the year 2000. The Commission evaluates these programmes in order to assess whether progress in the Community as a whole is sufficient to ensure the stabilisation of CO₂ emissions by the year 2000 at 1990 levels. The results are reported to the European Parliament and the Council.

- National programmes.

The Community strategy requires policy programmes which limit greenhouse gas emissions at Member State level, and which will be complementary to actions taken at the Community level.

From 1 January 1995 THERMIE has continued as the new Non-Nuclear Energy programme, better known as JOULE-THERMIE; This new Programme (1995-1998) brings together for the first time the research and development aspects of JOULE with the demonstration and promotion initiatives of THERMIE.

The Commission has adopted its proposal for a new SAVE programme (SAVE-II) on 31 May 1995. Two other programmes with similar aims and activities, the PACE programme for electricity efficiency and the annual Programme of support for Regional and Urban actions will be merged into SAVE-II. It is scheduled to begin on 1 January 1996 and will run until 31 December 2000. The proposed budget is 150 MECU.

- 4.2. Next to the policies and measures adopted in the framework of the Community strategy, some sectoral policies also contribute to the limitation of greenhouse gas emissions.
- The 1992 restructuring of the Common Agricultural Policy (CAP) contains measures, such as the reduction of agricultural support prices and the introduction of set-aside schemes for agricultural land, that have a limiting impact on greenhouse gas emissions. Moreover, the agri-environmental measures, that have been adopted as accompanying measures to the CAP reform, contribute to the limitation of greenhouse gas emissions.
 - The EC forestry policies, such as supporting financially afforestation and promoting the environmental productivity of forests by regulation, contribute to the uptake of CO₂ emissions.
 - Within the Community, transport is a major and strongly growing source of greenhouse gas emissions. From 1991 to 1994, a series of Council Directives has been adopted which prescribe standards for emissions of CO, hydrocarbons and NO_x from various types of vehicles. Fiscal policies with regard to excise duties on transport fuels harmonize minimum rates, and are aimed at a progressive increase of these duties.
 - Concerning waste, the Directive on packaging and packaging waste and the Directive on landfills of waste were adopted on 20 December 1994 (94/62/EC). Preventing the production of packaging waste, reusing packaging, recycling and reducing the final disposal of waste will result in a reduction of CO₂ and CH₄ emissions.
- 4.3. Before the first Conference of the Parties to UN FCCC and in response to the request of the Council the Commission prepared and adopted on 1 March 1995 a "Commission Working paper on the EU Climate Change Strategy: a set of options", (SEC 95/288/final). In the document a preliminary analysis of the policy options for CO₂ limitation in the perspective 2005-2010 is given. The document indicates, amongst others, that a technical potential for CO₂ emission reduction by 2010 of up to 10% exists, at no or low costs compared to 1990 level, provided

positive synergies between climate change policies and several other policy areas of the Community are exploited. A more detailed analysis will be carried out by the Commission at a later stage.

- 4.4. An overview of the policies and measures that have been adopted by the Council is provided in Table E.2.

Table E.2. Programmes, policies and measures adopted by the Council.

| Name | Period | Budget | Description |
|--|---|----------|---|
| THERMIE I | 1990 - 1994 | 700 MECU | Financial support for clean energy technologies |
| SAVE-programme | 1991 - 1995 | 35 MECU | Financial support for energy efficiency projects |
| SAVE-legislation | 1992 - 1992 - 1994 - | | Energy efficiency standards for new hot water boilers Energy labelling of major household appliances, Framework Directive Energy labelling of refrigerators and freezers |
| Energy Management at Regional and Urban level | 1990-1995 | 20 MECU | Rationalisation of energy use at regional and urban level |
| ALTENER-programme | 1993 - 1997 | 40 MECU | Financial support for renewables |
| Voluntary agreement | | | CEN/CENELEC will elaborate standards for thermal solar with CEN/ CENELEC systems, photovoltaics and wind turbines |
| Monitoring mechanism | 1993 - 2000 | | Procedures to monitor progress towards CO ₂ stabilisation target |
| CAP Reform, price lowering | 1992 - | | Reduction of agricultural prices makes the use of mineral fertilizer less profitable and is one reason for decreasing use of mineral fertilizers (and thereby N ₂ O emissions) in the last years |
| CAP Reform, set-aside scheme | 1992 - | | Compulsory set-aside scheme promotes growing of biofuels |

Table E.2. Programmes, policies and measures adopted by the Council (continued).

| Name | Period | Budget | Description |
|--|-------------|-----------|--|
| CAP Reform, extensification of beef production | 1992 - | | Premiums are related to maximum stocking rates, reducing CH ₄ emissions from ruminants per ha |
| Agri-environmental measures | 1993-1997 | 3670MECU | Financial support for zonal programmes, incl. environmental measures |
| Afforestation | 1993 - 1997 | 1260 MECU | Financial support for afforestation |
| Protection of forests from pollution | 1992 - 1996 | 29.4 MECU | Measures increase net primary productivity of trees and thereby potential CO ₂ uptake. |
| Protection of forests from fires | 1992 - 1996 | 70 MECU | Measures contribute to CO ₂ uptake |
| Emission standards for heavy duty vehicles | 1993 - | | Emission standards for CO, hydrocarbons and NO _x |
| Emission standards for light duty vehicles | 1993 - | | Emission standards for CO, hydrocarbons and NO _x |
| Emission standards for passenger cars | 1997 - | | Emission standards for CO, hydrocarbons and NO _x |
| Fiscal measures for transport fuels | 1992 - | | Minimum excise duties on petrol and diesel fuels |

Table E.2. Programmes, policies and measures adopted by the Council (continued).

| Name | Period | BudgetDescription |
|--------------------|-------------|---|
| Landfill directive | 1994 - | Environmental standards for landfilling of waste contributes to limitation of CH ₄ emissions |

5. National programmes of the Member States

- 5.1. One of the pillars of the strategy of the European Community to limit greenhouse gas emissions consists of the national programmes adopted by the Member States. All Member States, except Belgium, already reported under the UN FCCC. Belgium submitted to the UN FCCC its national programmes under the EC Monitoring Mechanism for CO₂ and other greenhouse gases.
- 5.2. All national reports include a 1990 emission inventory, a list of programmes, policies and measures adopted to limit greenhouse gas emissions, and projections of greenhouse gas emissions in 2000. Since the projections included in the national reports have been compiled using various modelling tools and key input assumptions, they cannot be added together to arrive at projections for the European Community.
- 5.3. Eight Member States expect an increase in CO₂ emissions in 2000 compared to 1990: Austria, Finland, France, Greece, Ireland, Italy, Portugal, and Spain. One Member State expects to reach a stabilisation of CO₂ emissions in 1990: Sweden². Five Member States are expecting a decrease in CO₂ emissions in 2000: Belgium, Denmark³, Luxembourg, the Netherlands⁴ and the United Kingdom. Germany provides a projection for CO₂ emissions in 2005 and expects a CO₂ emission reduction by that year.

Eleven Member States provided projections of CH₄ and N₂O emissions in 2000. Two Member States expect an increase in CH₄ emissions: Ireland and Luxembourg; Another two expect a stabilization: Austria and France; and the remaining seven Member States expect a reduction in CH₄ emissions: Denmark, Finland, Greece, Italy, the Netherlands, Sweden and the United Kingdom. Six Member States expect an increase in N₂O emissions: Denmark, Finland, Greece, Ireland, Luxembourg and the Netherlands; two Member States expect a stabilization: Austria and Italy; and three other Member States expect a reduction in N₂O emissions: France, Sweden and the United Kingdom. Germany provided projections for 2005 and expects a reduction in both CH₄ and N₂O emissions.

² If based on temperature corrected CO₂ emissions in 1990. If projected figures are compared with *actual* CO₂ emissions in 1990, an increase in CO₂ emissions of 4% is estimated.

³ If based on CO₂ emissions in 1990 which have been corrected for electricity import fluctuations. If projected figures are compared with *actual* CO₂ emissions in 1990, an increase in CO₂ emissions of 3% is estimated.

⁴ If based on temperature corrected CO₂ emissions in 1990. If projected figures are compared with *actual* CO₂ emissions in 1990, CO₂ emissions are estimated to stabilize.

6. Projections of CO₂ emissions in 2000

6.1. As a first attempt to project energy related CO₂ emissions in the EC, the large scale energy planning and forecasting model MIDAS (Model Integrating Demand and Supply) has been used. The model combines an econometric top-down approach with a micro-economic approach. Several scenarios have been applied in the model. The MIDAS model and the scenarios applied differ, in structure and in assumptions with regard to exogenous variables, from the models and scenarios used by Member States to forecast their CO₂ emissions. Results are therefore not comparable.

However, it should be stressed that the simulations described in this report are not official simulations to assess the impact of climate change policies in the EC. The results of the simulations are provided as a first indication of future EC greenhouse gas emission. Further work is being undertaken to develop more accurate modelling tools and scenarios.

6.2. Table E.3 shows the trend in energy related CO₂ emissions in EUR-15.

Table E.3. Trends in energy related CO₂ emissions in the EC (15 Member States). (1000 Gg.); preliminary results

| | 1990 | 2000 | 2010 | 2020 |
|---------------------|-------|-------|-------|-------|
| Conventional Wisdom | 3,155 | 3,326 | 3,557 | 3,648 |
| Battlefield | 3,155 | 3,357 | 3,428 | 3,368 |
| Forum | 3,155 | 3,089 | 2,986 | 2,855 |
| Hypermarket | 3,155 | 3,325 | 3,597 | 3,686 |

6.3. According to the Conventional Wisdom Scenario, which denotes the "business as usual" world representing a conventional wisdom view of the most likely evaluation of events, CO₂ emissions in the EC are expected to increase with 5% by the year 2000, with 13% by the year 2010 and with 16% by the year 2020 (compared with 1990 levels). The results of the Hypermarket scenario, which gives a predominant role to market forces, liberalism and free trade, show a similar increase: an increase is expected of 5%, 14% and 17% for the years 2000, 2010 and 2020 respectively. The Battlefield scenario, which assumes amongst others that the world reverts to isolation, power blocks and protectionism, results in a decreasing growth of CO₂ emissions: an increase of 6% in 2000, of 9% in 2010 and of 7% in 2020. According to the Forum scenario, "which assumes amongst others that the world moves more to consensus and cooperative international structures with a strong role for public administration and intervention," a reduction in CO₂ emissions is expected: 2% in 2000, 5% in 2010 and 10% in 2020.

7. Adaptation and vulnerability

- 7.1. Since the territory of the European Community consists of a rich variety of landscapes and also the climate varies considerably among the different parts of the Community, the possible impacts of climate change can differ enormously depending on local or regional circumstances.
- 7.2. Assuming a doubling of atmospheric CO₂ concentrations, average winter temperatures in northern Europe are expected to increase by 2-5 °C, while the winters in the central and southern region can be 1-3 °C warmer. Average summer temperatures are expected to increase by 1-4 °C throughout all of Europe. The change of temperatures and precipitation has enormous impacts for agriculture. depending on the region these impacts could be both positive and negative. despite of partially positive impacts, negative impacts will predominate for agriculture in general. Sea level rise is a potential threat to the large coastal area of the European Community (approximately 89 000 km of coastline, without counting the coasts of the small islands), especially to low lying lands. The impact of major storms will become more widespread as the sea surface rises. Especially in the North and Mediterranean Seas, the impacts of storms are a matter of particular concern. Analysis of economic impacts show that economic costs will most likely be the overall consequence of global warming for the EC, although some sectors and regions may benefit.
- 7.3. One of the key targets of the Fifth Action Programme of the EC "Towards Sustainability" is the integrated management of coastal zones. The Commission is currently preparing a Communication on the integrated management of coastal zones. It was felt that instruments exist but that they need to be better implemented. Coordination is seen as a means to that end. A three years demonstration programme is proposed in order to investigate and demonstrate the conditions of coordination, horizontally between the multiple sectors of activity (integration) and vertically between the levels of competence (subsidiarity). Research and development activities will provide a scientific basis for sound ecological management of the coastal zones.
- 7.4. In June 1994, the European Community signed the Resolution on strategies for a process of long-term adaptation of forests in Europe to climate change. European research on the linkages between climate change and forests ecosystems is being intensified.

8. Finance and international cooperation

- 8.1. Since the adoption of the Fifth Action Programme "Towards Sustainability", progress has been made in integrating environmental requirements into cooperation with developing countries and countries with economies in transition. Environmental concerns are now reflected in most of the bilateral cooperation contracts established between the Community and its partner countries.
- 8.2. Cooperation with non Community countries, the so called "third countries" relating to climate change, inter alia, takes place in the frame of the SYNERGY initiative and the European Energy Charter. For all cooperation projects likely to have an impact on the environment an Environment Impact Assessment is required. The Commission has proposed to change this initiative in a programme. The objective

of the SYNERGY initiative is to improve the long term world energy situation and hence, Community energy security, by helping other countries to make effective energy policy decisions. By encouraging energy planning, the rational use of energy and counselling and training, SYNERGY contributes to the reduction of greenhouse gas emissions. The Programme is to last five years and has a budget of 50 MECU. The European Energy Charter was signed in December 1994. The charter includes a political declaration committing its signatories to cooperate in trade, investment and other policies in all energy sectors. These efforts should lead to the creation of a true energy market throughout Europe. Environment protection and more efficient use of energy brought about by treaties and protocols in the frame of the charter will have a positive impact on limiting CO₂ and other greenhouse gas emissions in particular by encouraging market prices, and hence, more efficient energy usage.

- 8.3. Cooperation with developing countries takes place in the framework of general and more specific cooperation programmes. The specific programmes include research cooperation, energy and forestry related issues. The research cooperation has been targeted through the "Life sciences and technologies for Developing Countries" on areas of relevance for global change issues, and in particular those relative to the use and management of ecosystems. cooperation on energy and forestry related issues have made possible the financing of projects relative to renewable energy in Asian and Latin America countries (ALA) and to conservation and sustainable management of tropical and subtropical forests in the African, Caribbean and Pacific countries (ACP).

The most comprehensive of all the general agreements with developing countries are those with the ACP-countries, the so-called Lomé Conventions. Under Lomé IV (1990-1995), environment has become one of the main areas of cooperation. Within the framework of efforts to protect the environment and restore natural balances, cooperation aims to promote specific operations concerning the conservation of natural resources, renewable and non-renewable, the protection of ecosystems and the control of drought, desertification and deforestation. Another main area of cooperation is energy development, in particular energy efficiency and the promotion of new and renewable sources of energy.

Since 1976, the Community has been pursuing a policy of financial, technical and, more recently, also economic cooperation with the ALA-developing countries. Under the new guidelines for Community cooperation with ALA countries, long-term priorities are the protection of the environment and natural resources, and sustainable development. 10 % of the total budget for the period 1991-1995, has been set aside for projects specifically aimed at protecting the environment, in particular tropical forests.

- 8.4. EC cooperation with the central and eastern European countries (CEECs) and the former Soviet Union is mainly based on the PHARE (Poland and Hungary Assistance to the Restructuring of the Economy) and the TACIS (Technical Assistance to the Commonwealth of Independent States) programmes. The PHARE programme is an EC initiative which supports the political and economic development of the CEECs. Of relevance to the climate change issue are particularly the activities related to energy.

The overall aim of the TACIS programme is to contribute to the transition towards a market economy of the independent states of the former Soviet Union. Since 1993, the TACIS Regulation includes a specific reference to the environment. Energy is specified as one of the priority sectors of the TACIS programme. Important to note is that each project in the energy sector contains an energy saving component.

9. Research, demonstration and development

- 9.1. Research on climate change is embedded in the EC Framework Programmes of Research and Development. Within these framework programmes, the specific research programmes on environmental issues, non-nuclear energy and marine science are of particular importance to climate change. Research budgets in all three areas have been largely increased during the last years.
- 9.2. During the Second Framework Programme of Research and Development (1987-1991), the European Programme on Climatology and natural Hazards (EPOCH) had the strongest liaison with the climate change issue. Research focused on: past climates and climate change, climate processes and models, climatic impacts and climate-related hazards, and seismic hazard.
- 9.3. The emphasis on environmental research has increased in the Third Framework Programme of Research and Development (1990-1994). The Environment programme consisted of the following research areas: participation in global change programmes, environmental technologies and engineering, research on economic and social aspects of environmental issues, and technological and natural risks.
- 9.4. The Fourth Framework Programme of Research and Development (1994-1998) includes a specific programme on Environment and climate. The programme covers four themes: the natural environment, environmental quality and global change; environmental technologies; space techniques applied to environmental monitoring and research, and human dimensions of environmental change. The Joint Research Centre (JRC) will also contribute, through its own programme of activities, to the attainment of the Community objectives in the areas covered by the programme on Environment and climate.
- 9.5. Two successive programmes regarding new energy technologies, JOULE I (1989-1992) and JOULE II (1990-1994), have been established by the Community. Both programmes addressed the development of clean and efficient energy technologies in the three following areas: rational use of energy (in industry, transport and building), advanced technologies for fossil fuels, and renewable energies; a large activity about energy-economy-environment modelling is also undertaken which has been focused in particular on the CO₂ strategy. The environment dimension which was already an integral part of JOULE I has been strengthened in JOULE II.
- 9.6. A specific programme on non-nuclear energy is continuing under the Fourth Framework Programme. It is called JOULE-THERMIE. This programme will integrate for the first time the R&D and the Demonstration activities. R&D will give more emphasis to the renewable energy and transport, whereas demonstration activity will support more rational use of energy, fossil fuel technology and dissemination. a substantial support to the RDT strategy will be ensured and

focused on a Climate Change technology strategy and on the internalisation of environmental costs of energy.

- 9.7. The European Community's Marine Science and Technology (MAST) programmes aim to introduce the necessary Community dimension to various on-going research activities of the Member States. MAST intends to contribute to establishing a scientific and technological basis for the exploration, exploitation, management and protection of Europe's coastal waters and the seas surrounding the EC's Member States and thereby to achieve a better balance in the marine science potential of the various areas of the EC.

10. Education, training and public awareness

- 10.1. The success of policies and measures addressing the problem of climate change will depend to a large extent on the decisions and actions of the general public. At the EC level, information, education and training programmes concerning climate change and energy use mainly take place within the scope of (sectoral) policy programmes, such as energy supply, transport, urban development and agriculture.
- 10.2. Information for the wider public is a key element of the SAVE, ALTENER, THERMIE programmes and the action on Energy Management at Regional and Urban level. THERMIE's dissemination actions include a network of some forty Organisations for the Promotion of Energy Technology (OPET) focusing on distributing and promoting innovative energy technologies across Europe, including Central and Eastern European countries and the former Soviet Union.
- 10.3. The EC supports pan-European environmental campaigns of local authorities aiming at local sustainability, or significant local contribution to global sustainability, such as Sustainable Cities and Towns, the Car Free Cities Club and Cities for Climate Protection.
- 10.4. Training and education belong to the accompanying measures of the EC research programmes. An example of these activities are the courses which are organised by the European School of Climatology and Natural Hazards.

1. INTRODUCTION

The Treaty establishing the European Community (EC) entered into force in 1958. Since then, it has been modified several times to allow new States to accede to membership and to reinforce and enlarge its objectives. The two major texts modifying the original Treaty are the Single European Act, which entered into force in 1987, and the Treaty on European Union known also as the Treaty of Maastricht. The latter entered into force at the 1st November 1993. Until 1 January 1995, the European Community consisted of the following Member States: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom. Since 1 January 1995, Austria, Finland and Sweden also became Members of the European Community. Although this communication mainly deals with the the period 1990-1994, relevant information of the three new Member States have been included. In addition, relevant developments on community and national level since 1 January 1995 have been addressed as well.

The main objectives of the European Community are set out in article 2 of the Treaty on European Union: "to promote throughout the Community a harmonious and balanced development of economic activities, sustainable and non-inflationary growth respecting the environment, a high degree of convergence of economic performance, a high level of employment and of social protection, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among Member States"⁵. The Treaty on European Union has introduced as a principal objective the promotion of sustainable and non-inflationary growth respecting the environment. The Treaty recognizes that environmental protection requirements must be integrated into the definition and implementation of other Community policies. One of the objectives of Community environmental policy is to promote measures at the international level to deal with regional or worldwide environmental problems.

The Fifth Environment Action Programme "Towards Sustainability", adopted by the Commission in 1992 and its broad strategy of which was agreed by the Council in 1993 (OJ C138/5, 17.5.1993), is the process by which Community environment policy is moving forward. It lays out a strategy for reconciling economic development to the protection of the environment (sustainability). For the first time, the programme recognizes the need for a comprehensive and targeted approach towards environmental issues at Community level. It takes as its starting point the need to involve all the relevant "actors" of society in a spirit of shared responsibility to achieve sustainable development. It focuses on five main target areas - industry, agriculture, energy, transport and tourism - where the environmental problems are the most profound and where action can have most benefits for the environment as a whole. The programme recognizes that the legislative or regulatory approach is not sufficient and recommends a broadening of

⁵ Art. 2, Treaty establishing the European Community (as amended) by Art. G(1) and G(2) of the Treaty on European Union.

the range of instruments, to include economic/fiscal instruments, financial support mechanisms, and horizontal instruments such as information, education, research and development, and data gathering.

The tasks entrusted to the European Community are carried out by the following institutions: an elected European Parliament, a Council consisting of a representative of each Member State at ministerial level, a Commission consisting of independent Members and a Court of Justice to ensure the interpretation and application of the Treaty.

In order to carry out their tasks, the Commission and the Council acting jointly or in cooperation with the European Parliament can make Regulations, issue Directives, take Decisions, make Recommendations or deliver Opinions. Regulations are of general application. They are binding in their entirety and are directly applicable in all Member States. Directives are binding as to the result to be achieved, but leave to Member States the choice of form and methods. That means that Directives need to be incorporated into national legislation within a certain time limit fixed by the Directive itself. Decisions are binding in their entirety upon those to whom they are addressed. Finally, Recommendations and Opinions have no binding force.

To enact Community legislation under normal conditions, a proposal from the Commission is necessary. Acting on the basis of such proposal, the legislative bodies under the Treaty (the Council, and to some extent, the Parliament), assisted by some advisory bodies, adopt the final text.

Action by the Community regarding environmental issues has to be taken in accordance with, *inter alia*, the principle of subsidiarity. This principle states that the Community should only take action if and in so far as the objectives of the proposed actions cannot be sufficiently achieved by the member states and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community.

The European Community⁶ signed the UN Framework Convention on Climate Change (UN FCCC) at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. As a follow-up, the Commission submitted a proposal for a Council Decision concerning the conclusion of the UN FCCC in December 1992. This proposal was *inter alia* founded on Article 22 of the Convention which allows ratification, acceptance or approval by States and by Regional Economic Integration Organisations. In the proposed Council Decision it was considered that "since the Community and its Member States share competence in the areas covered by the Convention, it is necessary according to the Community and its Member States to become Contracting Parties so that all the obligations under the Convention can be properly fulfilled". More specifically it was considered necessary that the Community became a contracting Party to the Convention and assumed the relevant responsibilities in order to comply with the emission stabilisation objective of the Convention while not all the Member States were ready to meet that objective individually.

In December 1993, the Council agreed to adopt the Commissions' proposal for the Council Decision, "recognizing the importance for the Community of ratifying the

⁶ Throughout the text the term "European Community" is used, since under the Treaty of the European Economic Community has been converted into European Community. In this communication, the term European Community refers to either the 12 (EUR-12) or 15 Member States (EUR-15). The "Commission of the European Communities" is the formal name of the European Commission.

Convention before it enters into force and alongside its Member States, so as to allow the fulfilment of the commitment relating to the limitation of CO₂ emissions "in the Community by the Community as a whole through action by the Community and its Member States, within their respective competences". As a result, the European Community ratified the UN FCCC on 21 December 1993. On the same day, the threshold of 50 ratifications was met, leading to the Convention entering into force on 21 March 1994.

As a Party to the Convention, the European Community accepts, among others, the commitment to adopt policies and take corresponding measures aimed at returning emissions of greenhouse gases to 1990 levels, individually or jointly, by the year 2000. With respect to CO₂, the European Community set itself the objective to stabilize emissions by the year 2000 at 1990 levels, in the terms agreed by the Council of Ministers of 29 October 1990 .

The present Communication of the European Community under the UN FCCC explicitly describes policies and measures to address climate change which are or will be pursued at the Community level. However, the commitments of the European Community are to be reached with complementary Community and national programmes. Only a short summary of the national communications/programmes is included in order to provide a complete overview of activities taking place within the European Community.

2. SPECIFIC CIRCUMSTANCES IN THE EUROPEAN COMMUNITY

2.1. Introduction

The Member States of the European Community vary enormously in size, population, geographical and economic profile. In this chapter, an overview is provided of background information relevant to this report. Basic data and characteristics of the Member States are provided, including data relating to geography, climate, society, economy and energy.

2.2. Geographical setting of the European Community

The European Community, as a geographical entity, is relatively modest in size, but owing to the restricted area it occupies, its situation and favourable natural conditions, it is a densely populated part of the world.

In a comparatively small area, the European continent contains a rich variety of landscapes. Four major morphological zones can be distinguished:

- the North European Plain, site of many major cities and fertile agricultural lands;
- the central and southern European Highlands, comprising the Sierra Nevada, Pyrenees, and Alps;
- the old Fennoscandian Shield and Caledonian range, consisting of the Scandinavian highlands and the north and western part of Ireland and the UK; and
- the littoral zone of the Mediterranean.

The coastal zones of the European Community constitute a unique environmental heritage, with important ecological, cultural and economic resources. As an indication of the scale, the European Community has about 89.000 km of coastline excluding the small islands and inland seas (CEC, 1993)

The territory of the European Community is made up of a wide variety of land of varying quality, almost a quarter of which is arable (27%), approximately a third wooded (35%) and a substantial proportion grassland (18%). Table 2.1 provides an overview of land use in the Member States, and Figure 2.1 shows the relative contribution of land use in the European Community.

Forests are unevenly distributed, and the proportion of territory they occupy varies from one country to another. Finland (69%) and Sweden (62%) have the highest proportion of forest cover, while Ireland (5%) and the Netherlands (8%) are well below the Community average (20%). Ireland has the highest proportion of agricultural land: 80% of the total area consists of agricultural land.

Table 2.1. Agricultural land, wooded areas and other land (km²) in the Member States (figures provided for 1991).

| | Agricultural area | | Wooded area | Other land | Total area |
|--------------------|-------------------------|----------------------|-------------|------------|------------|
| | Crop lands ¹ | Meadows ² | | | |
| Austria | 15,060 | 19,860 | 32,100 | 16,700 | 83,860 |
| Belgium | 8,270 | 5,280 | 6,170 | 10,798 | 30,518 |
| Denmark | 25,480 | 2,080 | 4,450 | 11,083 | 43,093 |
| Finland | 25,130 | 1,200 | 232,220 | 79,600 | 338,150 |
| France | 192,500 | 111,040 | 148,720 | 96,826 | 549,096 |
| Germany | 119,100 | 52,430 | 104,120 | 81,297 | 356,947 |
| Greece | 39,050 | 52,550 | 26,200 | 14,157 | 131,957 |
| Ireland | 9,230 | 46,900 | 3,200 | 10,955 | 70,285 |
| Italy | 119,700 | 48,750 | 67,680 | 65,181 | 301,311 |
| Luxembourg | 560 | 696 | 890 | 446 | 2,586 |
| Netherlands | 9,220 | 10,640 | 3,500 | 18,120 | 41,480 |
| Portugal | 31,730 | 8,380 | 33,000 | 18,876 | 91,986 |
| Spain | 199,460 | 102,600 | 159,150 | 43,585 | 504,759 |
| Sweden | 27,680 | 5,520 | 280,200 | 136,560 | 449,960 |
| United Kingdom | 65,910 | 111,090 | 24,250 | 42,880 | 244,138 |
| European Community | 888,080 | 579,010 | 1,125,930 | 647,133 | 3,240,153 |

¹ Arable land and permanent crops.

² Permanent meadows and pastures.

Source: Eurostat.

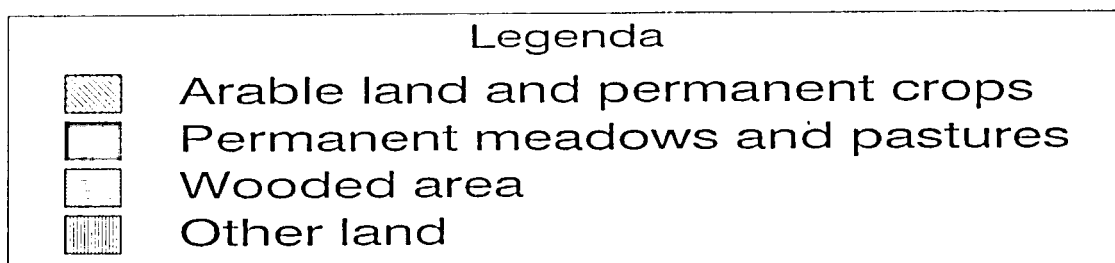
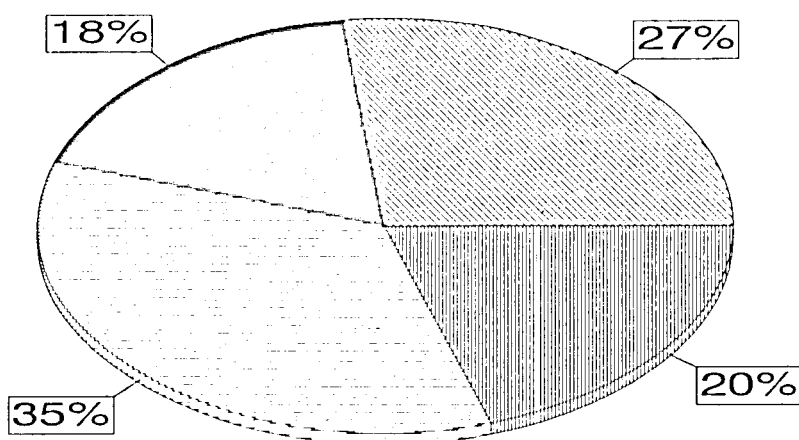


Figure 2.1. Land use in the European Community.

Source: Eurostat

2.3. Climate profile

This section deals with the EUR-12 since no data could yet be obtained from the three new Member States.

Four main types of climate can be identified in the European Community:

- the maritime climate, with mild winters, cool summers and constant humidity. This climate type dominates the western edge of the European continent.
- the semi-continental climate, with cold, dry winters and hot, stormy summers. The eastern fringes of the European Community is dominated by this type of climate.
- the Mediterranean climate, with mild, wet winters, hot dry summers and infrequent but heavy rainfall. This climate is found in the coastal areas of the Mediterranean.
- the climate found in mountain areas, which depends on altitude and exposure to sun, wind and rain.

The average temperature and precipitation varies considerably among countries. An overview is provided in Table 2.2. The coldest country is Belgium, with average temperatures of 7.2 °C (minimum) and 9.7 °C (maximum). The warmest country is Greece with average temperatures of 14.1 °C (minimum) and 18.2 °C (maximum). Spain shows the most variation in rainfall: minimum rainfall amounts to 218 mm per year, maximum rainfall amounts to 1702 mm per year.

Table 2.2. Minimum and maximum average temperature and precipitation in Eur-12 .
Long term averages.

| | Average temperature over the year (°C) | | Precipitation (mm H ₂ O) | |
|----------------|---|------|-------------------------------------|------|
| | Min. | Max. | Min. | Max. |
| Belgium | 7.2 | 9.7 | 824 | 1191 |
| Denmark | 7.5 | 8.1 | 551 | 874 |
| France | 9.5 | 14.9 | 493 | 1236 |
| Germany | 7.8 | 10.6 | 560 | 979 |
| Greece | 14.1 | 18.2 | 422 | 1044 |
| Ireland | 9.0 | 10.6 | 781 | 1502 |
| Italy | 11.5 | 18.4 | 424 | 1142 |
| Luxembourg | 8.4 | | 856 | |
| Netherlands | 8.5 | 9.7 | 562 | 777 |
| Portugal | 13.2 | 17.2 | 527 | 1064 |
| Spain | 11.0 | 18.5 | 218 | 1702 |
| United Kingdom | 8.4 | 10.9 | 496 | 967 |

Source: Eurostat

An indicator for the need for space heating is the number of degree-days, a measure of the severity of the cold during a specific period of time. The number of degree-days equals to: $(18\text{ }^{\circ}\text{C} - T_m) * d$, if T_m is lower than or equal to $15\text{ }^{\circ}\text{C}$ (heating threshold); and are nil, if T_m is greater than $15\text{ }^{\circ}\text{C}$; where T_m is the mean temperature and d is the number of days. Figure 2.2 provides an overview of the number of degree-days in the Member States. The figure shows that the greater part of the Member States has a relatively high need for space heating. No similar data are available for the need for air-conditioning in the Member States.

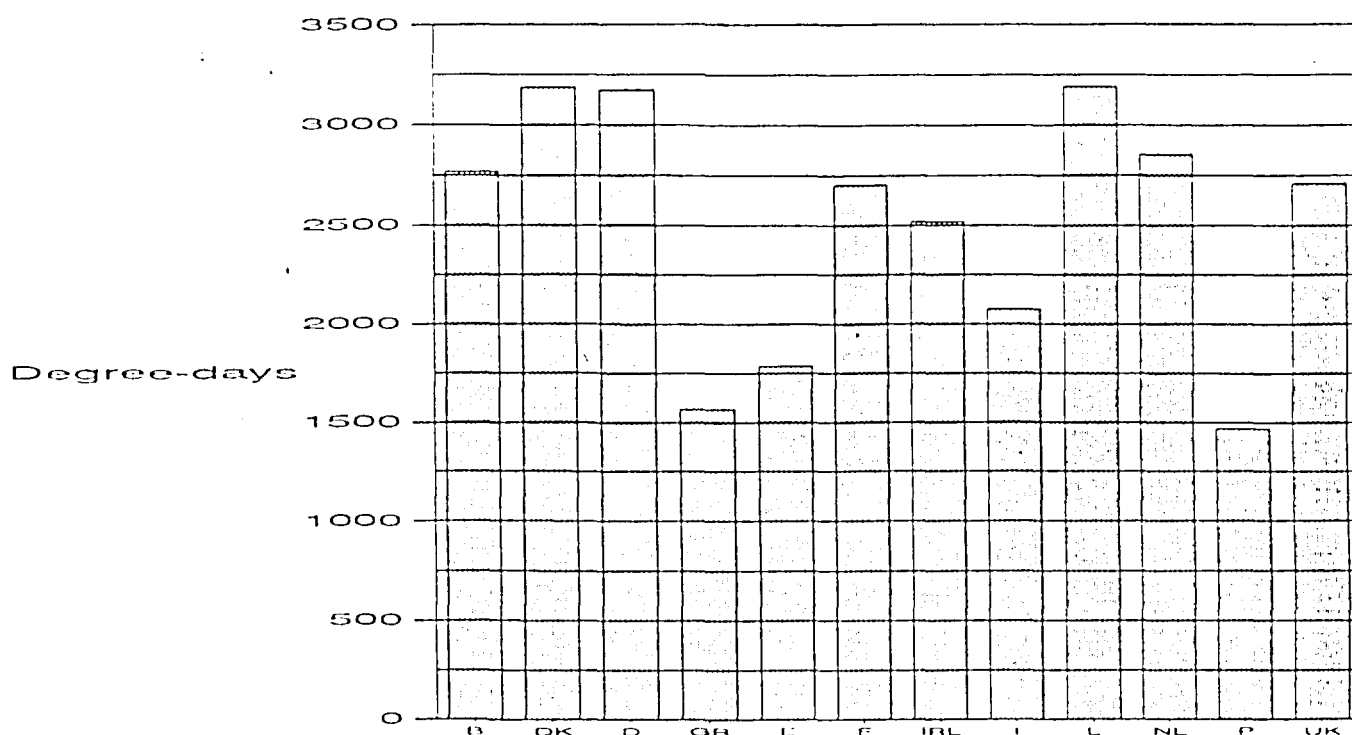


Figure 2.2. Number of degree-days¹ in the EUR-15 (figures provided for 1991).
Source: Eurostat (EU.12)

¹ The number of degree-days equals to:
 $(18\text{ }^{\circ}\text{C} - T_m) * d$, if T_m is lower than or equal to $15\text{ }^{\circ}\text{C}$ (heating threshold);
and are nil, if T_m is greater than $15\text{ }^{\circ}\text{C}$;
where T_m is the mean temperature and d is the number of days.

2.4. Social profile

In 1993, the total population of the 15 Member States of the European Community amounted to 370 million. This represented 6.5% of the total world population, compared with 9.8% in 1960 and the projected figure of 4.2% in 2020. This drop in the share of the world's population is due to a relative low increase in population compared to the increase in total world population.

The average population density of the European Community amounts to 114 inhabitants per km². In the more densely populated regions this rises to over 300 per km². The zones with a high population density are concentrated along a diagonal line from north-west England to the north of Italy through Belgium, the Netherlands and the industrialized regions of the Ruhr in Germany.

The total population, the population density and the increase in population varies considerably among the Member States. An overview of population statistics is provided in Table 2.3. The most densely populated country of the European Community is the Netherlands (369 inhabitants per km²), which also has the highest population increase (33% increase between 1960 and 1990). The average population increase in the European Community between 1960 and 1990 amounts to 17 %.

The total number of households in the European Community in 1990 amounts to 137 million, while the average household size is 2.7 persons.

Table 2.3. Population profile in the Member States.

| Member State | Total area (km ²) | Population (1000) 1993 | Population density 1993 | Population increase in % 1960 - 1993 |
|----------------|-------------------------------|------------------------|-------------------------|--------------------------------------|
| Austria | 83 860 | 7 991 | 95 | 13 |
| Belgium | 30 518 | 10 084 | 330 | 11 |
| Denmark | 43 093 | 5 189 | 120 | 13 |
| Finland | 338 150 | 5 066 | 15 | 14 |
| France | 549 086 | 57 655 | 105 | 26 |
| Germany | 356 947 | 81 179 | 227 | 12 |
| Greece | 131 957 | 10 380 | 79 | 25 |
| Ireland | 70 285 | 3 563 | 51 | 26 |
| Italy | 301 311 | 57 049 | 189 | 14 |
| Luxembourg | 2 586 | 398 | 154 | 26 |
| Netherlands | 41 480 | 15 290 | 369 | 33 |
| Portugal | 91 986 | 9 876 | 107 | 11 |
| Spain | 504 795 | 39 083 | 77 | 28 |
| Sweden | 449 960 | 8 719 | 19 | 16 |
| United Kingdom | 244 138 | 58 191 | 238 | 11 |
| EUR-15 | 3 240 153 | 369 715 | 114 | 17 |

Source: Eurostat

2.5. Economic profile

In 1993, the Gross Domestic Product (GDP) of the European Community (expressed in constant prices of 1985) amounted approximately to 4400 billion ECU. The EC economy consists of a rather heterogeneous entity composed of a limited number of big economies and some medium-sized and smaller economies. Table 2.4 provides an overview of the GDP and the annual growth rate in the Member States. Germany, France, Italy and the United Kingdom, the four Member States with the highest GDP, account for 75% of the total GDP in the EC and, are therefore the driving forces of the EC's economic activities.

The level of development of the national economies in the European Community varies considerably among the Member States. Figure 2.3 shows the GDP per capita in the Member States in 1993. The GDP per capita of the majority of the Member States lies in between 11 500 ECU and 16 500 ECU (figures in 1985 prices and exchange rates). Four Member States have a GDP per capita which is considerably lower than the average GDP per capita for the European Community, ranging from 4 200 ECU to 10 500 ECU. The trend in GDP growth, however, shows that those countries have the highest annual growth rate in GDP and thus are currently catching up with the other countries in the European Community.

Table 2.4. Gross Domestic Products at market prices in the European Community (expressed in 1985 prices and 1985 exchange rates).

| Member State | GDP 1993 (bill. ECU) | Annual % change 1970-1993 |
|----------------|-------------------------|------------------------------|
| Austria | 104.6 | 2.7% |
| Belgium | 125.3 | 2.3% |
| Denmark | 85.1 | 2.0% |
| Finland | 73.3 | 2.3% |
| France | 808.0 | 2.4% |
| Germany | 1049.6 | 2.5% |
| Greece | 59.3 | 2.8% |
| Ireland | 37.2 | 4.4% |
| Italy | 658.5 | 2.6% |
| Luxembourg | 7.7 | 4.0% |
| Netherlands | 204.7 | 2.3% |
| Portugal | 41.2 | 3.5% |
| Spain | 276.9 | 2.9% |
| Sweden | 141.3 | 1.5% |
| United Kingdom | 708.7 | 2.0% |
| EUR-15 | 4381.2 | 2.4% |

Source: Eurostat

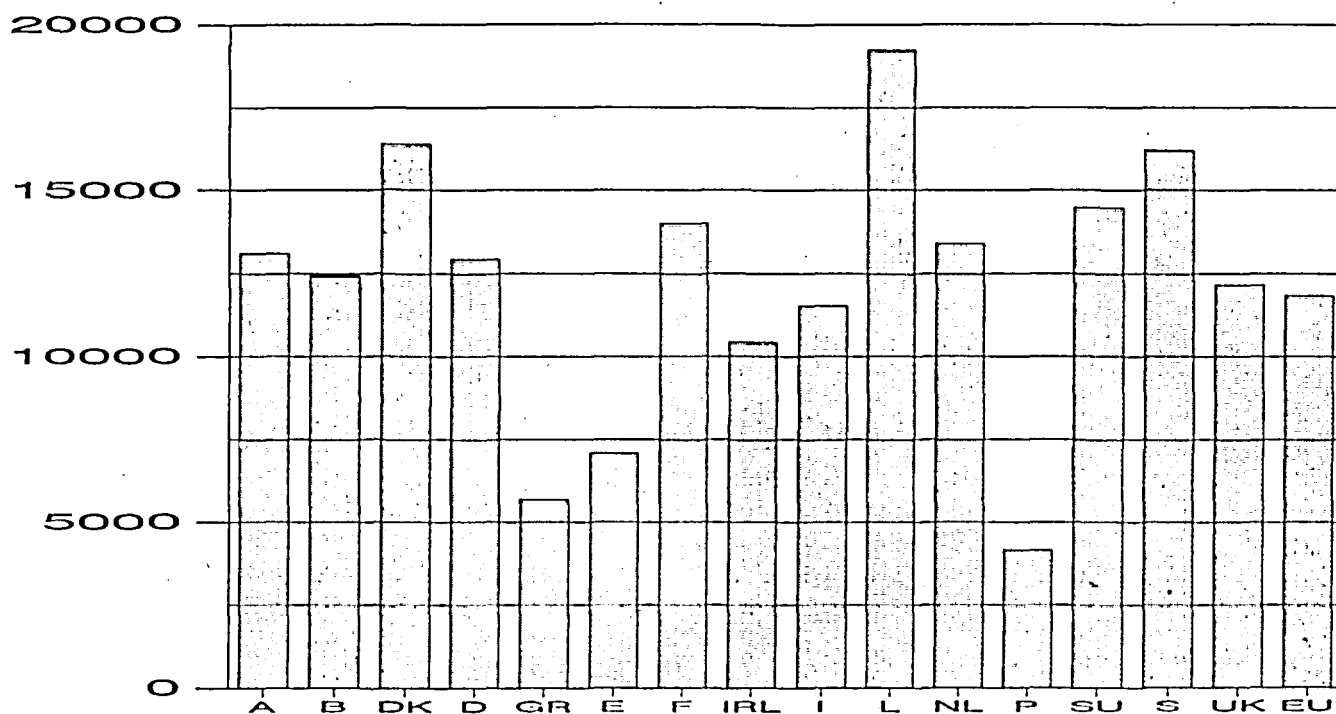


Figure 2.3. GDP per capita in the European Community in 1993 (in ECU at 1985 prices and 1985 exchange rates).

Source: Eurostat

Service sectors (both market and non-market services) are the most important economic sectors in the European Community. Their relative share in economic activities is still growing. Manufacturing industries are the second most important sector. The importance of the agricultural sector is currently decreasing. Table 2.5 shows the Gross Value Added (GVA) per economic sector.

Table 2.5. Relative contribution of sectoral Gross Value Added in the European Community (in current prices and exchange rates); EUR-12.

| Sector | GVA 1992 (mill. ECU) | GVA 1992 (% of total GVA) | Annual change of GVA 1980 - 1992 (%) |
|-------------------------|-------------------------|------------------------------|--|
| Agriculture/Forestry | 131,832 | 2.6 % | 3.8 % |
| Energy | 241,028 | 4.7 % | 6.1 % |
| Manufacturing | 1,139,325 | 22.3 % | 5.9 % |
| Building & Construction | 312,820 | 6.1 % | 6.0 % |
| Market Services | 2,520,722 | 49.4 % | 8.8 % |
| Non-Market Services | 753,758 | 14.8 % | 7.4 % |
| Total of Branches | 5,099,491 | 100 % | 7.4 % |

Source: Eurostat.

Transport

Transport has made a major contribution to economic growth in the European Community. It has enabled the achievement of important economies of scale in production and led to increased competition. In the EC, the transport sector accounts for approximately 7-8% of the GDP and 4-5% of the total salaried workforce (White Paper on the Common Transport Policy, COM (92)494 final 2.12.1992). The transport sector in the EC is characterised by strong growth. Since 1970, the overall annual growth in inland transport has averaged 3.1% for passengers and 2.3% for goods (White Paper on the Common Transport Policy, COM (92)494 final, 2.12.1992). Since 1980, the increase in air passenger transport has averaged 6.2% per annum (CEC, 1993).

Transport is a major source of greenhouse gas emissions in the Community. Road transport accounts for 85% of the CO₂ emissions and 90% of the CH₄ of inland transport emissions. Passenger cars are responsible for 45% and commercial vehicles for 32% (Green Paper on Transport and Environment; COM(92),46 final, 20.02.92). The average number of cars in the European Community per 1000 inhabitants amounted in 1993 to 420 (Eurostat). Air transport is the second single most important source of CO₂ emissions, with a share of 11%. Rail and inland waterways account for 1% and 3% respectively (Eurostat).

2.6. Energy profile

As a result of developments in final energy demand and in inputs for electricity generation, EC Gross Inland Consumption (GIC) of energy in 1990, at 1239 Mtoe, was 17.7% higher than in 1974. However, this figure hides large fluctuations in the mid-seventies and early eighties, due to the oil shocks of that period. Table 2.6 shows the Gross Inland Consumption in the EC.

Table 2.6. EC Gross Inland Consumption (Mtoe).

| | 1974 | 1986 | 1990 | 1993 ⁷ | Average Annual Increase |
|-------------|------|------|------|-------------------|-------------------------|
| Solids | 235 | 243 | 245 | 247 | 0.3% |
| Oil | 626 | 515 | 532 | 561 | 0.6% |
| Natural gas | 137 | 193 | 216 | 252 | 3.3% |
| Other | 56 | 219 | 247 | 271 | 8.6% |
| Total | 1053 | 1169 | 1239 | 1331 | 1.2% |

Source: IEA and Eurostat

The increase is entirely due to non-fossil fuels, mainly nuclear power. Furthermore, in 1990 consumption of fossil fuels was at the same level as in 1974 (source: Eurostat).

For its energy provision, the EC depends on imports. The degree of self-sufficiency, i.e. total domestic production divided by GIC, rose from 37% in 1974 to 57% in 1986, declining again to 52% in 1992.

The composition of indigenous energy production is provided in Table 2.7.

Table 2.7. EC Primary Production (Mtoe).

| | 1974 | 1986 | 1990 | 1993 ⁸ | Average Annual Increase |
|----------------|------|------|------|-------------------|-------------------------|
| Solids | 189 | 176 | 155 | 156 | -1.0% |
| Oil | 15 | 150 | 115 | 125 | 11.9% |
| Natural gas | 130 | 126 | 131 | 158 | 1.1% |
| Nuclear | 22 | 155 | 180 | 198 | 12.3% |
| Hydro and wind | 21 | 23 | 23 | 25 | 0.8% |
| Geothermal | 2 | 2 | 2 | 3 | 1.6% |
| Other | 10 | 42 | 42 | 46 | 8.3% |
| Total | 389 | 675 | 647 | 709 | 3.2% |

Source: IEA and Eurostat

⁷Data for 1993 include the NEW BUNDESLANDER and DDR.

⁸Data for 1993 include the NEW BUNDESLANDER and DDR.

Table 2.8 relates the development of energy intensity, measured as the quotient of GIC and Gross Domestic Product (GDP). Moreover, the development of GIC per inhabitant is shown.

Table 2.8. Indicators.

| | 1974 | 1986 | 1990 | 1993 ⁹ |
|------------------------------|------|------|------|-------------------|
| GIC/GDP (toe/1985 MECU) | 358 | 312 | 294 | 304 |
| GIC/Capita (kgoe/inhabitant) | 3027 | 3253 | 3401 | 3600 |

Source: IEA and Eurostat

From 1974 to 1993 the total GDP of EC Member States rose by an annual average of 2.1%. Energy intensity declined on average by an annual percentage of 0.9%. GIC per capita rose annually by 0.9% on average.

Regarding Final Energy Consumption by economic sectors, developments from 1974 until 1993 are given in Table 2.9.

Table 2.9. Final Energy Consumption (FEC) by economic sectors (Mtoe).

| | 1974 | 1986 | 1990 | 1993 ¹⁰ |
|-----------------------|------|------|------|--------------------|
| Industry | 304 | 233 | 251 | 253 |
| Transport | 150 | 208 | 247 | 271 |
| Domestic and Tertiary | 281 | 332 | 320 | 367 |
| TOTAL | 736 | 773 | 817 | 890 |

Source: IEA and Eurostat

In industry, there has been a 40% improvement in energy intensity (FEC/production) from "1974 until 1993". Industrial production rose by 28%, while FEC declined. In transport energy demand has grown faster than the overall economic activity.

⁹Data for 1993 include the NEW BUNDESLÄNDER and DDR.

¹⁰Data for 1993 include the NEW BUNDESLÄNDER and DDR.

3. THE EC EMISSION INVENTORY

3.1. Introduction

This chapter provides a summary of the 1990 emission inventory of greenhouse gases for the EC. The following gases will be discussed: CO₂, CH₄, N₂O, CO, NO_x and NMVOCs. Emission estimates have been calculated on the basis of the national inventories of the 15 Member States and by using the "IPCC guidelines for national greenhouse gas inventories" as far as possible. A more detailed description of the approach applied to arrive at the EC inventory is provided in Section 3.2. The emission inventories of each of the 15 Member States are included in Annex 1. Details on activity data and emission factors have not been included in this Communication since these have all been reported in national reports or Eurostat and/or CORINAIR databases. In Annex 1, reference is made to the information sources.

3.2. Inventory methodology

Greenhouse gas emissions in the European Community in 1990 are presented in Table 3.1.

The EC inventory for the year 1990 has been compiled based on the inventories of the 15 individual Member States. The following sources have been used to compile the emission inventories of the individual Member States:

- National communications prepared by the Member States under the UN Framework Convention on Climate Change and/or national programmes under the EC Decision on a Monitoring Mechanism for CO₂ and other greenhouse gases. In general, the inventories reported in these national reports followed the IPCC guidelines for National Greenhouse Gas Inventories.
- CORINAIR inventory programme. 1990 databases have been used, which were provided to the European Environment Agency by the Member States.
- Eurostat. CO₂ emission estimates have been compiled from Eurostat energy balances and harmonized emission factors derived by Eurostat from an analysis of emission factors used by the Member States in about 1990.

To estimate total greenhouse gas emissions in the European Community, total greenhouse gas emissions in each of the Member States were added together¹¹. Estimates of emissions in the Member States were primarily taken from the national reports. If no

¹¹ Estimates provided in Table 3.1 are provisional figures, updated up to June 1995.

nationally reported emission estimates were available, CORINAIR figures were used. Fuel combustion related CO₂ emissions reported in national reports and/or CORINAIR were compared with Eurostat CO₂ figures. Nationally reported (non-CORINAIR) emission estimates were used if these figures were available, and consistent with Eurostat figures. However, if the nationally reported estimate was significantly lower than the Eurostat estimate, the Eurostat estimate was used since it was assumed that the nationally reported value was likely to be incomplete. If no nationally reported estimates were available, CORINAIR figures were similarly compared with Eurostat.

It should be noted that the national reports of the Member States and/or CORINAIR databases are not complete and thus the emission inventories for each of the Member States do not always cover all source categories identified in the IPCC guidelines for national greenhouse gas emissions. Therefore, the sub-totals of the various categories presented in Table 3.1 do not add up to the category totals in Table 3.1. This apparent inconsistency can only be resolved when the sub-totals for all Member States become available.

Since nationally reported inventories were not available for all EC Member States, and CORINAIR does not include removals of CO₂, CO₂ emissions and/or removals from the category land use change have not been quantified in the EC inventory.

Table 3.1. EC inventory of greenhouse gas emissions. 1990. (Gg). Provisional estimates.

| Estimates of greenhouse gases in European Community (EUR-15) - 1990 (Gg). | | | | | | |
|---|-----------------|-----------------|------------------|-----------------|--------------|--------------|
| | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NM VOC |
| 1 All energy | 3142840 | 5599 | 156 | 13290 | 46229 | 8422 |
| 1a Fuel combustion | 3134740 | 794 | 156 | 13202 | 46137 | 7697 |
| 1a1 Energy & transformation | 1173200 | 49 | 66 | 2947 | 1215 | 105 |
| 1a2 Industry | 606600 | 60 | 29 | 1412 | 3191 | 99 |
| 1a3 Transport | 704900 | 206 | 36 | 7883 | 33718 | 6529 |
| 1a4 Commercial/institutional | 325000 | 84 | 12 | 231 | 2164 | 342 |
| 1a5 Residential | 265900 | 286 | 12 | 263 | 4037 | 464 |
| 1a6 Agriculture/forestry | 34500 | 27 | 0 | 268 | 1048 | 155 |
| 1a7 Other | 25400 | 6 | 0 | 191 | 227 | 61 |
| 1a8 Biomass | 13200 | 87 | 2 | 29 | 1711 | 111 |
| 1b Fugitive fuel | 8100 | 4806 | 1 | 88 | 92 | 849 |
| 1b1 Oil & gas | 7800 | 485 | 0 | 88 | 59 | 792 |
| 1b2 Coal mining | 0 | 2817 | 0 | 0 | 0 | 0 |
| 2 Industrial processes | 130730 | 40 | 351 | 151 | 2811 | 1060 |
| 2a Iron & steel | 4300 | 9 | 0 | 12 | 1563 | 21 |
| 2b Non-ferrous metals | 4800 | 0 | 2 | 1 | 398 | 0 |
| 2c Inorganic chemicals | 8700 | 6 | 90 | 60 | 6 | 31 |
| 2d Organic chemicals | 2600 | 5 | 234 | 0 | 14 | 584 |
| 2e Non-metallic minerals | 102400 | 2 | 0 | 14 | 0 | 0 |
| 2f Other | 2000 | 3 | 0 | 14 | 224 | 260 |
| 3 Solvent use | 300 | 0 | 6 | 0 | 0 | 4045 |
| 3a Paint application | 100 | 0 | 0 | 0 | 0 | 1399 |
| 3b Degreasing & Dry cleaning | 50 | 0 | 0 | 0 | 0 | 352 |
| 3c Chemical prods manuf/proc | 50 | 0 | 0 | 0 | 0 | 470 |
| 3d Other | 100 | 0 | 6 | 0 | 0 | 1327 |
| 4 Agriculture | 500 | 10361 | 393 | 50 | 2763 | 739 |
| 4a Enteric fermentation | 500 | 6267 | 0 | 0 | 0 | 0 |
| 4b Animal wastes | 0 | 2571 | 15 | 0 | 0 | 381 |
| 4c Rice cultivation | 0 | 98 | 1 | 0 | 0 | 0 |
| 4d Agricultural soils | 0 | 299 | 277 | 0 | 0 | 178 |
| 4e Agricultural waste burning | 0 | 141 | 64 | 43 | 2362 | 131 |
| 4f Savannah burning | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 Waste | 11050 | 8669 | 20 | 48 | 125 | 109 |
| 6a Landfills | 5400 | 7912 | 0 | 5 | 58 | 67 |
| 6b Wastewater | 0 | 233 | 9 | 0 | 0 | 0 |
| 6c Other | 5650 | 90 | 11 | 21 | 51 | 13 |
| Total emissions | 3285620 | 24671 | 928 | 13546 | 52006 | 14397 |
| Marine bunkers | 113600 | | | | | |
| Aviation bunkers | 56500 | | | | | |
| FNEC | 243600 | | | | | |

Notes:

- Estimates of greenhouse gas emissions in the European Community are based on estimates of emissions in the 15 Member States, updated up to June 1995.
- Sub-totals of categories (e.g. 1b1 and 1b2) do not always add up to total emissions per category (e.g. 1b). This is due to the fact that the emission inventories for each of the Member States do not always cover all categories as identified in the draft IPCC guidelines for national greenhouse gas inventories.
- Emissions from Final Non Energy Consumption (including feedstocks) have not been included in total emissions. Therefore, total emissions are underestimated in comparison with the IPCC methodology. Emissions from Final Non

Energy Consumption (FNEC) are based on the total carbon contained in the products. The addition of total emissions and emissions from FNEC would therefore produce an overestimation compared to the IPCC methodology. CO₂ emissions and/or removals from Land Use Change are not known for many countries and hence have not been included in this table. Non-CO₂ greenhouse gas emissions from Land Use Change have neither been estimated.

3.3. Feedstocks

The emission estimates presented in Table 3.1 are structured according to the reporting instructions of the IPCC guidelines for greenhouse gas inventories. However, the category "Final Non Energy Consumption (FNEC)" was added to the table, since inconsistencies exist between the detailed IPCC approach to calculate energy-related CO₂ emissions and the IPCC reporting instructions. In general, national reports of the Member States do not explicitly describe their approach to calculate emissions from feedstocks. For reasons of consistency, EUROSTAT estimates have been used for each of the Member States to calculate feedstock emissions. These have been reported separately in the category "Final Non Energy Consumption (FNEC)".

It should be noted that this approach results in lower total CO₂ emissions than the approach followed by the IPCC guidelines. The latter includes carbon emitted by the use of feedstocks in their total estimates of CO₂ emissions from energy sources, where the approach taken here excludes emissions from feedstocks from total emissions. The emissions reported in the category "Final Non Energy Consumption" should be seen as the *potential* emissions from feedstocks and other non-energy uses. This category also includes the carbon actually stored in products and not emitted into the atmosphere. Thus, total CO₂ emissions as expressed in Table 3.1 are underestimated compared with the IPCC methodology, while the addition of total CO₂ emissions and "Final Non Energy Emissions" would produce an overestimation.

3.4. Bunkers

Following the decisions taken at INC-9, emissions from bunkers are not included in the total emissions in summary Table 3.1. Total CO₂ emissions from marine bunkers in the EC amounted to 113,600 Gg in 1990, while total CO₂ emissions from aviation bunkers amounted to 59 100 Gg. Since only a few Member States provided estimates of bunker emissions, emission estimates from maritime bunkers are based on Eurostat figures. Aviation bunker emissions have been estimated by reconciling non-road transport figures from Eurostat against estimates reported in CORINAIR and/or country reports. Annex 1 provides the emission estimates for each of the Member States.

3.5. Uncertainties involved

The uncertainty in the emission estimates has not been quantified, since quantitative estimates of the uncertainty would be highly unreliable. A statistical approach to quantify uncertainties in the emission estimates would not result in reliable figures at this stage for the reasons given below.

Estimates for CO₂ emissions from fuel combustion activities (based on energy balance figures) are rather reliable and are likely to be least uncertain (within about +/- 3%).

The uncertainty in estimates of non-CO₂ greenhouse gas emissions is considerably higher, due to the lack of knowledge or awareness of some of the sources and appropriate emission factors for these gases. As there may be some as yet unknown sources of these gases, estimates of these emissions are likely to be underestimated. The uncertainty in emission estimates is increasing in the following order: CO < NO_x < CH₄ < NMVOC < N₂O, with uncertainties increasing to several orders of magnitude (several hundreds of percent).

4. PROGRAMMES, POLICIES AND MEASURES

4.1. Introduction

This chapter surveys the policies and measures that have been adopted by the European Community with the objective of limiting emissions of greenhouse gases. Policies that are explicitly and primarily directed towards a limitation of greenhouse gas emissions are described in sections 4.2 to 4.5. Sectoral policies that include specific environmental measures and/or have side-effects on greenhouse gas emissions are described in section 4.6, nl. EC policies on agriculture, forestry, transport and waste. If available, assessments are presented of the impact of the policies on greenhouse gas emissions. Section 4.7 summarizes the policies and measures described in this chapter, distinguishing policies and measures adopted by the Council, proposed by the Commission and in preparation by the Commission.

4.2. The Community strategy to limit CO₂ emissions and improve energy efficiency

In October 1991, the Commission presented an overall strategy to limit CO₂ emissions and improve energy efficiency, with the objective of stabilising CO₂ emissions in the Community in the year 2000 at the 1990 level (SEC(91)1744 final). This so-called "no-regret" strategy consists in unlocking the zero- or low-cost potential for limiting CO₂ emissions, which currently exists in all sectors of the economy and which also brings benefits in the field of air pollution and energy security as well as competitiveness and employment.

In June 1992, a mutually reinforcing package of measures and programmes was proposed to the Council (COM(92)246 final). It rests on four pillars:

- *The EC energy technology programmes and trans-European networks.*
The existing Community programmes, THERMIE and SAVE, have been reinforced. A new programme, ALTENER, and an action, which aims at the Rationalisation of Energy Use at Regional and Urban Level, have been adopted since 1990. The THERMIE programme is an energy technology dissemination programme. SAVE and ALTENER provide financial support for various actions in the field of energy efficiency and renewables, but also include the preparation of regulatory measures at EC level. Also "Energy Management at Regional and Urban level" and the development of trans-European networks contributes to the goal of CO₂ emission limitation (section 4.3).

- *Fiscal measure.*
In June 1992, the Commission issued a draft Council Directive proposing a harmonised tax on carbon dioxide emissions and energy use imposed at Member State level, which has not been adopted yet by the Council (section 4.4).
- *Complementary national programmes.*
The Community strategy requires policy programmes which limit greenhouse gas emissions at Member State level, and which will be complementary to actions taken at the Community level. The national programmes of the Member States are described in chapter 5.
- *EC Decision on a Monitoring Mechanism for CO₂ and other greenhouse gases.*
Part of the Community strategy is a monitoring mechanism to follow whether the CO₂ stabilisation target of the Community is attainable. In the framework of the Monitoring Mechanism Member States are required to submit their national programmes to the Commission for evaluation. In June 1993, a Decision establishing the monitoring mechanism was adopted (section 4.5) Member States have submitted their national programmes and/or communications under the Convention. The first evaluation was carried out on the basis of national programmes received by the Commission in 1993. A second evaluation of the up dated national programmes/communications under the Convention is foreseen for the fall of 1995.

The four pillars constitute the first step towards the goal of reducing emissions of carbon dioxide. With the formulation of the strategy a continuous process has begun of evaluating measures adopted, and formulating new policies and measures to attain the carbon dioxide objectives the Community has committed itself to.

4.3. Community programmes and initiatives

This section describes the Community programmes for support of energy technology (THERMIE), energy efficiency (SAVE), the use of renewable energy sources (ALTENER) and the initiative "Energy Management at Regional and Urban level". Moreover, a brief description is included of the recent initiative on trans-European networks and of voluntary schemes.

THERMIE (Energy Technology Support Programme)

The abatement of environmental impacts through energy efficiency, as well as the introduction of renewables or cleaner ways of using fossil fuels ultimately depend on the implementation of better energy technologies. The THERMIE programme, Council Regulation (EEC) No. 2008/90, dealt with the demonstration and dissemination of cleaner and more efficient energy techniques in order to facilitate their widespread market penetration. THERMIE also focused on other Community objectives: security of energy supply, economic and social cohesion, improving competitiveness and

employment, the single market and cooperation with Central and Eastern Europe and the CIS (Commonwealth of Independent States).

The original THERMIE programme came to an end in 1994, although the projects supported from 1990 to 1994 are still being monitored and promoted. The overall budget amounted to 700 MECU¹², or 140 MECU annually (0.2% of the EC budget). The main portion of the THERMIE budget (85%) was devoted to innovative technologies and projects, which have already passed through the R&D stage, but have not been implemented on a wider scale due to technical and economic risks. The remaining portion of the budget (ca. 15%) was spent on a wide range of promotional activities such as market assessments, monitoring, documentation, databases, workshops, conferences and training. To implement the wide range of measures, the Commission has set up a network of Organisations for the Promotion of Energy Technologies (OPET) in 1991, consisting of 49 organisations from EC Member States that are both from the public and the private sector. The organisations assist in the promotion and dissemination of innovative energy technologies.

From 1990 to 1994, 726 THERMIE projects were supported. A cost-benefit analysis of the THERMIE projects supported in 1990-1993, predicted that they would lead to a reduction in CO₂ emissions of 42 million tonnes in the Community (rising to more than 625 million tonnes with anticipated replication) as well as contributing to reductions in the emissions of other pollutants such as acid rain gases, volatile organic compounds and carbon monoxide.

According to an assessment made by the Directorate-general for Energy of the Commission every ECU spent in the Programme will contribute, on average, to 1,617 kg of avoided cumulative CO₂ emissions compared to a "normal" energy technology using fossil fuels. This estimate is encumbered by the following uncertainties:

- the supported projects may not have been implemented as planned;
- included in the assessment is an estimate of the dissemination impact, i.e. the expected replication in other projects of the technologies applied in the projects supported by THERMIE.

The replication is estimated to be ca 15 times the direct effect of the supported projects.

From 1 January 1995 the programme has continued as the new Non-Nuclear Energy Programme, better known as JOULE-THERMIE, within the European Community's Fourth Framework Programme for Research and technological development including demonstration. This new programme brings together for the first time the research and development aspects of the JOULE with the demonstration and promotion initiatives of THERMIE.

The Programme is a vital part of the EC's strategy for meeting the energy challenges we face today. Building on past successes, the JOULE-THERMIE Programme will help to

¹² 1 MECU = 1 million ECU.

reduce the negative environmental impacts associated with the production and use of energy, ensure lasting and reliable energy sources, at affordable costs and strengthen the technological basis of European industry.

SAVE (Specific Actions for Vigorous Energy Efficiency)

The SAVE programme was adopted in October 1991 (Council Directive 91/565/EEC). It will terminate at the end of 1995. The objective is to increase energy efficiency and thereby reduce CO₂ emissions through legislation on mandatory energy efficiency standards, quality labels, standardization, creation of infrastructures, pilot actions, training and dissemination of information. By creating a Community framework, SAVE enables the Member States to adopt energy efficiency measures at the national level. The budget of the programme is 35 MECU for the period 1.1.1991 - 31.12.1995.

SAVE consists of three elements:

1. A programme of energy efficiency legislation, aimed at removing institutional and administrative barriers to investment in energy efficiency and creating standards for energy equipment.

The following directives have been adopted:

- Efficiency of new hot water boilers (Council Directive 92/42/EEC);
 - Energy labelling of major household appliances, (Council Directive 92/75/EEC). In the framework of this labelling directive, an implementation directive on energy labelling of household refrigerators and freezers (94/2/EEC) has been adopted.
 - Building certification, billing according to actual consumption, third party finance, insulation of new buildings, boiler inspection and energy management (Council Directive 93/76/EEC).
2. Financial Support for the creation of energy efficiency infrastructures in Member States.

The programme includes projects in areas such as: education and training, integrated resource planning, third-party financing, cogeneration, monitoring and targeting, energy efficiency in the transport and building sectors, and introduction of Community legislation in Member States. The budget of the financial support programme is 35 MECU for the years 1991 to 1995. The level of support can amount to 50% of total project costs. 204 projects have received support at a total budgetary cost of 21 MECU.

3. Information Exchange Network.

The network involves a database on energy efficiency measures and specific promotional activities, such as conferences, symposia and workshops.

In the framework of the programme of energy efficiency legislation a number of Directives are in preparation:

- 2 Directives on appliance standards for energy efficiency.

The Council adopted a Decision (OJ No L 157) establishing PACE, a Community action programme for improving the efficiency of electricity use. In the framework of PACE, directives are being prepared on appliance efficiency standards for refrigerators, electric motors, office equipment and commercial lighting.

- A Directive on Integrated Resource Planning.

Integrated resource planning for electricity and gas is actively promoted in the framework of the completion of the internal market for energy. Utilities should therefore investigate supply side and demand side management options (energy efficiency and renewables at consumer level) on an equal footing. This requires that utilities be able to obtain profits, not only from selling gas or electricity, but also from *energy services* they provide in the form i.a. of energy efficiency investments in end-use sectors.

- Labelling directives for washing machines and dish washers, and light bulbs.

For the SAVE programme no assessment is available on the impacts in terms of avoided emissions of CO₂ or other greenhouse gases.

The first SAVE programme terminates at the end of 1995, but energy efficiency remains a key political area: for environmental reasons, for security of supply, and because its promotion is linked to important Single Market/competitiveness and coherent objectives. In its proposal for a new SAVE programme, SAVE-II, (COM (95) 225), the Commission proposed to incorporate both the Electricity End Use Programme (PACE) and the Regional and Urban Energy management Initiative. All these actions have complementary goals and the SAVE-II Programme provides a comprehensive framework for undertaking all these related activities.

The following nine categories of actions on energy efficiency policy are proposed to be financed under the programme:

- studies and other actions leading to the implementation and completion of Community energy efficiency legislation and performance standards;
- sectoral pilot actions aimed at accelerating energy efficiency investments and/or improving consumer energy use patterns, to be carried out essentially by Community wide networks;
- targeted sectoral pilot actions aimed at accelerating energy efficiency investment and improving consumer energy use patterns, to be carried out essentially by public and private enterprises;
- measures proposed by the Commission or by third parties to foster the exchange of experience mainly through information networks aimed at promoting better coordination between Community, international, national, regional and local activities through the establishment of appropriate means for exchanging information;

- an action relating to the detailed sectoral; monitoring of energy efficiency progress in the Community, in individual member states and including the SAVE programme itself;
- specific actions in favour of greater cohesion in member states and regions in the field of energy efficiency through support for the creation of energy efficiency infrastructures in those member states and regions where energy efficiency policies are not yet sufficiently developed;
- specific actions in favour of energy management at the regional and urban level;
- studies and other actions in support of energy efficiency initiatives, within other programmes or aimed at establishing energy efficiency as a criterion within EC strategic programmes; and
- evaluation and monitoring of the actions undertaken.

SAVE-II is scheduled to begin on 1 January 1996 and will run until 31 December 2000. The proposed budget is 150 MECU.

ALTENER (Programme for the Promotion of Renewable Energy Sources)

The ALTENER programme was adopted by the Council in September 1993 (Council Decision 93/500/EEC). The overall purpose is to establish a framework for specific actions whose objective is a greater market penetration of renewable energy sources (small hydroelectric plants, wind power, solar energy, biomass, biofuels and biogas, geothermal energy). The programme runs from 1993 until 1997 and has a budget of MECU 40. So far 114 pilot projects have been supported at a cost of MECU 11.

Specific objectives for the development of renewable energy sources in the Member States, as set out in ALTENER are:

- increasing the market share of renewable energy sources from 4% in 1991 to 8% in 2005;
- tripling the production of electricity from renewable energies;
- securing a 5% market share of biofuels in motor vehicle consumption.

Similar to SAVE, ALTENER has the following elements:

- In preparation: legislative and standardization measures.
Standardization measures are geared at ensuring the free circulation of renewable energy equipment. Envisaged are a harmonization of safety standards for wind generators and specifications for biodiesel as motor fuel.
- Financial support programme for the development of technical standards and specifications, training and information activities, sectoral pilot projects, biofuels, integrated resource planning and demand-side management, third party finance, the guarantee of financial risks, local development plans and feasibility studies. In 1993 and 1994, a total of 114 projects have been supported.
- Information Exchange Network.

Information and promotional activities include: coordination of national, Community and international activities, symposia, conferences and workshops and databases.

For the ALTENER programme no assessment is available on the impacts of the programme in terms of avoided emissions of CO₂ or other greenhouse gases.

Energy management at regional and Urban level

This initiative, initiated in 1990, promotes studies on the definition and implementation of energy plans. It further aims to disseminate and transfer the expertise in this field throughout the Union. A fundamental goal of local and regional projects undertaken in the context of the initiative is to protect the environment by developing energy management, improving energy efficiency, and by providing alternative energy production options. The initiative, with a total budget of 20 MECU will be incorporated in the SAVE-II programme.

In preparation: Trans-European networks

Switching to cleaner fuel with lower carbon content can produce energy and environmental benefits, especially in those regions where due to infrastructure limitations fuels such as natural gas had been unavailable in the past. Trans-European networks have a crucial role to play in bringing cleaner fuel to peripheral regions as well as in improving the flexibility of the European gas supply system. The more efficient and flexible these networks can be operated, the less reason exists for security of supply concerns in the case of a rapid switch to natural gas. The same applies for trans-European electricity networks which support the use of electricity produced from low/zero carbon sources throughout the Community.

Voluntary schemes

Limitation of CO₂ and other greenhouse gases requires the active involvement and participation of all economic and social actors. Voluntary schemes and auto regulation will have to play an important role in the future. The Commission has recently given a mandate to CEN/CENELEC (an international body for standardization in the electricity field) to elaborate European Standards in the field of thermal solar systems and their components. Likewise, standards are being elaborated concerning photovoltaics and wind turbines. The dissemination of cost-effective minimum standards is beneficial in both energy and environmental terms. Commission services have also been collaborating with the European Electricity Supply Industry to find cost-effective ways to limit CO₂ emissions through electricity related supply and demand side options.

Moreover, negotiations are underway for a voluntary labelling programme concerning energy efficiency of computer and other office equipment. This voluntary scheme, which could include manufacturers from the USA and Japan, would provide for a quasi worldwide labelling scheme.

4.4. The proposal for an energy/carbon tax

In June 1992, the European Commission proposed a draft Directive (COM(92)226 final) for the introduction of a tax on all energy products, excluding renewables, based 50% on energy content and 50% on carbon content of fuels. The objective was to improve energy efficiency and favour fuel substitution towards products emitting less or no CO₂.

It was proposed to introduce the tax in steps, starting at a rate of 0.21 ECU/GJ and 2.81 ECU/t CO₂ in the first year (equivalent to \$3 per barrel of oil). In each of the following seven years these rates were to be increased by one third of the tax rates of the initial year. In the last year these rates would therefore have reached 0.7 ECU/GJ and 9.4 ECU/t CO₂, equivalent to \$10 per barrel.

Concerning electricity, the inputs in power stations would be taxed according to the carbon content of the fuels used. As regards the energy part, the tax would be fixed in terms of ECU per MWh. Raw materials, i.e. energy sources used as feedstocks, would not be taxed.

Graduated reductions and conditional exemptions of the tax were to be applied for energy intensive firms. The reductions would depend on the share of energy costs in total value added of the products obtained using the energy. Full exemption of the tax would be reserved for those firms which use energy-intensive production processes and are very dependent on external trade.

The tax proposal has been estimated to lead to a reduction of 3.8% of 1990 CO₂ emissions by the year 2000.

Present status of the proposal

Unanimous approval from the Council is required for adopting a fiscal measure. At its meeting at Essen on 9 December 1994, the Council has taken note of the Commission's intention to present guidelines on common parameters for those Member States willing to apply a CO₂/energy tax. As a follow-up of these Conclusions the Commission decided on 10 May 1995 to amend its initial proposal, in order to overcome the obstacles raised during previous discussions in Council (COM (95) 172).

The main change proposed is that the implementation of a harmonised tax will be preceded by a transitional period during which the Member States, while respecting a harmonised structure, are free to set the tax rates product by product, provided that the Community objectives of limiting CO₂ emissions through improvement of energy efficiency and fuel switching towards low- no carbon fuels is fully reflected in the structure of the rates applied.

In addition, the minimum rates set out in the original proposal (3 US\$/bbl) are revised (10US\$/bbl) and become target rates towards which the Member states endeavour to make their domestic rates converge in the medium term.

The Commission also considers preferable to refer as much as possible to the existing provisions of the excise duties Directives for reasons of simplification and reducing administrative costs. Of course this approach does away with the need for certain safeguard clauses (conditionality and temporary suspension of the tax), which are deleted. Moreover, the wish to safeguard the competitiveness of Community firms should encourage Member states to use the revenues of the tax to reduce other discriminatory charges, particularly those on labour.

4.5. The monitoring mechanism

In the Council Decision of 24 June 1993 (93/389/EEC), a monitoring mechanism was established for Member States' anthropogenic emissions of CO₂ and other greenhouse gases not controlled by the Montreal Protocol.

According to the Council Decision, Member States shall devise, publish and implement national programmes for limiting their anthropogenic emissions of CO₂. The programmes shall be periodically updated. The Commission annually evaluates the national programmes, in order to assess whether progress in the Community as a whole is sufficient to attain the stabilisation objective. The second evaluation report, which covers 1994-1995, is currently under preparation. After its finalisation it will be sent to the Council and the European Parliament.

The Council Decision specifies the information the national programmes must include: emissions in the 1990 base year, inventories of emissions by sources and removal by sinks, details of national policies and measures contributing to limitation and sequestration of CO₂ emissions, trajectories of national emissions between 1994 and 2000, measures taken or envisaged for the implementation of relevant Community legislation and policies, and an assessment of the economic impact of the above measures. The methodology for determining emissions and removals by sinks must be compatible with the methodology developed by the IPCC. It has to take account of developments decided within the framework of the UN FCCC.

With respect to other greenhouse gases the Member States should send to the Commission data concerning emissions of these gases, as well as a description of the measures being taken or envisaged which will limit emissions.

The Decision includes a Committee composed of the representatives of the Member States and chaired by the representative of the Commission. Until mid 1995 the monitoring committee has held five meetings. It has approved two documents ("Content and format of annual inventories" and "Methodology for the evaluation of progress and for the content of national programmes").

4.6. Sectoral policies

This section reviews those sectoral policies, which include specific environmental measures and/or contribute to the limitation of greenhouse gases. Except for transport policy, no assessments have been made with regard to the quantitative impacts of the policies on the emissions of greenhouse gases.

Agricultural policy

A milestone in EC agricultural policies in the 90's was the Common Agricultural Policy (CAP) Reform in 1992. Some measures of the CAP Reform itself, that was driven primarily by economic and social considerations, have an impact on greenhouse gas emissions. Next to the reform a number of agri-environmental measures were adopted, as a part of the so-called "accompanying measures".

Before the CAP Reform, the Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (EEC 676/91) and the Community Drinking Water Directive (EEC 778/80) were adopted, with the aim of reducing Nitrate concentrations in drinking water. Together, these two Directives have an impact on the use of Nitrate fertilisers and therefore may result in reductions of N₂O emissions. However, the implementation of the Drinking Water Directive took place before 1990, so its impact has mostly already been felt. Also before the CAP Reform, the European Agricultural Guidance and Guarantee Fund (EAGGF) was established (Council Regulation (EEC 2328/91), that provided funds for, inter alia, measures to protect the environment.

As to the impacts of the CAP Reform itself, one of the effects of the reform is a reduction of agricultural prices. This reduction of prices makes the use of mineral fertilizers less profitable, leading to a reduction of consumption by about a third. This decreases the total amount of N₂O emissions from nitrate and ammonium fertilizers. In addition, the compulsory set-aside scheme (EEC 1765/92) reduces the intensity of the entire rotation¹³. Moreover, the possibility of growing non-food products on set-aside land constitutes a positive link to the reduction of greenhouse gas emissions, helping to substitute fossil fuel by bio-fuel.

Regulation EEC (2066/92) aims to extensify beef production by restricting premiums to maximum stocking rates. The maximum rate is currently 3 Livestock Units per hectare of forage area, to be reduced to 2 Livestock Units in 1996. This reduces emissions of CH₄

¹³ Intensification on remaining land will only result if there is an increase in market price due to reduced total production. This price effect is hardly to be expected since agricultural markets are still regulated and, therefore, continue to have limited responsiveness.

from ruminants per ha. The Member States are authorized to restrict provision of the beef premium to those farmers who comply with certain environmental rules (EEC 3611/93).

As accompanying measures to the CAP Reform, the regulations concerning the European Agricultural Guidance and Guarantee Fund (EAGGF) were changed, concerning agri-environmental measures (EEC 2078/92) and the promotion of afforestation (EEC 2080/92).

The agri-environmental measures are established by zonal programmes which are set up on the Member State level. The programmes comprise the promotion of:

- extensive and environmentally sound production methods;
- conversion of arable land into grassland;
- reduction of livestock density;
- upkeep of abandoned farmland;
- 20 years set-aside for ecological purposes;
- public access to farmland;
- protection of genetic variety;
- pilot-projects and training of farmers.

The agri-environmental measures are cofinanced by the EAGGF at a rate of 75% in the less developed regions, and at 50% in the other regions. The available budget for the 1993-1997 period is 3670 MECU. The assessment of altogether 214 zonal programmes by the Commission is still going on. Until now, 59 programmes have been approved.

Forestry policy

A number of EC regulations promote afforestation in Member States, and the contribution of forests to environmental improvement. EC Regulation 1610/89 on the development of forest in rural areas allows for Community co-financing of, inter alia, the following measures:

- afforestation and improvement of forests;
- the creation of nurseries;
- reconstitution of forests damaged by fire;
- forestry awareness campaigns.

These measures are limited to less developed areas and have to be implemented in the framework of regional development programmes submitted by the Member States and approved by the Commission. A measure accompanying the reform of the CAP Reform is the promotion of afforestation (EEC 2080/92). This measure contributes to an improved environmental balance by establishing forests in agricultural areas and by enlargement of the CO₂ absorption capacity.

Financial aid is given on a contractual basis to cover the costs for:

- afforestation on agricultural land;
- income losses from agricultural land (20 years);
- upkeep of afforested land (5 years);

- investments on the improvement of forests (fire protection).

The measures are cofinanced by the EAGGF at a rate of 75% for the less developed regions, and at 50% in the other regions. The available budget for the 1993-1997 period is 1260 MECU.

Indirectly, measures designed to protect forests from atmospheric pollution increase the net primary productivity of the trees and therefore increase potential CO₂ uptake (EEC 3528/86 and 2157/92). Measures include regular surveys of forest conditions and pilot projects for the improvement of knowledge on air pollution impacts on forests. In addition, Regulation EEC 2158/92 aims to protect forests from fires. The measure includes:

- the elaboration by Member States of plans to protect forests against fire;
- a Community information system on forest fire;
- a Community support for projects with the aim of fire prevention.

Transport policy

Transport is a major source of greenhouse gas emissions in the Community. Behind power generation, it is the second most important CO₂ emitting sector, before the domestic and tertiary sector and industry. Presently, transport accounts for about one-quarter of total Community CO₂ emissions. Under a business as usual scenario, CO₂ emissions from transport are forecasted to grow significantly between 1990 and 2000. This makes it a key concern in any strategy to combat climate change.

The transport sector in the EC is characterized by strong growth:

- expected growth from 1990 to 2000 of vehicle kilometres is 17% for passenger cars, 26% for light-duty vehicles and 13% for two-wheelers;
- air traffic in Europe (excluding the newly independent states) is expected to grow by 5.2% per year until 2003, according to the International Civil Aviation Organisation.

In relation to greenhouse gas emissions from transport, the Community essentially has two types of instruments at its disposal:

- Regulatory instruments, i.e. the setting of emission or other technical standards for vehicles, aircraft, etc.

Commission Directive 93/226/EC defines a measurement method for CO₂ emissions from passenger cars, but no standards have been set in this respect. The Commission intends to present a Communication on this matter in the fall of 1995. The Community has made substantial progress in reducing other transport related greenhouse gases. Building on earlier legislation, between 1990 and 1994 Community standards have been strengthened for NO_x, CO and VOC's from road vehicles. The standards are legally binding for Member States. The dates below refer to the mandatory application of the standards to all new vehicles in the Community:

- * For heavy-duty vehicles, Council Directive 91/542 EEC of 1.10.1991 reduces CO, hydrocarbons and NO_x emission limits in two steps, from 1.10.1993 and 1.10.1996 on.
 - * For light-duty vehicles Council Directive 93/59 EEC of 28.6.1993 reduces CO, hydrocarbons and NO_x emission values from 1994 on.
 - * For passenger cars, European Parliament and Council Directive 94/12 EC of 23.3.1994 reduces CO, hydrocarbons and NO_x emission values from 1997 on.
 - * Directive 92/6 EEC requires lorries (85 km/h), buses and coaches (100 km/h) to be fitted with speed limiters, in part retroactively. It is estimated that this Directive reduces energy consumption, and thus CO₂ emissions, by these vehicles by at least 5%.
 - * In the framework of Community legislation on roadworthiness tests, Directive 92/55/EEC sets minimum standards and criteria for emission tests on all vehicles. Given that a large share of emissions is caused by badly maintained vehicles, this Directive is likely to have a significant impact.
- Fiscal measures, to influence transport demand, modal choice and environmental characteristics of fuels.

The potential of fiscal incentives to promote environmental objectives has been demonstrated by the experience on car emissions. Various Member States have used fiscal incentives to promote the introduction of cars that meet new Community standards before their mandatory application, and Council Directive 92/458/EEC on emissions from small cars set a framework for such fiscal incentives. The levying of excise duties on transport fuels raises transport prices and can hence be used to reduce the consumption of these products and thereby contribute to a limitation of greenhouse gas emissions. Council Directive 92/82 EEC sets minimum rates for excise duties on petrol and diesel fuels as follows¹⁴:

- ECU 337 per 1000 litres for leaded petrol;
- ECU 287 per 1000 litres for unleaded petrol;
- ECU 245 per 1000 litres of gas oil used as propellant;
- ECU 100 per 1000 kg for liquid petroleum gas and methane used as propellant;
- ECU 245 per 1000 litres of kerosene used as propellant.

So far, this instrument has not been used with the explicit view of reducing CO₂ emissions and other noxious emissions as the minimum excise duties at Community level exist mainly with concern to national fiscal policies of the Member states and Internal Market requirements. However, in its report on the bi-annual review of minimum excise duties on mineral oils for 1993 and 1994, the Commission identified environmental

¹⁴ Specific (lower) rates are valid for Luxemburg.

policy and CO₂ emissions as topics that should be considered in the development of fiscal policy.

The Commission is currently looking into the problem of the external costs of transport and how to internalise them. It is the intention of the Commission to present a Green paper on this subject in the near future.

With a view to promoting the use of renewable energy in the transport sector, the Commission has made a proposal for a Directive on excise duties on motor fuels from agricultural sources ("biofuels"). This proposal provides for a detaxation of biofuels in relation to conventional (petrol and diesel) fuels.

The proposal for a carbon/energy tax (see section 4.4), if adopted, will have an impact on greenhouse gas emissions from transport.

Under "business-as-usual" total CO₂ emissions from road transport are expected to increase by 24.5 % between 1990 and 2000 (DGXVII, (Energy): "Consequences of the proposed carbon/energy tax", 23.10.1992).

With regard to other greenhouse gases the projections are as follows:

| | <u>emissions in 2000 compared to 1990</u> |
|------------------|---|
| CH ₄ | - 41.3% |
| N ₂ O | + 237.6% |
| CO | - 53.3% |
| NO _x | - 37.1% |
| NM VOC | - 52.9% |

Waste policy

Concerning packaging and packaging waste, the Council and the European Parliament adopted on 20 December 1994 a Directive (94/62/EEC) with the aims of harmonizing national measures concerning the management of packaging and packaging waste, and of providing a high level of environmental protection. The measures aim, as a first priority, at preventing the production of packaging waste and, as additional fundamental principles, at reusing packaging, at recycling and other forms of recovering packaging waste and hence, at reducing the final disposal of such waste. Thus it will result in a reduction of CO₂ and CH₄ emissions. The measures include, inter alia, an obligation for Member States to attain, within five years after implementation of the Directive, a 50% to recoverage rate of packaging waste¹⁵. The recycling percentage must be between 25 and 45%. For a second five year period new targets will be established by the Council. In addition, the Directive provides for marking and identification systems, standardization, maximum allowable concentrations of heavy metals, information systems

¹⁵ Exceptions are made for Greece, Ireland and Portugal.

to harmonize data on packaging waste management between Member States, information for users of packaging and reporting requirements for Member States.

The Council of 8 and 9 June 1994 agreed on a common position on a Council Directive on the landfill of waste. The amended Directive contains an obligation for permitting, including requirements for monitoring and control procedures. The contents of the permit will have to satisfy "general requirements for all classes of landfills", among which are the taking of appropriate measures in order to control the accumulation and migration of landfill gas. Landfill gas has to be collected, treated and used, unless the competent authority determines otherwise after environmental evaluation. This will result in more efficient management of landfills and thus in a reduction in methane emissions.

4.7. Commission Working Paper on the EU Climate Change Strategy : a set of options

Analyses indicated that with prevailing expectations concerning energy prices and economic growth the Community could fall short of its CO₂ stabilisation commitment by 5% to 8%. It was felt that a more vigorous implementation of existing Community and Member State was required. On the request of the Council the Commission prepared on 1 March 1995 a preliminary analysis of the policy options which the Council should consider for CO₂ limitation in the perspective of 2005-2010 (SEC 95/288/final).

From the preliminary analysis it is already clear that a significant technical potential exists to limit and reduce CO₂ emissions beyond the year 2000. If this potential is to be exploited, substantive measures will have to be taken: the improvement of energy efficiency and the penetration of renewable energy sources, completion of the internal energy market, a change of transport modes, an upward review of energy taxes, a better focus of its R&D policies, and an intensified cooperation with third countries. In addition, the Commission underlined that many of those measures can be introduced with a view to achieve substantial benefits in other policy areas, like energy, R&D and transport as well as growth, competitiveness and employment, as already indicated in the Commission White Paper of December 1993.

In the light of the deliberations on the Working Paper in Council and the Decision of the first Conference of the Parties to the UN FCCC the Commission is currently elaborating on a more detailed analysis.

4.8. Summary

The following tables summarize the programmes, policies and measures described in this chapter. A clear distinction is made between programmes, policies and measures adopted by the Council (listed in Table 4.1), proposed by the Commission (listed in Table 4.2) and in preparation by the Commission (listed in Table 4.3).

Table 4.1. Programmes, policies and measures adopted by the Council.

| Name | Period | Budget | Description |
|------|--------|--------|-------------|
|------|--------|--------|-------------|

| | | | |
|-----------|-------------|----------|---|
| THERMIE I | 1990 - 1994 | 700 MECU | Financial support for clean energy technologies |
|-----------|-------------|----------|---|

| | | | |
|----------------|-------------|---------|--|
| SAVE-programme | 1991 - 1995 | 35 MECU | Financial support for energy efficiency projects |
|----------------|-------------|---------|--|

| | | | |
|------------------|-------------|--|---|
| SAVE-legislation | 1992 - | | Energy efficiency standards for new hot water boilers |
|------------------|-------------|--|---|

| | | | |
|--|-------------|--|---|
| | 1992 - | | Energy labelling of major household appliances, Framework Directive |
|--|-------------|--|---|

| | | | |
|--|-------------|--|--|
| | 1994 - | | Energy labelling of refrigerators and freezers |
|--|-------------|--|--|

| | | | |
|----------------------|--|--|--|
| Energy Management at | | | |
|----------------------|--|--|--|

| | | | |
|--------------------------|-----------|---------|--|
| Regional and Urban level | 1990-1995 | 20 MECU | Support for energy plans at regional and urban level |
|--------------------------|-----------|---------|--|

| | | | |
|-------------------|-------------|---------|----------------------------------|
| ALTENER-programme | 1993 - 1997 | 40 MECU | Financial support for renewables |
|-------------------|-------------|---------|----------------------------------|

| | | | |
|---------------------|---|--|--|
| Voluntary agreement | CEN/CENELEC will elaborate standards for thermal solar with CEN/ CENELEC systems, photovoltaics and wind turbines | | |
|---------------------|---|--|--|

| | | | |
|------------|-------------|--|---|
| Monitoring | 1993 - 2000 | | Procedures to monitor progress towards CO ₂ stabilisation target mechanism |
|------------|-------------|--|---|

| | | | |
|-------------------------|--|--|--|
| CAP Reform, 1992 - | Lowering of agricultural prices reduces fertilizer use and price lowering thereby N ₂ O emissions | | |
|-------------------------|--|--|--|

| | | | |
|-------------------------|---|--|--|
| CAP Reform, 1992 - | Compulsory set-aside scheme promotes growing of biofuels set-aside scheme | | |
|-------------------------|---|--|--|

| | | | |
|-------------------------|--|--|--|
| CAP Reform, 1992 - | Premiums are related to maximum stocking rates, reducing extensification of CH ₄ emissions from ruminants beef production | | |
|-------------------------|--|--|--|

Table 4.1. Programmes, policies and measures adopted by the Council (continued).

| Name | Period | Budget | Description |
|--|-------------|-----------|---|
| Agri-environmental measures | 1993 - 1997 | 3670 MECU | Financial support for zonal programmes, incl. environmental measures |
| Afforestation | 1993 - 1997 | 1260 MECU | Financial support for afforestation |
| Protection of forests from pollution | 1992 -1996 | 29.4 MECU | Measures increase net primary productivity of trees and thereby potential CO ₂ uptake. |
| Protection of forests from fires | 1992 - 1996 | 70 MECU | Measures contribute to CO ₂ uptake |
| Emission standards for heavy duty vehicles | 1993 - | | Emission standards for CO, hydrocarbons and NO _x |
| Emission standards for light duty vehicles | 1993 - | | Emission standards for CO, hydrocarbons and NO _x |
| Emission standards for passenger cars | 1997 - | | Emission standards for CO, hydrocarbons and NO _x |
| Fiscal measures for transport fuels | 1992 - | | Minimum excise duties on petrol and diesel fuels |
| Landfill directive | 1994 - | | Environmental standards for landfilling of waste contributes to limitation of CH ₄ emissions |

Table 4.2. Programmes, policies and measures proposed by the Commission.

| Name | Period | Description |
|---------------------------|-------------|--|
| THERMIE II | 1994 - 1998 | Financial support for clean energy technologies |
| Energy / carbon tax | | Tax on fossil fuels based 50/50 on energy and carbon content |
| Packaging waste Directive | | Harmonization of national measures concerning packaging waste, prescription of 50% recoverage rate and 25 - 45% recycling rate |

Table 4.3. Programmes, policies and measures in preparation by the Commission

| Name | Description |
|---|---|
| SAVE-legislation | Appliance energy efficiency standards for refrigerators, electric motors, office equipment and commercial lighting Directive on Integrated Resource Planning Labelling directives for washing machines and dishwashers, and light bulbs |
| ALTENER-legislation | Harmonization of safety standards for wind generators and specifications for biodiesel |
| Trans European networks | Creation of infrastructures for transport of gas and electricity |
| Voluntary agreement | Voluntary energy efficiency labelling of computer and other office equipment |
| CO ₂ emission standards for passenger cars | New emission standards for passenger cars will include standards for CO ₂ emissions |
| Fiscal measures for transport | Rise in minimum rates of fuel excise duties, equalization of minimum rates of excise duties for petrol and diesel fuels, target rates for gradual increase in excise duties on mineral oils |

5. NATIONAL REPORTS OF THE MEMBER STATES

5.1. Introduction

The national programmes adopted by the Member States are one of the pillars of the strategy of the European Community to limit greenhouse gas emissions. This chapter briefly summarizes the national reports of the Member States to limit their greenhouse gas emissions. All Member States, except Belgium have submitted their communication to the UN FCCC. Information included in their national communications has been summarized in this chapter. Since Belgium did not yet ratify the UN FCCC, a short description is provided of its national programme under the EC Monitoring Mechanism for CO₂ and other greenhouse gas emissions.

In each of the summaries of the national reports of the Member States, an overview is given of greenhouse gas emission estimates as provided in the national reports. The CO₂ emission estimates correspond with total CO₂ emissions. CO₂ removals by sequestering of carbon in sinks have not been subtracted from these total emissions. The estimates of greenhouse gas emissions provided in this chapter do not necessarily correspond with the figures included in the Annex to Chapter 3 "The EC emission inventory". The figures of the latter have been adjusted according to the draft IPCC guidelines for national greenhouse gas inventories for reasons of comparison. Besides estimates of greenhouse gas emissions in 1990, projections are provided of emissions in 2000.

Further, for each of the Member States a short description is provided of the policies and measures included in its national report.

5.2. The Member States' national reports to limit greenhouse gas emissions

Austria

Austria submitted its national communication to the secretariat of the UN FCCC at 21 September 1994¹⁶. Austria adopted as its national target a 20% reduction of CO₂ emissions by the year 2005 compared to 1988 levels.

Emissions in 1990 and 2000

Table 5.1 provides details of emissions of CO₂, CH₄ and N₂O in Austria in 1990 and 2000. According to a projection from as early as 1991 ("reference scenario"), CO₂ emissions are expected

¹⁶ National Climate Report of the Austrian Federal Government, in compliance with the obligations under Art.4.2. and Art.12 of the Framework Convention on Climate Change (Federal Law Gazette No. 414/1994). Federal Ministry of Environment, Youth and Family Affairs, August 1994.

to increase by 10% in the year 2000 compared with 1990. However, this scenario does not represent all policies and measures implemented or committed to; these are not fully quantified and may permit Austria to stabilize its CO₂ emissions by the time period around 2000 to 2005. CH₄ and N₂O emissions are expected to be at roughly the same level as 1990 emissions.

Table 5.1. Emissions of CO₂, CH₄ and N₂O in Austria in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|---------------------|---------------------|
| CO ₂ | 59,200 ¹ | 63,700 ² |
| CH ₄ | 602.8 | 600 |
| N ₂ O | 4.1 | 4.2 |

¹ Including process related emissions (2,100 Gg)

² Not including process related emissions

Policies and measures

Austria established two committees to develop an effective climate protection strategy: the Austrian CO₂ commission and the Interministerial Committee to Coordinate Measures to Protect Global Climate (IMC Climate). With the last interim report of the IMC Climate, Austria adopted a comprehensive catalogue of measures. This strategy includes the following points of main emphasis:

CO₂

Power production/electricity supply industry:

- Fuel switching at thermal powerplants (e.g. fuel switch to gas);

Room heating and water heaters:

- Mix of measures for a tightening of building regulations and norms, introduction of an energy coefficient, tightening of residential building subsidies, co-ordination of the extension of conducted energy, priority for the utilization of district heating;

Renewable energies:

- Full utilization of the potentials of energy use through renewable fuels (wind, biogas, sewage gas, landfill gas, biomass, sun);

Combined heat and power plants:

- Large-scale replacement of thermal power plants without heat utilization by those by CHP;

Traffic:

- Comprehensive catalogue of measures (extension of infrastructure for combined carriage, traffic organization, R&D, fleet fuel consumption, regulations);

Economic instruments:

- Introduction of a comprehensive energy and CO₂ levy with due consideration for international competitiveness.

CH₄

A draft ordinance on landfills has been drawn up to promote the energy utilization of landfill gas. Research and development is being carried out on the economically feasible use of biogas.

N₂O

Biological farming is being promoted. Requirements promote the targeted use of fertilizers, leading to a further reduction in N₂O emissions.

Belgium

Belgium did not yet ratify the UN FCCC. At its Council of Ministers (6 June 1991), Belgium committed itself to achieve a CO₂ emission reduction of 5% by 2000 compared to 1990. In June 1994, it submitted its national programme under the EC Monitoring Mechanism¹⁷.

Emissions in 1990 and 2000

CO₂ emissions in Belgium amounted to 114 410 Gg in 1990. The inventory was carried out using the CORINAIR methodology which was adjusted according to the draft IPCC guidelines for national greenhouse gas inventories. If the total package of (proposed) policies and measures is implemented, Belgium expects to be able to reduce CO₂ emissions by 8-9% by the year 2000 compared to 1990. This estimate assumes the application of a European carbon/energy tax and is based on a standardization of temperature in 2000 compared to 1990.

Policies and measures

The Belgium national programme includes various measures and policies to address climate change. It includes measures already adopted by Government as well as proposed measures. Regarding energy, these measures include the establishment of cooperation between the authorities, the business community and the energy distributors, a more efficient electricity production, promotion of the use of renewable energy, the increased use of natural gas and investments to reduce energy electricity demand. Structural modifications are taken in the iron and steel sector to reduce energy consumption. Initiatives are taken in the tax system to promote an energy friendly behaviour. The Belgium Government established at 1 August 1993, an energy tax based on the European proposals for an energy/CO₂ tax. Other measures are speed limits on roads and motorways, transport plans for personnel in companies, promotion of the public transport, information and awareness-raising activities and promotion of research. Belgium also participates in THERMIE, SAVE, PACE and ALTENER.

¹⁷ Belgian National Reduction Programme CO₂ emissions. Under the "Council Decision concerning a mechanism of monitoring of CO₂ emissions and other greenhouse gases in the Community". June 1994.

Denmark

Denmark's national communication¹⁸ was submitted to the secretariat of the UN FCCC in August 1994. The national CO₂ target of Denmark is to achieve an emission reduction of 20% of emissions from energy-use by the year 2005 compared to 1988. Sectoral CO₂ targets have been set for the energy sector and the transport sector. Apart from the national targets, Denmark has committed itself to stabilize emissions at the 1990 level in 2000 within the framework of the Climate Convention, as well as to achieve a 5% reduction of CO₂ emissions, as a contribution to the objective of stabilising CO₂ emissions in the Community as a whole by the year 2000.

Emissions in 1990, 2000 and 2005

Table 5.2 provides details of emissions of CO₂, CH₄ and N₂O in Denmark in 1990, 2000 and 2005. According to Denmark's projections, the national CO₂ target for the year 2000 is most likely to be achieved. A CO₂ emission reduction of approximately 8% is expected by the year 2000 compared to 1990 levels. This estimate is based on a situation with net zero electricity import, in both the target year and the base year. The projected CO₂ emission reduction is thus based on corrected 1990 figures for fluctuating imports of electricity. If imports become zero, or change to exports (as happens in dry years in Scandinavia), emissions may surpass the 1990 level by 3% or more. CH₄ emissions are expected to decrease by about 13% by the year 2000. N₂O emissions are expected to increase by 10% by 2000.

Table 5.2. Emissions of CO₂, CH₄ and N₂O in Denmark in 1990, 2000 and 2005 (Gg).

| | 1990 | 2000 | 2005 |
|------------------|---------------------|--------|--------|
| CO ₂ | 58,353 ¹ | 53,753 | 52,051 |
| CH ₄ | 406.3 ² | 354.2 | 353.5 |
| N ₂ O | 10.5 ³ | 11.5 | 12.1 |

¹ CO₂ emissions are corrected for electricity import. Actual emissions amount to 52,053 Gg.

² CH₄ emissions are corrected for electricity import. Actual emissions amount to 406.2 Gg.

³ N₂O emissions are corrected for electricity import. Actual emission amount to 10.3 Gg.

Policies and measures

Limitations of greenhouse gas emissions, notably CO₂, were introduced as explicit targets in the Energy Action Plan and the Transport Action plan, which were adopted in 1990. A package of measures to further decrease greenhouse gas emissions was launched in the action plan "Follow up on Energy 2000", published in November 1993. The objectives of the Danish waste policy were described in the Danish Government's Action Plan for Waste and Recycling 1993-1997 (1992).

¹⁸ Climate Protection in Denmark. Ministry of the Environment. Danish Environmental Protection Agency. Denmark, 1994.

Energy

The Energy Action Plan ("Energy 2000") emphasized efficiency improvements in both end use (especially electricity) and energy supply (notably increased use of combined heat and power), changing to cleaner fuels (a.o. biomass and wind) and increasing energy R&D. Major initiatives taken include inter alia;

- securing continued growth in the market shares of district heating and natural gas;
- conversion of local district heating plants to combined heat and power production based on natural gas or biomass;
- increased use of renewables;
- changing the taxation of electricity and fuels to a consistent system of energy and CO₂ taxes;
- implementation of efficiency standards;
- subsidy schemes for energy saving by industry and for installation of individual metering;

Transport

The transport action plan promotes an efficient transport system. Experiments are supported with alternative public transport services.

Waste

The Danish waste policy aims to recycle about 50% of the total amount of waste generated in the year 2000. The remainder should primarily be incinerated and landfilling should be minimized. The energy content of the incinerated waste will be used to replace fossil fuels. The waste objectives will be achieved using a series of instruments, such as agreements with industry and local authorities, increase and differentiation of waste charges, and legislation.

Forestry

Regarding the forestry sector, the Danish Parliament decided that during a period of rotation, e.g. 80-100 years, the forest area should be doubled, leading to a CO₂ fixation rate of approximately 5% of the yearly CO₂ emission at its highest level.

Finland

Finland submitted its National Communication¹⁹ to the secretariat of the UN FCCC in January 1995. In its energy report to Parliament, the Finnish Government adopted the national goal of halting growth in CO₂ emissions from energy production and use at the end of the '90s.

Emissions in 1990 and 2000

Table 5.3. provides details of emissions of CO₂, CH₄ and N₂O in Finland in 1990 and 2000. CO₂ emissions are expected to increase by 30% in the year 2000 compared with 1990. This estimate is based on the assumption that all electricity consumed in 2000 is produced in Finland. However, in

¹⁹ Finland's National Report under the United Nations Framework Convention on Climate Change. Ministry of Environment, January 1995.

1990 Finland imported 17% of its electricity which is equivalent to 11,000 Gg of CO₂ emissions. A reduction of about 10% in CH₄ emissions is expected in 2000 compared to 1990 levels, while N₂O emissions are expected to increase by about 20%.

Table 5.3. Emissions of CO₂, CH₄ and N₂O in Finland in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------------------|--------|---------------------|
| CO ₂ ¹ | 54,200 | 70,200 ² |
| CH ₄ | 252 | 204 |
| N ₂ O | 23 | 28 |

¹ CO₂ emissions from fossil fuels and peat, and from industrial processes.

² In the projections of CO₂ emissions in 2000 it is assumed that all electricity consumed in Finland is also produced in Finland. To compare these figures with 1990 emissions, it should be noted that in 1990 Finland imported 17% of its electricity, equivalent to 11,000 Gg of CO₂ emissions.

Policies and measures

The main focus in Finland's climate strategy is to intensify already existing programmes to reduce greenhouse gas emissions, such as improvements in the efficiency of the energy production and utilization system, and the use of energy and carbon taxes. The Finnish action programme also includes measures to enhance carbon reservoirs and sinks.

Energy

Finland introduced a CO₂ tax in 1990. This tax favours low-emission energy sources, promotes energy conservation and encourages the use of renewable fuels such as biomass to replace fossil fuels. In 1992, the Finnish Government approved an energy conservation programme aimed at rationalizing end uses of energy in individual sectors. The following targets of reducing specific energy consumption have been adopted (compared to 1990 levels): space heating 10%, household use 15%, services 15% and industry 10%.

Measures are being undertaken to promote the use of biofuels. The objective is to increase the use of biofuels by 25% by the year 2005. Research on energy conservation is being continued and new energy technology development programmes have been launched.

Transport

A tax relief has been granted on cars with catalytic converters. A relatively high tax on car purchases curbed the growth in the car stock. Other measures include subsidies for public transport, investments in the rail network, a cut in the right to tax-deduct business travel costs, and a reduction in the transport subsidies to industry in developing areas.

Forestry

The forest and timber resources in Finland are still growing substantially. According to the forestry environmental programme, an annual increment of 5-10 million cubic metres is estimated to be untouched by commercial exploitation, as a result of environmental protection goals, such as the conservation of biodiversity. The forest CO₂ sink in 1990 is put at around 31000 Gg of CO₂.

Other sectors

The Rural Environment Programme approved in 1992 and the agri-environmental support programme both include action to reduce greenhouse gas emissions from farming and greenhouse cultivation. The waste management development programme calls for a substantial decrease in the number of

landfills, which will result in more efficient management and thus in a reduction in methane emissions.

France

France published its national communication in February 1995²⁰. In parallel to the commitments of the UN FCCC for developed countries and the European strategy to stabilize CO₂ emissions at their 1990 levels by 2000, France has announced its commitment to maintain annual per capita CO₂ emissions below 2 tonnes of carbon (7.33 tonne CO₂).

Emissions in 1990 and 2000

Table 5.4. provides details of emissions of CO₂, CH₄ and N₂O in France in 1990 and 2000. Energy related CO₂ emissions are expected to increase by 9% in 2000 compared to 1990. Total annual per capita CO₂ emissions are expected not to exceed 2 tonnes of carbon. A relative increase is expected of 7.5% for net CO₂ emissions in 2000 compared to 1990. This relative increase amounts to 4.4% if these estimates are corrected for climate variations. CH₄ emissions in 2000 are expected to be at roughly the same level as 1990 emissions. A reduction of 47% in N₂O emissions is expected in 2000 compared to 1990 levels.

Table 5.4. Emissions of CO₂, CH₄ and N₂O in France in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|---------|----------------------|
| CO ₂ | 367,000 | 382,000 ¹ |
| CH ₄ | 2,900 | 2,900 |
| N ₂ O | 177 | 93 |

¹ Energy related CO₂ emissions. 1990 energy related CO₂ emissions amounted to 350,000 Gg.

Policies and measures

The French national programme emphasises the transport sector, since a strong rise in emissions is expected in this sector. Besides, possibilities of reducing CO₂ emissions in other sectors are limited, as a substantial emission reduction, amounting to 26.5%, has already been realized in the eighties. To a large extent, the reduction was achieved by the nuclear programme in the electricity sector. Presently, the electricity sector accounts for only about 10% of total emissions, much less than in other EC Member States.

CO₂ - Energy

Tariff policies changing the demand pattern for electricity will enable a larger utilization of nuclear energy. As a general policy, the use of (nuclear produced) electricity instead of fossil fuels is stimulated. For isolated locations, the attention is increasing for stand-alone applications of renewable energies, as an alternative to expensive connections to the net. In the housing and construction sector, energy end-use efficiency is stimulated by a programme of standards, labelling and information

²⁰ Programme National de Prevention du changement de climat. Republique Francaise, Fevrier 1995.

dissemination. Biofuels are exempted from taxes, and the development of technology in this field is stimulated by credits.

CO₂ - Transport

Transport policies are directed towards an increase of energy efficiency, stimulation of transport modes with favourable environmental characteristics (public transport, combined transport in road haulage, electric cars), an improvement of the efficiency of transport infrastructure (new technologies for reducing congestion, better coordination of transport by road, railway and water), policies for road haulage (speed limiter, increased enforcement of maximum driving time regulations) and technical measures affecting the efficiency of vehicles.

CO₂ - Industry

Voluntary agreements ("contrats de branch") are being discussed with companies in the most energy intensive branches of industry. A range of support measures are already in place: mandatory energy audits for industrial facilities, financial assistance including R&D support and fiscal incentives.

Forestry

The objective of forestry policies is an afforestation of 30.000 ha per year.

CH₄

The French waste policy is promoting incineration, composting and recycling of waste to limit CH₄ emissions. A tax on household wastes will be increased. Technical measures are undertaken against gas leakages from networks.

N₂O

Regulatory action and industrial standardisation using the best available technologies will decrease N₂O emissions from adipic, nitric and glyoxylic acid production. A strategy for limiting agricultural N₂O emissions is under study.

Germany

Germany submitted its national communication to the UN FCCC in September 1994²¹. The Federal Cabinet of Germany resolved to strive for a 25-30% reduction of CO₂ emissions in Germany by the year 2005, in relation to 1987 levels.

Emissions in 1990 and 2000

Table 5.5. provides details of CO₂, CH₄ and N₂O emissions in Germany in 1990 and 2005. Germany's national communication did not provide projections for the year 2000. CH₄ emissions are expected to decrease by 48% in 2005 compared to the 1990 emission level, N₂O emissions are

²¹ Environmental policy. Climate protection in Germany. First report of the Government of the Federal Republic of Germany Pursuant to the United Nations Framework Convention on Climate Change. An information paper from the Federal Environment Ministry. September 1994.

expected to decrease by 25%. CO₂ emissions are expected to decrease by 3% in 2005 compared to 1990. However, Germany's national communication does not specify which measures are included in this projection.

Policies and measures

Germany's national communication provides an extensive list of measures. A distinction is made between measures that have been approved and are being/have been implemented and measures still in the approval phase. Below a summary is given of some of the most important measures already approved.

Table 5.5. Emissions of CO₂, CH₄ and N₂O in Germany in 1990 and 2005¹ (Gg).

| | 1990 | 2005 |
|------------------|-----------|--------------------|
| CO ₂ | 1,012,000 | --- ² |
| CH ₄ | 6,218 | 3,233 ³ |
| N ₂ O | 223 | 167 ⁴ |

¹ Germany's national communication does not include projections of greenhouse gas emissions for the year 2000.

² Germany's national communication provides an estimate of 980 000 Gg CO₂ emissions in 2005 (table 6.15, page 144) but does not specify which measures are included in this projection.

³ Germany's national communication does not provide this figure, but states that CH₄ emissions are expected to decrease by 48% in 2005 compared to 1990.

⁴ Germany's national communication does not provide this figure, but states that N₂O emissions are expected to decrease by 25% in 2005 compared to 1990.

Energy supply

- energy saving programmes and incentives for saving electricity;
- incentives to increase the use of renewable energy sources;
- a support programme to increase heat/power cogeneration (including tax breaks) and to modernise the district heating network in former GDR;

Traffic and transport

- increase of the mineral-oil tax;
- investments in the national transport infrastructure, including long-distance motorways, the railway network and the national waterways;
- information on energy-saving and environmentally oriented driving habits;

Buildings and structures

- amendment of the Thermal Insulation Ordinance and of the Heating-systems Ordinance;
- tax breaks for the use of renewable energies;
- subsidies for modernisation of heating-systems and thermal insulation in the former GDR;

New technologies

- various research programmes on environmentally sound technologies, especially in the field of energy;

Agriculture and forestry

- improving animal digestive efficiency;
- conservation of existing forests and support for afforestation;

Waste management

- Acts and Ordinances to reduce the total amount of waste, to increase recycling of material and for better waste management.

Greece

Greece published its national communication in February 1995²². The Council of Ministers of Greece accepted the stabilization objective of the European Community based on a fair distribution of responsibilities and burdens. The Greek Government considers that a realistic objective for its national programme is to restrict the total increase in CO₂ emissions to 15% (or 12,400 Gg) in 2000 compared to 1990 levels.

Emissions in 1990 and 2000

Table 5.6 provides emissions of CO₂, CH₄ and N₂O Greece in 1990 and projected emissions in 2000. Greece expects that a successful implementation of its action programme could reduce the increase in CO₂ emissions in 2000 to 9,800 Gg or 12%, compared to 1990 levels. Total methane emissions in 2000 are expected to be lower than 1990 emissions, while N₂O emissions are expected to increase. The Greek national communication does not quantify future CH₄ and N₂O emissions.

Table 5.6. Emissions of CO₂, CH₄ and N₂O in Greece in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|--------|--------|
| CO ₂ | 82,000 | 91,800 |
| CH ₄ | 343 | NE |
| N ₂ O | 13.7 | NE |

Policies and measures

The main elements of Greece's national programme are the transformation of the energy sector and policies in the transport, waste and forestry sector.

CO₂

Measures being taken in the energy sector are aiming at energy conservation and the substitution of fossil fuels. Measures in the energy supply sector include: increased use of natural gas, increased use

²² Climate Change. The Greek Action Plan for the abatement of CO₂ and other greenhouse gas emissions. February 1995.

of renewable sources of energy (such as wind, solar, biomass, hydro and geothermal energy), improving existing power station's efficiency, promotion of combined heat and power, and the use of cleaner technologies for lignite combustion. Measures taken at the demand side include an evaluation of building standards in force, the promotion of natural gas, renewable energy sources and co-generation in existing buildings, and interventions in the lighting sector.

Measures taken in the transport sector are replacement of old vehicles, development of public transport services and the establishment of inspections and standards. In the forestry sector, reforestation programmes are on the way.

CH₄ and N₂O

Greece adopted the following measures to reduce CH₄ and N₂O emissions:

- promotion of the use of biogas in controlled waste disposal sites;
- reduction of solid waste production by the implementation of recycling programmes;
- improvements of the natural gas distribution system to prevent leakages;
- the adoption of a "Code of Good Agricultural Practices for the Protection of Water", addressing among others manure disposal and the rational use of fertilizers;
- subsidizing of ecological agriculture.

Ireland

Ireland submitted its national communication to the UN FCCC in October 1994²³. As a member of the EU, Ireland is involved in the achievement of the stabilisation objective of the Union as a whole at 1990 levels by the year 2000. The national objective of Ireland is to limit CO₂ emissions so as not to exceed 36 988 Gg of CO₂ in the year 2000. This would represent an increase of 20% above 1990 levels, or an increase of 11% if account is taken of increased carbon sinks capacity. According to Ireland's national communication, this national target is based on the EU policy which recognizes that a number of Member States, including Ireland, will need targets and measures which will accommodate necessary economic growth.

Emissions in 1990 and 2000

Table 5.7 provides details of emissions of CO₂, CH₄ and N₂O in Ireland in 1990 and 2000. CO₂ emissions in Ireland are expected to increase by 20% in 2000 compared to 1990 levels. CH₄ emissions are expected to increase slightly in 2000 compared to 1990 levels, while N₂O emissions are expected to increase by 3%.

Table 5.7. Emissions of CO₂, CH₄ and N₂O in Ireland in 1990 and 2000 (Gg)₁.

| | 1990 | 2000 |
|------------------|--------|--------|
| CO ₂ | 30,719 | 36,988 |
| CH ₄ | 795.9 | 798.6 |
| N ₂ O | 42.3 | 43.7 |

²³ Ireland. Communication under the UN Framework Convention on Climate Change. Prepared for the Conference of the Parties in accordance with Article 12 of the Framework Convention on Climate Change. Department of the Environment, Ireland. October 1994.

Policies and measures

Ireland's national programme includes policies and measures in the field of energy, transport, waste and forestry.

Energy

Within the energy sector a number of programmes are underway including:

- promotion of more efficient use of energy by consumers in the domestic, industrial and commercial sectors, including maintenance and operation standards;
- insulation standards for new buildings;
- the establishment of a new energy body, the Irish Energy Centre, to operate an enhanced energy conservation programme;
- initiatives under the EU programmes SAVE and ALTENER;
- promotion of the use of natural gas and renewables.

Transport

Within the transport sector, the National Development Plan 1994-1999 and the Operational Programme on Transport provides major investments to improve public transport and traffic management.

Waste

A recycling strategy for waste has recently been published. The potentials of CH₄ recovery from landfills are being examined.

Forestry

Ireland's annual target for planting (afforestation and reforestation) is 30 000 hectares.

Italy

Italy submitted its national communication to the secretariat of the UN FCCC at 16 January 1995²⁴. Italy complies with the decisions taken by the EC on 29 October 1990 to stabilize CO₂ emissions by the year 2000 at 1990 levels.

Emissions in 1990 and 2000

Table 5.8 provides emissions of CO₂, CH₄ and N₂O in Italy in 1990 and projected emissions in 2000. Compared with actual emissions in 1990, CO₂ emissions are expected to increase by 11% in 2000, a CH₄ emission reduction is expected of 15% in 2000 compared with 1990, and N₂O emissions in 2000 are expected to be at roughly the same level as 1990 emissions.

²⁴ First Italian National Communication to the Framework Convention on Climate Change. Ministry of Environment, January 1995.

Table 5.8. Emissions of CO₂, CH₄ and N₂O in Italy in 1990 and 2000 (Gg).

| | 1990 | 2000 ¹ |
|------------------|---------|-------------------|
| CO ₂ | 392,213 | 435,710 |
| CH ₄ | 3,901 | 3,300 |
| N ₂ O | 120 | 119.4 |

¹ Based on "Business as Usual" Scenario

Policies and measures

Italy's strategy to mitigate greenhouse gas emissions includes policies and measures in the energy, transport, waste, forestry and agricultural sector.

Energy

The national programme consists of packages of measures aiming at the electricity generating industry and at private production. Programmes have been set up for thermal power stations, aiming at the increased use of natural gas. Energy efficiency is promoted by increasing combined heat and power in private industrial production of electricity. Italy adopted various degrees to reduce energy demand in the residential/commercial and residential sector. A voluntary system has been set up to improve environmental management in industries.

Transport

An investment plan is being implemented to expand the railway network and the urban underground railway network. A pilot programme is under way aiming at the use of alternative fuels in urban transport systems. Tax exemptions for alternative fuels are adopted.

Waste Management

Financial incentives are being provided to promote differentiated waste collection and for the construction of waste disposal sites. The use of biogas from waste disposal sites is being promoted.

Forestry and Agriculture

Italy adopted a National Forestry Plan in 1987. This plan includes among other incentives to promote reforestation, improvement of forestry management and research and promotional activities for the wood industry. Several EU regulations have been implemented leading to a reduction in the use of nitrogen fertilizers.

Luxembourg

Luxembourg submitted its national communication to the secretariat of the UN FCCC at March 1995²⁵. Luxembourg adopted the national target to reduce CO₂ emissions by 20% by the year 2005 at 1990 levels.

Emissions in 1990 and 2000

Table 5.9 provides details of emissions of CO₂, CH₄ and N₂O in Luxembourg in 1990 and 2000. CO₂ emissions are expected to decrease by 33% in 2000 compared to 1990 levels. CH₄ emissions are expected to increase by 5% in 2000 compared to 1990 levels, and N₂O emissions are expected to increase by 3%.

Table 5.9. Emissions of CO₂, CH₄ and N₂O in Luxembourg in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|---------------------|-------|
| CO ₂ | 11,244 ¹ | 7,556 |
| CH ₄ | 24.6 ² | 26.1 |
| N ₂ O | 0.691 ³ | 0.693 |

¹ Including 105 Gg of "Nature" emissions.

² Including 0.802 Gg of "Nature" emissions

³ Including 0.091 Gg of "Nature" emissions

Policies and measures

Energy conservation and the promotion of renewable energy sources are important elements of Luxembourg's national programme of Luxembourg. In 1993, a law has been adopted concerning the rational use of energy. This law aims to promote energy savings and the rational use of energy in all economic sectors, and to promote the use of alternative energy sources. As yet, regulations have been adopted concerning the use of renewable energy sources and cogeneration for energy production. In 1991, the Agency for Energy has been established, promoting innovative and pilot projects in the field of renewable energy sources, and the rational use of energy. Structural changes in the iron and steel industry from conventional plants to electric arc furnaces will contribute significantly to the limitation of CO₂ emissions. Luxembourg's national programme lists inter alia the following measures which have been adopted and/or implemented:

Energy

- establishment of combined heat and power stations;
- grants to promote investments in energy saving measures;

Transport

- improvement of public transport and rail connections;
- development of combined transport services for freight transport;

²⁵ Rapport National du Luxembourg en vue de la 1^e Conférence des Parties à la Convention-Cadres des Nations-Unies sur les Changement Climatiques. Ministère de l'Environnement, Mars 1995.

- development of water transport by the construction of a channel in cooperation with France and Germany;
- promotion of cleaner technologies for buses;

Industrial sector

- licenses for new enterprises include obligations for the application of "best available technologies"; existing enterprises need to use best available technologies in future;

Domestic sector

- introduction of subsidies for insulation of housing;
- studies are being carried out on energy savings and the use of renewable energy sources.

The Netherlands

The Netherlands' national communication was submitted to the secretariat of the UN FCCC at 21 September 1994²⁶. The national CO₂ target adopted by the Netherlands is to stabilize emissions by 1994-1995 and to achieve an emission reduction of 3-5% by 2000 compared to 1989-1990. The CH₄ emission reduction target is 10% by 2000 compared to the 1990 level and the target for N₂O is to stabilize emissions at the 1990 level by 2000.

Emissions in 1990 and 2000

Table 5.10 provides details of emissions of CO₂, CH₄ and N₂O in the Netherlands in 1990 and in 2000 according to the draft IPCC guidelines for national greenhouse gas inventories. The national CO₂ target is based on another inventory methodology. So, CO₂ emission projections for the year 2000 calculated according to the IPCC methodology cannot be compared with the national CO₂ target. According to the Netherlands' projections (based on the IPCC methodology), the national CO₂ and CH₄ targets are likely to be achieved. A CO₂ emission reduction of approximately 4% compared to 1990 levels is expected by the year 2000. This estimate is based on temperature corrected figures for CO₂ emissions in 1990. Compared to *actual* CO₂ emissions in 1990, a CO₂ emission stabilisation is expected by the year 2000. CH₄ emissions are expected to decrease by about 25% by the year 2000. The stabilisation target for N₂O emissions is unlikely to be achieved: emissions are expected to increase by 5% by 2000.

Table 5.10 Emissions of CO₂, CH₄ and N₂O in the Netherlands in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|----------------------|---------|
| CO ₂ | 174,000 ¹ | 167,600 |
| CH ₄ | 1,067 | 786 |
| N ₂ O | 59.6 | 62.2 |

¹ CO₂ emissions corrected for temperature influences. Actual emissions in 1990 amount to 167,600 Gg.

²⁶ Netherlands' National Communication on Climate Change Policies. Prepared for the Conference of the Parties under the Framework Convention on Climate Change. The Netherlands, August 1994.

Policies and measures

The Netherlands' policy package to address climate change has been formulated in a number of memoranda and plans (such as in the National Environmental Policy Plan 2 and the Second Memorandum on Energy Conservation) and has been approved by Parliament. It includes a wide range of policies and measures in various sectors, primarily energy, transport and waste.

CO₂

To a large extent, the policy package for reducing CO₂ emissions is directed at energy conservation. The package consists of voluntary agreements (especially with industry, including the energy and transformation sector and the energy distribution sector), standards (especially for residential use and for buildings), transport infrastructure investment, financial support for renewables and energy conservation, and reduction of waste landfilling in addition to energy recovery. In selecting appropriate instruments, preference is given to support for 'self-regulation', i.e. voluntary agreements. This usually takes the form of a Long Term Agreement between the Government and intermediary organisations, such as branch organisations. The principle reason for the emphasis on voluntary agreements is the acceptance of measures by all relevant participants.

CH₄

Direct measures for reducing methane emissions include regulations for waste management and improvement of gas distribution networks. Agro-environmental policies and the Common Agricultural Policy of the European Community will lead to a decreasing number of cattle and manure production.

N₂O

Specific policies whose aim is the reduction of N₂O emissions are being studied. Any reduction in N₂O emissions is the result of policies in other areas than climate change, mainly the acidification abatement policy.

Portugal

Portugal submitted its national communication to the secretariat of the UN FCCC at the end of 1994²⁷. Portugal's strategy to mitigate climate change is "in compliance with its commitments as a European Union country, in accordance with the principle of joint but different responsibilities." Portugal adopted the national target of limiting the increase of CO₂ emissions to 40% in 2000 compared to 1990.

Emissions in 1990 and 2000

Table 5.11 provides emissions of CO₂, CH₄ and N₂O in Portugal in 1990 and projected emissions in 2000. CO₂ emissions from fossil fuels are expected to increase by 29% in the year 2000 compared with 1990 emissions. Portugal's national communication does not provide projections for future CH₄ and N₂O emissions.

²⁷ Portuguese report in accordance with Article 12 of the United Nations Framework Convention on Climate Change. Ministry of the Environment and Natural Resources, Lisbon, 1994.

Table 5.11. Emissions of CO₂, CH₄ and N₂O in Portugal in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|--------|---------------------|
| CO ₂ | 42,148 | 54,274 ¹ |
| CH ₄ | 227 | NE |
| N ₂ O | 10.6 | NE |

¹ Relates to CO₂ emissions from fossil fuel combustion. 1990 CO₂ emissions from fossil fuel combustion amount to 38,686 Gg.

Policies and measures

Portugal's strategy to mitigate greenhouse gas emissions includes policies and measures in the energy, industrial, transport and agricultural sector.

Energy

The major policies adopted in the energy sector by Portugal are in compliance with environmental protection objectives, aiming at an increase in diversification and energy efficiency, the use of clean technologies and the promotion of renewable energy sources. Policies and measures include:

- the use of natural gas for electricity production and end use (starting in 1997);
- promotion of combined heat and power in various industrial sectors;
- promotion of renewable energy sources for energy production;
- improvements of efficiency of thermal power stations;
- promotion of rational use of energy in all end users sectors.

Industry

In the industrial sector, economic instruments, legislative measures and information campaigns are adopted to support environmental protection.

Transport

Policy measures in the transport sector are targeted at strengthening the competitiveness of rail transport. Important investments have been made in both road and rail infrastructure.

Agriculture and forestry

Policies and measures in the agricultural sector relate to the Common Agricultural Policy (CAP) reform of the EC, which is targeted at reducing incentives for agricultural production. Support measures introduced within the context of the CAP reform lead to reduction in the use of fertilizers and the number of cattle, and thus to a reduction in CH₄ and N₂O emissions. Measures taken in the forestry sector encourage the maintenance, expansion and protection of forests.

Spain

Spain submitted its national communication to the UN FCCC in September 1994²⁸.

Emissions in 1990 and 2000

Table 5.12 provides details of emissions of CO₂, CH₄ and N₂O in Spain in 1990 and 2000. The projected CO₂ emissions in 2000 only relate to energy. CO₂ emissions from fuel combustion are expected to increase by 24% in 2000 compared to 1990 levels. Spain's national communication did not provide projections for CH₄ and N₂O.

Table 5.12. Emissions of CO₂, CH₄ and N₂O in Spain in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|----------------------|----------------------|
| CO ₂ | 260,655 ¹ | 276,504 ² |
| CH ₄ | 2,129.8 | --- |
| N ₂ O | 86.5 | --- |

¹ Total CO₂ emissions. Spain included in its national communication an estimate for total **net** emissions, including CO₂ removals by land use change and forestry, amounting to 256,476 Gg.

² Energy related CO₂ emissions. Energy related CO₂ emissions in 1990 amounted to 222,908 Gg.

Policies and measures

The main element of Spain's national programme to reduce greenhouse gas emissions is the 1991 National Energy Plan. Measures are also taken in the industry, transport, agriculture and forestry sector.

Energy

The main instrument of the 1991 National Energy Plan to address the greenhouse effect is the Energy Saving and Efficiency Plan. This plan consists of four sets of measures:

- the Energy Saving Programme to reduce the final energy consumption without reducing the economic activity;
- the Energy Substitution Programme to increase the use of natural gas as an alternative to oil and coal products in industry and in the residential and commercial sector;
- the Cogeneration Programme to encourage combined heat and power generation. Projects are especially aiming at energy-intensive industries (such as refining and chemicals), and in hotels and hostels;
- the Renewable Energies Programme to increase the use of renewable energy sources for electricity generation and for end use.

The 1991 National Energy Plan also includes measures in the energy generation and supply sector. The main measures in this area are fuel switching to natural gas, and the promotion of clean coal technologies.

²⁸ Report by Spain on the United Nations Framework Convention on Climate Change. Provisional Version. National Climate Committee. Spain.

Industry

The Industrial and Technological Environmental Programme encourages industry to meet increasingly stringent environmental standards.

Transport

State subsidies are granted to promote public transport. The Plan on Transport in Large Cities 1990-1993 aims to modernize public transport systems. Freight transport by rail is encouraged.

Agriculture

Relevant agricultural policy includes energy saving measures, the use of biomass as an energy source, information on good farmers practices regarding the storage of manure and the application of fertilizers.

Forestry

Cooperation agreements between the Spanish Government and the Autonomous Communities, which already lead to reafforestation of 63 700 hectares took place between 1990 and 1993. Further, efforts are undertaken to prevent forest fires and to protect ecosystems against pests and atmospheric pollution.

Sweden

The Swedish Government adopted its national communication on the 15th of September 1994²⁹. Since 1970, CO₂ emissions have been reduced with approximately 40%. The national target adopted by Sweden is, pursuant to the UN FCCC, to stabilize CO₂ emissions from fossil fuels in the year 2000 at the 1990 level and to reduce these emissions after that. Furthermore, CH₄ emissions from landfills shall be reduced by 30% between 1990 and 2000.

Emissions in 1990 and 2000

Table 5.13 provides details of emissions of CO₂, CH₄ and N₂O in Sweden in 1990 and 2000. Sweden stresses that estimates of CO₂ emissions in 1990 are based on actual emissions, and that these estimates have not been adjusted for temperature influences. If figures are adjusted for average climatic circumstances, CO₂ emissions in 2000 are expected to be at the same level as CO₂ emissions in 1990. If compared to actual emissions in 1990, CO₂ emissions are expected to increase by 4% in 2000. CH₄ emissions are expected to decrease by 10% in 2000 compared to 1990 levels, and N₂O emissions by 15%.

²⁹ Sweden's national report under the United Nations Framework Convention on Climate Change. Ministry of the Environment and Natural Resources, September 1994.

Table 5.13. Emissions of CO₂, CH₄ and N₂O in Sweden in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|---------------------|--------|
| CO ₂ | 61,256 ¹ | 63,800 |
| CH ₄ | 329 | 300 |
| N ₂ O | 15.2 | 13 |

¹ Actual CO₂ emissions. CO₂ emissions adjusted for temperature influences amount to 64,000 Gg.

Policies and measures

A concrete strategy for Swedish climate policy has been formulated in the "Government Bill on Actions to Counteract Climate Change" of 1993. The main element of Sweden's strategy is to limit the demand for fossil fuels and to increase the contribution of renewable energy sources, along with improved energy management and more efficient use of energy. Taxation of fossil fuels is the central policy instrument to limit CO₂ emissions.

Energy and transportation

Measures to improve energy efficiency include technology procurement and demonstration of energy electricity efficient products, processes and systems in homes, non-housing premises and industry. In 1991, a CO₂ tax was introduced as part of a major tax reform, aiming to reduce taxes on income and capital and to increase environmental taxes. Several programmes have been adopted to promote and stimulate energy efficiency and the use of renewable energy sources. These programmes include the programme for energy management and promotion of biofuels, wind power and solar energy. In the transport sector, several research and development programmes (concerning the use of alternative fuels and hybrid and electrical vehicles) have started. Since only 5% of the electricity production in Sweden is based on fossil fuels, the potential of greenhouse gas reduction in the electricity sector is very limited.

Forestry and agriculture

Sweden adopted various measures to reduce carbon releases from soils, e.g. through restrictions on forest site preparation operations and drainage. Some of the policies of the new agricultural policy adopted in 1990 indirectly effect greenhouse gas emissions. These include improved nitrogen application methods, land use change from arable land to grazing grounds or forests, and increased use of winter overgrown land.

United Kingdom

The United Kingdom's national communication was published in January 1994 and presented to the Ninth Session of the Intergovernmental Negotiating Committee (INC)³⁰. An executive summary and minimum tables for greenhouse gas emissions according to the guidelines for the preparation of first

³⁰ Climate Change. The UK report. United Kingdom's Report under the Framework Convention on Climate Change. January 1994.

communications by Annex I countries (Decision 9/2, INC/FCCC, 1994) was submitted in August 1994. The UK's CO₂ programme is currently being updated in the light of new energy projections published in March 1995 and other developments which have taken place since the programme was first published. This update will be available in the autumn of 1995. Figures for CO₂ emissions given in this document are based on the forthcoming update.

The UK accepts the commitment of the UN FCCC to take measures aimed at returning emissions of greenhouse gases to 1990 levels by the year 2000.

Emissions in 1990 and 2000

Table 5.14 provides emissions of CO₂, CH₄ and N₂O in the United Kingdom in 1990 and projected emissions in 2000 taking into account the policies and measures in the national programme. The programme is expected to produce a small reduction in CO₂ emissions, a 10% reduction of CH₄ emissions and a 75% reduction of N₂O emissions.

Table 5.14. Emissions of CO₂, CH₄ and N₂O in the United Kingdom in 1990 and 2000 (Gg).

| | 1990 | 2000 |
|------------------|---------|---------|
| CO ₂ | 580,268 | 551,283 |
| CH ₄ | 4,844 | 4,400 |
| N ₂ O | 109 | 30 |

Policies and measures

The UK's national communication "Climate Change; the UK Programme" sets out measures aimed at returning emissions of each of the main greenhouse gases to 1990 levels by the year 2000.

CO₂

The CO₂ programme is based on a national partnership approach drawn up after extensive public consultation, involving business, voluntary, environmental and other interest groups. Measures are spread across all sectors:

- domestic energy consumption, through measures which include the introduction of taxation on domestic fuel and power, and a new Energy Saving Trust;
- energy consumption by business, including energy efficiency advice and information;
- energy consumption by the public sector, through targets for central and local government and public sector bodies; and
- transport, through increases in road fuel duties, and a commitment to real increases of at least 5% on average in future budgets.

CH₄

Initiatives are being taken to encourage the use of CH₄ for energy generation and reducing emissions from coal production. New guidance on limiting emissions from several industrial sectors is also being prepared.

N₂O

An 75% reduction is expected by 2000 compared to 1990 levels, mainly through the reduction of nitrous oxide emissions from nylon manufacture.

5.3. Summary

All Member States, except Belgium, ratified the UN FCCC and submitted their national communications to the secretariat of the UN FCCC. Besides the commitments of the UN FCCC, most of the Member States adopted also national targets to reduce greenhouse gas emissions, varying in objectives and time scales. All Member States, except Belgium, carried out inventories of CO₂, CH₄ and N₂O emissions in 1990. Belgium provided estimates of CO₂ emissions in 1990. Estimates for emissions in 1990 provided in the national reports are not always comparable. In general, the draft IPCC guidelines for national greenhouse gas inventories have been used, while some countries base their estimates on CORINAIR. Some countries apply correction factors to adjust for temperature influences or for imported/exported electricity.

Most of the Member States provided projections of CO₂, CH₄ and N₂O emissions in 2000. Important to note is that projections of greenhouse gas emissions included in the national reports are not comparable and cannot be added together. The projections included in the national reports have been compiled using various modelling tools, key input assumptions, sources projected, and the representation of measures and policies. Some Member States have only estimated fuel related CO₂ emissions in 2000, and one Member State projected emissions in 2005 instead of 2000. Further, the projections do not always only take account of adopted measures, but include proposed measures as well.

8 Member States expect an increase in CO₂ emissions in 2000 compared to 1990: Austria, Finland, France, Greece, Ireland, Italy, Portugal, and Spain. 1 Member State expects to reach a stabilisation of CO₂ emissions in 1990: Sweden³¹ and 5 Member States are expecting a decrease in CO₂ emissions in 2000: Belgium, Denmark³², Luxembourg, the Netherlands³³ and the United Kingdom. Germany provides a projection for CO₂ emissions in 2005 and expects a CO₂ emission reduction by that year.

11 Member States provided projections of CH₄ and N₂O emissions in 2000. 2 of them expect an increase in CH₄ emissions: Ireland and Luxembourg; Another 2 expect a stabilization: Austria and France. The remaining 7 Member States expect a reduction in CH₄ emissions: Denmark, Finland, Greece, Italy, the Netherlands, Sweden and the United Kingdom.

³¹ If based on temperature corrected CO₂ emissions in 1990. If projected figures are compared with *actual* CO₂ emissions in 1990, an increase in CO₂ emissions of 4% is estimated.

³² If based on CO₂ emissions in 1990 which have been corrected for electricity import fluctuations. If projected figures are compared with *actual* CO₂ emissions in 1990, an increase in CO₂ emissions of 3% is estimated.

³³ If based on temperature corrected CO₂ emissions in 1990. If projected figures are compared with *actual* CO₂ emissions in 1990, CO₂ emissions are estimated to stabilize.

6 Member States expect an increase in N₂O emissions: Denmark, Finland, Greece, Ireland, Luxembourg and the Netherlands while 2 Member States expect a stabilization: Austria and Italy; and 3 other Member States expect a reduction in N₂O emissions: France, Sweden and the United Kingdom. Germany provided projections for 2005 and expects a reduction in both CH₄ and N₂O emissions.

6. PROJECTIONS OF CO₂ EMISSIONS IN 2000

6.1. Introduction

This chapter provides first estimates of projections of future greenhouse gas emissions in the European Community. As a first attempt to arrive at greenhouse gas emission projection, several scenarios have been applied. These, as well as the modelling techniques used, are described in section 6.2. Section 6.3 provides estimates of CO₂ emissions in 1990, 2000 and 2020.

The 1990 figures presented in this section differ from the figures provided in the 1990 EC emission inventory given in chapter 3, since they are estimated using the same methodology as has been used for the 2000, 2010 and 2020 figures. The 1990 figures presented here are only provided to show the trend in CO₂ emissions in the European Community.

It should be stressed that the simulations described in this chapter are not official simulations to assess the impact of climate change policies in the EC. The results of the simulations are provided as a first indication of future EC greenhouse gas emission. Further work is being undertaken to develop more accurate modelling tools and scenarios.

The models and scenarios used to arrive at the projections for future EC emissions differ, in structure and in assumptions with regard to exogenous variables, from the models and scenarios used by Member States to forecast their CO₂ emissions (see Chapter 5). Results are therefore not comparable.

Estimates of the effects of policies and measures on greenhouse gas emissions, if available, have been provided in chapter 4.

6.2. Modelling techniques and scenarios

The projections of future EC greenhouse gas emissions provided in this chapter are based on the EC model MIDAS (Model Integrating Demand and Supply) and various scenarios, which differ in assumptions with regard to exogenous variables. Below, a short description of MIDAS and the various scenarios is provided. Annex 2 provides a more detailed outline of the scenarios applied.

MIDAS (Model Integrating Demand and Supply)

Funded by the EC JOULE programme, the large scale energy system planning and forecasting model MIDAS (Model Integrating Demand and Supply) has been developed. MIDAS performs a dynamic simulation of the energy system, which is represented by combining engineering process analysis and econometric formulations. The model is used for scenario analysis and forecasting. An econometric top-down approach has been combined with a micro-economic approach.

MIDAS covers the whole energy system, including energy demand by sector and fuel, power generation, oil refineries, natural gas, solid fuels production, imports and energy market prices. The

model ensures, on an annual basis, the consistent and simultaneous projection of energy demand, energy supply, energy pricing and costing, so that the system is in a quantity and price-dependent balance. On the basis of exogenous projections of import prices, macroeconomic indicators and resource availability, MIDAS forecasts energy demand and computes the necessary capacity expansion and operation of the supply sectors to meet demand and their mutual energy exchanges. The model evaluates the energy production costs by sector and fuel and determines consumer prices, by considering also international energy prices, the national pricing policy and the government tax policy. Consumer prices are feeding again the demand sub-model that re-adjusts demand projections and, therefore, supply activities. Thus, a closed-loop iteration is established which converges on an annual basis to provide a consistent simulation of energy demand, supply and prices. Emission factors per plant and fuel are incorporated in the model to calculate emissions.

Conventional Wisdom scenario

The Conventional Wisdom scenario denotes the "business as usual" world, representing a conventional wisdom view of the most likely evolution of events. Economic growth gradually weakens in the long term. The GDP growth rates in the EC are expected to decrease from 2.9% in the period 1995-2000 to 1.8% in the period 2015-2020. Energy policy remains fragmented, the result of unresolved conflicting objectives for competitiveness, environment, security of supply and differing national aims. Some penetration of new, more efficient demand and supply technologies is expected. Regarding energy demand issues, continuation of current actions with some concern on increasing efficiency is expected. Energy prices are increasing smoothly. Gas prices are relatively low compared to oil prices, due to deregulation and growing networks. The development of energy prices can be found in Table 6.1.

Table 6.1. Primary energy prices (in constant 1993 prices and exchange rates). Conventional Wisdom Scenario.

| | Crude oil (ECU/toe) | Natural Gas N. Europe (ECU/toe) | Natural Gas S. Europe (ECU/toe) | Steam Coal (ECU/toe) |
|------|------------------------|---------------------------------------|---------------------------------------|-------------------------|
| 1990 | 188.1 | 101.5 | 111.6 | 65.0 |
| 1995 | 128.5 | 91.5 | 100.6 | 54.8 |
| 2000 | 153.3 | 123.6 | 133.5 | 60.0 |
| 2005 | 182.5 | 139.9 | 148.2 | 63.0 |
| 2010 | 211.7 | 158.3 | 164.6 | 64.0 |
| 2015 | 219.0 | 161.8 | 164.9 | 68.0 |
| 2020 | 226.3 | 167.2 | 167.2 | 75.0 |

Battlefield scenario

In the Battlefield scenario the world reverts to isolation, power blocs and protectionism. Contradictions and instabilities in the global system make economic integration very difficult. Globalization is seen as too ambitious. The geopolitical system fragments into blocs, with tensions and friction between and within blocs. The GDP growth rates in the EC are expected to decrease from 3.1% in the period 1995-2000 to 1.3 in the period 2015-2020. Energy policies are aimed at reducing import dependency. Supply side measures are likely to be more successful than demand

side measures. In spite of attempts to introduce alternative fuels, tension and conflict inhibit efficiency gains. The increasing dependency on fewer major suppliers leads to an oil price shock. Some penetration of new, more efficient demand and supply technologies is expected, partly driven by public standards and partly through industrial competitiveness.

Forum scenario

In Forum, the world moves more to consensus and cooperative international structures with a strong role for public administration and intervention. The process of global integration produces new imperatives for collective public action. National, European and international institutions are gradually restructured so as to be able to deal more effectively with broader, more complex shared problems and interests. The GDP growth rate in the EC increases from 2.3% in the period 1995-2000 to 2.6% in the period 2010-2015 and decreases somewhat after that period. Energy policies are most significantly affected by concern for the environment. Major policy shifts are expected through reinforced environmental concerns, limiting energy demand growth. Energy prices are expected to be stable. A strong penetration of more efficient demand and supply technologies will occur, which will go together with a high level of technology transfer.

Hypermarket scenario

In the Hypermarket scenario, the predominant themes are market forces, liberalism and free trade; there is a minimum of intervention from government and public administrators. Global economic integration is self-reinforcing and continues. The force driving this scenario is continued application of the market mechanism which is seen as the best way to produce wealth and handle complexity and uncertainty. Liberalization and privatization deliver results and produce new market entrants who demand more of the same. The GDP growth rates in the EC are expected to decrease from 3.2% in the period 1995-2000 to 1.9% in the period 2015-2020. Energy policy is driven by the desire to minimise government control and maximise efficient operations of free markets, nonetheless achieving desired standards. A strong growth in energy demand is expected. Penetration of new, more efficient demand and supply technologies depends on market forces and international competition. Energy prices are increasing smoothly.

6.3. Trends in CO₂ emissions

Table 6.2 provides projections of energy related CO₂ emissions in 2000, 2010 and 2020. It should be noted that these results are first estimates of future EC greenhouse gas emissions. For reasons of comparison, estimates of CO₂ emissions are also provided for the year 1990, using the same calculation methodology. Since the calculation methodology differs, the 1990 emission estimates provided in this section cannot be compared with the EC emission inventory as included in Chapter 3.

According to the Conventional Wisdom Scenario, which denotes the "business as usual" world representing a conventional wisdom view of the most likely evaluation of events, CO₂ emissions in the EC are expected to increase with 5% by the year 2000, with 13% by the year 2010 and with 16% by the year 2020 (compared with 1990 levels). The results of the Hypermarket scenario, which

gives a predominant role to market forces, liberalism and free trade, show a similar increase: an increase is expected of 5%, 14% and 17% for the years 2000, 2010 and 2020 respectively. The Battlefield scenario, which assumes, amongst others, that the world reverts to isolation, power blocs and protectionism, results in a decreasing growth of CO₂ emissions: an increase of 6% in 2000, of 9% in 2010 and of 7% in 2020. According to the Forum scenario, which assumes, amongst others, that the world moves more to consensus and cooperative international structures with a strong role for public administration and intervention, a reduction in CO₂ emissions is expected: 2% in 2000, 5% in 2010 and 10% in 2020.

Table 6.2. Trends in energy related CO₂ emissions in the EUR-15. (1000 Gg.); preliminary results.

| | 1990 | 2000 | 2010 | 2020 |
|---------------------|----------|------------|-------------|-------------|
| Conventional Wisdom | 3,155(0) | 3,326(+5%) | 3,557(+13%) | 3,648(+16%) |
| Battlefield | 3,155(0) | 3,357(+6%) | 3,428(+9%) | 3,368(+7%) |
| Forum | 3,155(0) | 3,089(-2%) | 2,986(-5%) | 2,855(-10%) |
| Hypermarket | 3,155(0) | 3,325(+5%) | 3,597(+14%) | 3,686(+17%) |

7. VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

7.1. Introduction

This chapter describes the possible impacts of climate change on the European Community and adaptation activities taken at the Community level. The Second, Third and Fourth Framework Programme of Research and Development contain specific programmes dealing with the assessment of possible impacts of climate change on various environmental sectors. The programmes on climate change impacts include research on sea level rise and subsequent impacts on European coastal resources, and the impacts of climate change on European land resources (agriculture and forestry). Also included in the research programmes is the research on "Desertification in the Mediterranean Area", as well as studies related to the socio-economic impacts of and policy responses to extreme events due to climate change. Section 7.2 provides a brief overview of the possible impacts of climate change on the European Community. Details on research programmes related to climate change are not discussed in this section, but can be found in Chapter 9 "Research and Development". Section 7.3 gives a brief overview of adaptation activities taken at the Community level.

7.2. Possible impacts of climate change on the European Community

Temperature increases

The timing and extent of a possible rise in temperature due to the enhanced greenhouse effect is highly uncertain, in particular on a local or regional level. Although the results of models predicting the increase in temperature can only be considered as rough estimates, it has become clear that temperature increases will be greater in the high latitudes than in the low latitudes. Therefore, it is expected that the extent of temperature increases in northern Europe will be larger than the temperature increase in the Mediterranean regions. Assuming a doubling of atmospheric CO₂ concentrations, scenario studies show that average winter temperatures in the far northern countries may increase by 2-5 °C, while the winters in the central and southern region can be 1-3 °C warmer. For the summer, average temperatures are 3-4 °C warmer throughout all of Europe (Thimbal et al., 1995; Cabasch et al., 1995). Aerosols emitted in the atmosphere have a net negative radiative forcing. However, any negative forcing due to aerosols cannot be regarded as a simple offset to the effect of greenhouse gases, because the regional patterns of the forcing are different (IPCC, 1994).

Precipitation

Large uncertainties exist with regard to the impacts of climate change on precipitation. Most likely summers will be drier. This is partly because earlier snow melt would affect the seasonal cycle of soil moisture reserves, and partly because warmer temperatures may lead to increased evaporation and evapotranspiration (Warrick et al., 1990).

The IPCC (Houghton et al., 1992) estimated under their business-as-usual scenario that the greenhouse effect can lead to 15 -25 % less soil moisture in summer for Mediterranean countries. Since these countries already depend heavily on irrigation, this may have enormous impacts on their agricultural potentials. Increased aridity may also lead to severe land degradation due to the breakdown of organic matter, salt accumulation and the formation of surface crusts. Therefore, impacts on the agricultural potential could be even more severe.

Water resources

Climate change also has significant potential impacts on water resources, their distribution in space and time, the hydrological cycle of water masses, water quality and water supply systems and requirements for water resources of different regions. This may lead to complex impacts on natural resources and human activities, in particular water storage and distribution, agriculture and electrical energy production. One of the most vulnerable areas in the European Community, with respect to impacts on water resources, is the Mediterranean area.

Sea level rise and extreme events

Sea level rise is one of the main impacts of global warming, due to the thermal expansion of sea water, the melting of mountain glaciers, the melting of inland ice caps and changes in the Antarctic ice sheet. Consequent effects of sea level rise vary from continuously inundation of low-lying lands, increased frequency of flooding, changes in erosion of beach, cliff or dunes, salinisation and changes in river hydrology. A changed sea level is also likely to have impacts on the tides, by altering the resonance of sea basins.

The recent best-estimate business-as-usual scenario of a greenhouse gas induced rise in the global sea surface of 45 cm by 2100 provides only a general guide for possible changes in the relative sea level along the European coasts. Climate change affects to a large extent the occurrence and severity of extreme events. Flooding associated with major storms is most likely of greater consequence than sea level rise on a human time scale. However, knowledge of the pattern and incidence of storminess around European coasts is limited to a few areas in North West Europe and parts of the Mediterranean. The impact of major storms will become more widespread as the sea surface rises. Especially in the North and Mediterranean Seas, the impacts of storms are a matter of particular concern. Currently, the EC administers several contracts to estimate the risk of coastal flooding along selected areas of the European Coastline and to provide bases for the monitoring and mapping of coastal changes on European coasts and of the impacts of change.

Agriculture

Although uncertainties remain in research results, it has been found that higher temperatures will shorten the duration of the growing period for annual crops (Harrison and Parry, 1993). This will lead to a decreased yield of the crop, although the direct fertilizer effects of increased CO₂ concentrations may offset this for some crops. Conditions in southern Europe will generally become hotter and probably drier, which will have negative effects on crop yields. Parts of western Europe (e.g. northern France and Germany) may benefit if there is an average increase in precipitation. Agricultural practices, such as sowing times, irrigation and the use of cultivars may have to change due to higher temperatures and potential droughts.

Grassland production is expected to increase across Europe (Jones et al. 1993). The production will be stimulated by the direct fertilizer effect of CO₂ and temperature increases. Assuming an equivalent doubling of preindustrial CO₂ levels, grassland production in temperate Europe will be about 10-15% higher than at present due to the direct fertilizer effect and a further 18% higher than at present due to the expected temperature increase.

Forestry

Changes in temperature and rainfall patterns are likely to alter the composition, distribution and growth patterns of forests. To avert irreparable damage and loss of forests, research programmes are being carried out to quantify the impacts of climate change on the forestry sector. Based on these studies, it can be concluded that responses vary not only between species, but also between juvenile and mature tissues. Nutrition is also a very important parameter in the responses of the plant to elevated CO₂ concentrations.

Only indicative estimates are available of regional effects of climate change on vegetation zones. However, models suggest a north-northeast movement of vegetation zones over Europe (Bengtsson, 1994).

Analysis of impacts in monetary terms

Although large uncertainties exist with respect to the type and magnitude of climate change impacts, experts and policy makers recognize that global warming will take place over the next century. Climate change is likely to affect nearly all economic sectors. An analysis of economic impacts for EUR-12 (ERM, 1992a) shows that although global warming will most likely result in a net economic cost for the EC as a whole, there will be sectoral and regional variations. For example, it is likely that there will be an increase in revenue to the agricultural sector as a whole in the EC, but this is due to large increases in northern Europe outweighing losses in revenue in southern Europe. Economic costs in the EC are likely to occur in other economic sectors, although economic benefits may occur in some regions, e.g. tourism in Belgium, manufacturing in Luxembourg and the services sector in the UK. 90% of the accumulated economic costs is likely to occur in the second half of the next century.

Monetary impact values have been estimated by impact indicator and by country (ERM, 1992b). Annual costs have been estimated, assuming a global warming of 1 °C and 4 °C. Assuming that no action is taken to control emissions, global warming could range from approximately 0.5 °C to 1 °C in the year 2020, and from 1.75 °C to 4 °C in the year 2100. Monetary impact values are related to levels of global warming rather than to particular years in the future. The years in which such values can be expected to occur depends on the emission control scenario selected. For this reason the estimates are presented as annual values and are not discounted. As the monetary impact values are not related to time, no projected economic growth rate is incorporated in the calculations. National income is assumed to remain constant.

Table 7.1 shows the monetary impact values for the EUR-12 at 1°C and 4°C. It can be seen that economic damage costs are likely to be significant as a proportion of GDP. Although the indicators agricultural yields, comfort threshold and heating and cooling degree days are positive, the total is negative. This is caused by the high economic costs of sea level rise.

Table 7.1. Monetary impact values for the EUR-12 by impact indication per year (Bn 1989 ECU¹) and as % of 1989 National Income

| | Bn 1989 ECU ¹ | | % of National Income | |
|---------------------------------|--------------------------|--------|----------------------|------|
| | 1.0 | 4.0 | 1.0 | 4.0 |
| Global Temperature increase | 1.0 | 4.0 | 1.0 | 4.0 |
| Sea level rise | -67.6 | -272.2 | -1.9 | -7.6 |
| Run-off | -5.7 | -18.4 | -0.2 | -0.5 |
| Comfort Threshold ² | 4.7 | 27.1 | 0.1 | 0.8 |
| Heating and cooling degree days | 13.4 | 35.5 | 0.4 | 1.0 |
| Agricultural yields | 3.2 | 12.2 | 0.1 | 0.3 |

Source: ERM, 1992 b.

¹ Billion of ECU, 1989 level.

² Indicator based on temperature, precipitation and sunshine, indicating the attractiveness for tourism.

Table 7.2 shows the monetary impact values for the Member States of EUR-12. It can be seen that significant differences exist between countries. For southern EC countries, monetary impact values are mostly negative: cooling requirements increase, and the attractiveness for tourism is decreasing due to the negative effects of sea level rise and water shortages. An exception is the agricultural yield indicator, which is positive or zero for all Member States. It should be noted that a positive indicator for agricultural yield does not imply that the agricultural sector as a whole will face economic benefits. Other factors such as the total agricultural land potential play an important role as well.

Table 7.2. Monetary impact values by impact indicator for Member States at 4 °C (Bn 1989¹).

| | Sea Level Rise | Run-off | Comfort Threshold ² | Heating and cooling degree days | Agri-cultural yields | Total |
|----------------|----------------|---------|--------------------------------|---------------------------------|----------------------|-------|
| Belgium | -2.1 | -0.3 | 4.0 | 2.4 | 0.8 | 4.8 |
| Denmark | -37.1 | 0.0 | 1.0 | 1.1 | 1.1 | -33.9 |
| France | -78.2 | -1.7 | 6.0 | 4.1 | 2.2 | -67.6 |
| Germany | -43.9 | -3.7 | 15.4 | 11.0 | 3.0 | -18.2 |
| Greece | -3.4 | -0.6 | -2.1 | -0.5 | 0.0 | -6.6 |
| Ireland | -13.0 | 0.0 | 0.0 | 0.7 | 0.5 | -11.8 |
| Italy | -37.2 | -5.4 | -2.9 | 0.6 | 0.8 | -44.1 |
| Luxembourg | 0.0 | 0.0 | 0.2 | 2.3 | 0.0 | 2.5 |
| Netherlands | -10.7 | 0.0 | 1.4 | 2.9 | 1.8 | -4.6 |
| Portugal | -1.5 | -1.5 | 0.7 | -0.1 | 0.1 | -2.3 |
| Spain | -18.4 | -5.4 | 2.8 | -0.4 | 0.9 | -20.5 |
| United Kingdom | -26.6 | 0.0 | 0.6 | 11.4 | 1.1 | -13.5 |

Source: ERM, 1992 b.

¹ Billion of ECU, 1989 level.

² Indicator based on temperature, precipitation and sunshine, indicating the attractiveness for tourism.

7.3. Adaptation activities

Coastal Zones

One of the key targets of the Fifth Action Programme of the ECs "Towards Sustainability" (CEC, 1993) is the integrated management of coastal zones. By request of the Council of Ministers (Environment), in a Resolution adopted on 25 February 1992, the Commission is currently preparing a Communication on the integrated management of coastal zones, with a view to providing a coherent environmental framework for integrated and sustainable forms of development. The Communication will deal with the entire ambit of the coastal zones of the EC, including fore-shore, coastal waters and estuaries, and coastal land up to the limit of the marine or coastal influence. Research and development activities, e.g. Environment and Climate and "MAST" programmes (see Chapter 8) will provide a scientific basis for sound ecological management of these zones. In

appropriate cases, financial support could be provided from existing instruments where rules and criteria would authorise potential stakeholders to submit projects in line with the Communication.

Foreseen for approval by the Commission in October 1995 is a Communication, which proposes a three years demonstration programme in order to investigate and demonstrate the conditions of coordination, horizontally between the multiple sectors of activity (principle of integration) and vertically between the levels of territorial competence (principle of subsidiarity). In effect it should show -on the coastal area example- how to better put in practice the driving principles of the fifth Environment Action Programme.

The stakeholders at the various levels(local, regional, national, european) would have perform the following tasks:

Description

- state of the environment
- existing environmental measures
- planned developments

Analysis

- causes of existing environment problems
- potential impacts of planned developments
- potential impacts of the evaluation of the global environment
- identification of management options

Concertation

- setting up mechanisms of coordination or adjusting existing ones
- evaluation of management options
- agreeing on plans/programmes:strategies for sustainable development of coastal areas

The Commission must ensure that the programme is set up, and that the results are discussed and disseminated in order to generate practical results on the way to achieve more quickly sustainable development in coastal areas. The programme should also identify needs for further action at European and other levels.

Forests

In June 1993, at the Helsinki Ministerial Conference on the protection of forests in Europe, the European Community signed the Resolution on strategies for a process of long term adaptation of forests in Europe to climate change. The European Community actively participates in the follow-up process of this conference and its resolutions. One of the objectives of the Resolution on climate change is to intensify European research and its international cooperation to improve the understanding of the linkages between climate change and forest ecosystems, including feedbacks from the ecosystem to the climate system. This should help to adjust European forest management systems in order to optimize the adaptation of forests to climate change. Another objective of the Resolution is the adaptation of existing forest monitoring schemes to assess alterations in forests that may be due to climate change.

8. FINANCE AND INTERNATIONAL COOPERATION

8.1. Introduction

As Party, listed in Annex II of the UN FCCC, the EC is obliged to communicate details of measures taken in accordance with Article 4, paragraphs 3, 4 and 5.

This chapter describes multilateral and bilateral cooperation between the European Community and developing countries and between the European Community and the countries with economies in transition. As a result of the Fifth Action Programme, progress has been made in integrating environmental requirements into cooperation with non Community countries, the so called "third countries". Environmental concerns are now reflected in most of the bilateral cooperation contracts established between the Community and its partner countries (CEC, 1994d).

Most of the cooperation programmes and structures mentioned in this chapter have elements related to climate change, but are not specifically orientated towards it. Also, some of these programmes and structures are not only orientated towards developing countries or countries with economies in transition, but to all "third countries".

The first Conference of the Parties to UN FCCC decided, amongst others, that the restructured Global Environment Facility (GEF) shall continue, on an interim basis, to be the international entity entrusted with the operation of the financial mechanism of the Convention. It decided also to review the financial mechanism within four years and take appropriate measures, including a determination of the definitive status of the GEF in the context of the Convention (Decision 9/CP.1).

The European Parliament has expressed itself, in the Resolution on the Global Environment Facility (EP Resolution, report A3-0378/93, 18.01.1994), to be in favour of the participation of the European Community in the GEF as this would facilitate its coordinating role in international environmental matters. The GEF has been requested on 15 June 1995 to invite the European Community as observers to attend future GEF Council meetings. Discussions are currently taking place with the European Parliament on how to allocate the foreseen 3 MECU for EC participation in the GEF.

8.2. Cooperation with third countries

Cooperation with third countries relating to climate change takes place in the framework of an initiative called SYNERGY since 1980, the LIFE instrument since 1992 and the European Energy Charter since 1994.

SYNERGY

The Commission has proposed on 23 May 1995 that the Council prolong and change the SYNERGY initiative in a programme(COM (95) 197 final).

The objective of SYNERGY is to improve the long term world energy situation and hence, Community energy security, by helping other countries to make effective energy policy decisions. By encouraging energy planning, the rational use of energy and counselling and training, SYNERGY contributes to the reduction of greenhouse gas emissions. The funding of the initiative amounted to 8 MECU per year.

Energy cooperation under this programme is aimed at all third countries, and that is an advantage over the other EC cooperation programmes which all have a limited field of geographical application.

Within the context of the SYNERGY initiative , the EC has contributed to regional planning studies by providing funds and experts. The impact of energy consumption on climate change is always taken into account in those studies. The EC has contributed to the following planning studies:

- energy plan for the state of Rio Grande do Sul, Brazil;
- study on improving demand forecasting tools for Brazil;
- energy study for the province of Buenos Aires, Argentina;
- energy prospects for South America;
- urban energy plan for Bydgoszcz and Gliwice, Poland;
- urban energy plan for Miskolc, Hungary;
- energy policy studies for China;
- energy planning in Maghreb countries;
- urban energy plan for Ankara, Turkey;
- national energy plan for Cyprus.

Concerning the rational use of energy, the main means in the SYNERGY initiative are the transfer of technology and methods for rational use of energy, the evaluation of potential energy savings in several economic sectors or countries and the promotion of cogeneration in energy production. The EC has supported the following projects:

- optimization of energy use in buildings in Brazil;
- energy efficiency in road transport and industry in Brazil;
- methodology for cogeneration in Brazil;
- promotion of cogeneration in Chile, Peru and Mexico;
- energy efficiency in the grain processing industry in Argentina;
- seminar on energy audits in Tunisia;
- plan for rational use of energy in industry, transport and buildings in Morocco;
- promotion of rational use of energy in Israel;
- energy savings in buildings in Mediterranean countries;
- industrial energy efficiency audits in Hungary.

Institution building is also an important element of the SYNERGY initiative. This is pursued by the establishment of energy centres in the countries of Eastern Europe and developing countries. The objectives of these centres are the stimulation of the market penetration of efficient energy

technologies, providing a permanent representation of European energy industrialists and experts, and assisting in setting up of effective energy infrastructure (CEC, 1994c). At present, energy centres have been set up in Slovenia, Hungary, Albania and Rumania. In the near future it is intended to establish energy centres in China, Indonesia, Senegal and Argentina.

The Commission has proposed that the Programme is to last five years with a total budget of 50 MECU.

LIFE

On 21 May 1992 the Community agreed upon the regulation on LIFE (Lending Instrument for the Environment)(1992/73/EEC). This provides for EC co-funding of demonstration actions, awareness raising campaigns and technical assistance projects in the area of environmental protection. The funding has been divided into several parts. The larger part is concerned with nature conservation, while the smaller part is concerned with environmental quality.

European Energy Charter

The European Energy Charter Treaty and the Energy Efficiency Protocol have been signed in Lisbon on 17 December 1994, after negotiations encompassing some 50 countries had been successfully concluded in June 1994. The European Energy Charter (COM (95) 440) is a political declaration committing its signatories to cooperate in trade, investment and other policies in all energy sectors. These efforts should lead to the creation of a true energy market throughout Europe. Environment protection and more efficient use of energy brought about by Treaties and Protocols in the frame of the charter will have a positive impact on limiting CO₂ and other greenhouse gas emissions in particular by encouraging market prices, and hence more efficient energy usage.

8.3.Cooperation with developing countries

Cooperation with developing countries takes place in the framework of general and more specific cooperation programmes. The specific programmes include research cooperation, energy and forestry related issues.

Research cooperation

Since 1982, the European Community has financed scientific cooperation with developing countries. A specific programme in this field which was targeted towards research cooperation with developing countries, was Life Sciences and Technologies for Developing Countries. This programme ran during the Third Framework Programme of Research and Development (1990-1994).

The Fourth Framework Programme of Research and Development (1994-1998) covers activities specifically aiming at the promotion of international scientific cooperation. This area has a budget of 540 MECU (i.e. approximately 5% of the total budget of the fourth framework programme) The largest part of the budget will be used for cooperation with the countries of Eastern and Central Europe, the independent states of former Soviet Union and developing countries.

The forthcoming research cooperation with developing countries covers topics that are seen to be common to all developing countries and of prime importance to their economic and social development. The new programme opens new areas; underlines the concept of sustainable development and strengthens interdisciplinary approaches. The programme will target three sectors:

- sustainable management of renewable natural resources;
- improvement of agricultural production and agro-industrial production;
- health research for development.

Areas of relevance to processes of global environmental change cover research on the use and management of ecosystems (e.g. forests, coastal zones, wetlands, drylands, oceans, mountain areas and highlands). Human driving forces behind changes in the use and management of ecosystems will also be covered, for instance the impact of various policies on land-use systems. While agriculture and agro-industrial production are sectors of great importance for developing countries, there is a need for research on sustainable production systems taking account of socio-economic as well as environmental considerations. An example is the improvement of systems for processing and use of crop and animal production. Additional scientific areas of mutual interest may also be covered.

Cooperation with developing countries will be implemented in close liaison with other forms for cooperation such as the Lomé Convention, the new Mediterranean policy and the regulation on financial and technical assistance to, and economic cooperation with, the developing countries in Asia and Latin America.

Cooperation on energy related issues

Energy projects in Asian and Latin American countries are funded within the frame of economic cooperation from Budget Line B7-3013. Since, 1990 eight projects have been set up within this budget line which are of direct relevance to the climate change issue. These projects involved the expenditure of around 15 MECU.

Since 1992, no specific budget line covers energy projects, which are funded under Economic cooperation or Financial and technical cooperation. For example, mid 1995 there are 16 energy projects on-going in Asia, for a total commitment of 56 MECU.

Cooperation on forestry related issues

With respect to forestry, worth mentioning is the establishment of the Community budget line "Tropical forest activities" (Budget Line B7-5041). This budget line is intended to finance projects concerned with the conservation and sustainable management of tropical and subtropical forests. The budget line was established in 1990 and resulted in an allocation of 2 MECU to tropical forest projects in 1991. This amount was increased to 50 MECU in the following years. Approximately one third of the budget line is devoted to projects in the African, Caribbean and Pacific countries and two-thirds to projects in Asia and Latin America. A proposal for a regulation to establish the legal basis of the budget line has been presented to the Council.

Some of the major actions financed to date or presently under preparation under the tropical forests budget line include:

The Pilot programme for the Conservation of Brazilian Tropical Forests: an initial EC contribution of 11.9 MECU was made to the Rain Forest Trust Fund in 1992, and cofinanced actions began in 1993 with a contribution of 4.8 MECU to the directed research component. Cofinancing of 4 MECU for the demonstration projects component, which will support local community and NGO activities for forest conservation and sustainable development, and a further 5MECU for extractive reserves aimed at assisting rubber tapers and other traditional forest users was committed in 1994. In 1995, a 16.7 MECU commitment for the Natural Resources Policy project has been decided.

In Colombia, funding has already provided for an Amazon Fund for sustainable development, geared to channelling resources to small-scale local initiatives aimed at sustainable use of forest resources. Funding is also provided for the implementation of the Alto Orinoco biosphere reserve in Venezuela, and is under consideration for the manus Biosphere reserve in Peru. In 1995 further new projects may be undertaken in Paraguay and Mexico.

The Community provides support to the Amazon pact countries through their Pro Tempore Secretariat in Lima. A programme of institutional strengthening for the pact, together with regional projects for the planning and management of protected areas across the region, and for the consolidation of indigenous areas, have already been initiated. Another important regional project which seeks to address the fundamental causes of deforestation concerns the control of the expansion of the agricultural frontier in Central America.

A number of initiatives have been undertaken in the context of the Community's forest sector support programme to Indonesia, and a sustainable forest management project for Berau in East Kalimantan was committed in 1994. A Geographical Information Systems project has been agreed with Malaysia, and a national parks programme with the Philippines.

In one country, in particular, Indonesia, actions, in favour of tropical forests have indeed represented, for the years 1993-1995 the backbone of the EC development cooperation with a total of 4 major projects presently in place and further 2 planned (100 MECU). Other countries targeted for EC assistance in the forestry sector (under budget line B7-3000) include, amongst other, Bangladesh, India, Bhutan, Laos, Vietnam, Malaysia and the Philippines.

Important projects undertaken in ACP countries include a regional Central African forest monitoring project (3.5MECU), Korup national park in Cameroun (7.3 MECU) and substantial programmes in Nigeria, Tanzania, Ivory Coast, Guinea and Papua New Guinea.

Numerous smaller-scale projects implemented by European, international or local NGOs and community groups and indigenous peoples' organisations have received support. Close attention has been paid to the human aspects of forest conservation, through to participatory sustainable development activities at local level. Biosphere reserves have provided a useful framework for the

combination of sustainable resource use with forest conservation, and there are around 10 reserves which have benefited or for which assistance is under consideration.

A number of non-country specific or horizontal actions have been financed or are under consideration, notably in the fields of promoting the establishment of timber certification systems, sustainable paper production, forest monitoring, tropical forests and biodiversity information resources, and partnership arrangements between the federation of European parks and protected areas in Latin America and Asia.

Other bilateral cooperation

African, Caribbean and Pacific countries (ACP)

The most comprehensive of all the Community's regional agreements with developing countries are those with the African, Caribbean and Pacific (ACP) countries, the so-called Lomé Conventions. The fourth convention was signed in Lomé on 15 December 1989 (Lomé IV) and will be into force from 1990 to 1995. The main objective of the convention is cooperation between ACP and EC countries in order to promote and expedite the economic, cultural and social development of the ACP States and to consolidate and diversify their relations in a spirit of solidarity and mutual interest (Article I of the Convention).

Under Lomé IV, environment is one of the main areas of cooperation. Within the framework of efforts to protect the environment and restore natural balances, cooperation aims to promote specific operations concerning the conservation of natural resources, renewable and non-renewable, the protection of ecosystems and the control of drought, desertification and deforestation. Other operations on specific themes are also being undertaken, notably locust control, the protection and utilization of water resources, the preservation of tropical forests and biological diversity, the promotion of a better balance between urban and rural areas, and the urban environment (Article 14 of the Convention).

Another main area of cooperation is energy development. The ACP States and the Community have agreed to cooperate in view of the seriousness of the energy situation in the majority of ACP States, owing partly to the crisis caused in many countries by dependence on imported petroleum products and the increasing scarcity of fuelwood, and in view of the effects the use of fossil fuels have on the climate (Article 105 of the Convention). In ACP-EC, cooperation particular emphasis shall be placed on energy programming, operations for saving and making efficient use of energy, reconnaissance of energy potential and the economically and technically appropriate promotion of new and renewable sources of energy.

Asian and Latin-American developing countries (ALA)

Since 1976, the Community has been pursuing a policy of financial, technical and, more recently, also economic cooperation with the Asian and Latin American developing countries (ALA). Under

the new guidelines for Community cooperation with Asian and Latin American (ALA) countries (Regulation 443/92), protection of the environment and natural resources, and sustainable development, are long-term priorities. 10 % of the total budget of 2,750 MECU for the period 1991-1995, has been set aside for projects specifically aimed at protecting the environment, in particular tropical forests (Article 5 of the Regulation).

Environmental Impact Assessment have been fully integrated in the activities of the EC operations with developing countries.

The overall volume of the financial resources committed to sustainable development cooperation is increasing since 1990, reaching 770 MECU in 1993, which were provided for projects in ALA, ACP and the Mediterranean countries in areas relevant to the implementation of Agenda 21 and other Rio Conference agreements, for example energy, biodiversity, forests, rural environment and desertification, water and urban environment.

While the bulk of this expenditure is channelled through bilateral (or regional) programmes, there are also two budget lines specifically devoted to environment in developing countries and to tropical forest.

The first (B7-5040) targeted at the environment in developing countries (13.2 MECU in 1995) is being used for small scale concrete activities related to the management of natural and urban environment including airpollution. A significant proportion of the budget line is devoted to assist developing countries to enhance their institutional capacity to deal with environmental issues. training in environmental management and establishment of local sustainable development plans and strategies with strong local community participation are some of its items.

The second budget line (B7-5041) concerns the protection of forests on which reference has been made in previous chapters.

8.4. Cooperation with the countries of Central and Eastern Europe and the former Soviet Union

The cooperation with the central and eastern European countries (CEECs) and the former Soviet Union is mainly based on the PHARE (Poland and Hungary Assistance to the Restructuring of the Economy) and the TACIS (Technical Assistance to the Commonwealth of Independent States) programmes. The PHARE programme was established in 1989 and its main objective was to provide direct assistance to Poland and Hungary. Since then, the programme has been expanded to other countries in Central and Eastern Europe. The TACIS programme, oriented on the Commonwealth of Independent States (CIS), was formally established by a regulation adopted by the Council of Ministers in July 1991 (EEC/Euratom, no. 2157/91). A new and revised regulation was passed in 1993 (EEC/Euratom, no. 2053/93). Close links are being maintained between the PHARE and the TACIS programme.

PHARE

The PHARE programme is an EC initiative which supports the political and economic development of the CEECs. PHARE provides grant finance to support the process of economic transformation and to strengthen newly created democratic societies. PHARE also provides grant finance to help countries with Europe Agreements to integrate with the EC. Within PHARE, close cooperation exists with the partner countries on how funds are to be spent, within a framework agreed by the EC.

Initial PHARE support in the environment area covered urgent actions such as the supply of equipment to monitor air and water pollution, studies on specific problems and help in establishing standards and legislation. Later, the focus was switched to develop a more strategic approach, including the development of policies and programmes for specific sectors such as waste treatment.

The main priorities for PHARE funding are common to all countries, although every country is at a different stage of transformation. The key areas include restructuring of state enterprises including agriculture, private sector development, reform of institutions and public administration, reform of social services, employment, education and health, development of energy, transport and telecommunications infrastructure, and environment and nuclear safety. At the end of its first five years of operation in 1994, the European Community, through the PHARE programme, made available 4,284 MECU to 11 partner countries (CEC, 1994b).

Of relevance to the climate change issue are particularly the activities in the key areas "environment and nuclear safety" and "development of energy". Other Community programmes are complementing the assistance in the energy sector, such as THERMIE (Section 4.3) and SYNERGY (Section 8.2). For all the CEECs and the EC, the European Energy Charter reflects common interests in the energy sector.

The support in the area of environment is being provided either in the form of yearly National or Regional Environmental Sector Programmes or through environmental components in the General Technical Assistance Facilities.

In 1991, technical assistance programmes in the energy sector started in Poland, the Czech and Slovak Federative Republic, Hungary and the Baltic States. In 1992 and 1993, PHARE extended its activities in the energy sector to the other partner countries and to "multi-country" activities. The aim of the multi-country energy programme is to facilitate cooperation between all the PHARE partner countries. These regional projects cover the following areas:

- interconnection of energy networks;
- twinning and training programmes;
- energy and environment.

Regarding "energy and environment", an important programme is currently being prepared, namely the development of a coordinated strategy in the field of clean and rational use of coal in central and eastern Europe (CEC, 1994b).

TACIS

The overall aim of the TACIS programme is to contribute to the transition towards a market economy of the independent states of the former Soviet Union. By the end of 1994, TACIS included 13 partner countries: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, the Russian Federation, Tajikistan, Turkmenistan, Ukraine en Uzbekistan. The TACIS programme provides support in the form of grant finance to foster the exchange of knowledge and expertise through partnerships, links and networks at all levels of society. TACIS started in 1991 with an annual budget of 400 MECU, which rose to 510 MECU in 1994 (CEC, 1994a).

The European Community and its partner countries work closely together to assess reform objectives and the needs for TACIS support based on the economic situation and progress of reform. The major focal areas currently supported by TACIS are:

- human resources development;
- enterprise restructuring and development;
- infrastructures;
- energy, including nuclear safety;
- food production, processing and distribution.

Although the first TACIS Regulation did not mention the environment as a focal area, environmental concerns have played a major role in all TACIS activities from the programme's inception. The Commission has chosen to integrate the environment in all sectors, rather than focusing on projects which are purely "environmental". Environmental impact assessment and auditing was an integral part or part of the feasibility study of all larger projects. However, the new TACIS Regulation (1993-1995) includes a specific reference to the environment. Article 4, paragraph 3 of the Regulation states that "Due regard shall be taken of environmental considerations when designing and implementing programmes".

In the beginning of 1995, the European Community has reinforced its commitment to the environment in the former Soviet Union, through the Environmental Support Facility project. The projects' main purpose is to provide a framework for environmentally sound economic growth in the region and to help restore areas which have suffered from serious environmental damage in the past. It will help industry, governments and non-governmental organisations to plan and implement environmental projects.

Energy is specified as one of the priority sectors of the TACIS programme. Important to note is that each project in the energy sector contains an energy saving component. Advice is also offered to assess the potential of renewable resources, mainly hydropower but also solar, wind and geothermal power.

The TACIS programme has inter alia financed a number of energy centres which were established under the THERMIE programme (CEC, 1994a). These energy centres develop energy saving strategies, promote commercial cooperation and establish dialogues between international energy

experts. Also a number of energy audits are carried out at industrial plants as a first step in demonstrating energy saving technologies. This technical assistance is aimed at reducing the energy intensity of the industrial and commercial sectors and is provided directly to specific energy-intensive enterprises through demonstration projects. Recent actions include energy audits in the aluminium, steel, cement and paper industries (CEC, 1994d). In the following years TACIS will provide energy saving advice to the existing institutions involved in energy distribution.

8.5. Summary

Table 8.1 gives an overview of budgets which have been spent on or reserved for programmes in the field of international cooperation. However, it should be emphasized that international cooperation programmes usually encompass a wide range of activities. It is difficult to isolate the environmental or energy component of the various integrated development projects. The table should be read in that context. Climate change related projects only cover a minor part of the total budgets.

Table 8.1 Summary of expenditures on EC cooperation programmes with third countries, especially developing countries and countries with economies in transition.

| Cooperation programme | Time period | Total budget (MECU) |
|---|-------------|---------------------|
| All third countries: | | |
| SYNERGY | 1990-1994 | |
| LIFE | 1991-1995 | 400 |
| Developing countries: | | |
| Research cooperation | 1990-1994 | |
| Energy cooperation (B7-3013) | 1990-1994 | |
| Forestry cooperation (B7-5041) | 1990-1994 | |
| ACP-countries | 1990-1995 | |
| ALA-countries | 1991-1995 | 2,750 |
| Countries with economies in transition: | | |
| PHARE | 1990-1994 | 4,284 |
| TACIS | 1991-1994 | 1,870 |

9. RESEARCH AND DEVELOPMENT

9.1. Introduction

Pursuant to Articles 4.1 (g), 5 and 12.1 (b) of the Convention, this chapter gives information about research efforts on physical and human aspects of global climate change, with a view to supporting the process of policy-making. These research efforts are described in the light of the Second, Third and Fourth Community Framework Programme of Research and Development (Section 9.2 to 9.4). Within these framework programmes, the specific research programmes on environment, energy and marine science are of particular importance to climate change (another action about RDT cooperation with third countries, also important for the Climate Change and Developing Countries issue, is presented in section 8.3).

The framework programmes have given emphasis to the integration of environmental concerns into the EC's activities over time. Protection of the environment and improvement of the quality of life were already important objectives of the third framework programme. These objectives have been considerably reinforced in the fourth framework programme, both through its overall commitment to promote sustainable development, and through the substantial increase in financial resources allocated to environment (CEC, 1994d).

9.2. Second Framework Programme of Research and Development

During the Second Framework Programme of Research and Development (1987-1991), research projects regarding climate change were included in the European Programme on Climatology and natural Hazards (EPOCH), the Science and Technology for Environmental Protection (STEP) programme and the Remote Sensing programme of the Joint Research Centre.

From these three programmes, EPOCH had the strongest liaison with the climate change issue. The programme consisted of the following research areas:

- past climates and climate change;
- climate processes and models;
- climatic impacts and climate-related hazards;
- seismic hazard.

The research activities on past climates and climate change focused on the functioning of the climate system (atmosphere, oceans, biosphere, cryosphere) apart from changes induced by human activities. The general goal of the research on climate processes and models was to understand the mechanisms ruling the various components of the climate system, and their interactions, in order to improve the physical formulation and the parametrization of climate models, and hence the ability to predict climate change.

The research on climatic impacts and climate-related hazards aimed to reach insight in the effects of climate change upon various sectors of the European environment, such as agriculture. Finally, the research on seismic hazard was oriented on developing and improving of the means for predicting, preventing and mitigating the seismic risk in Europe.

EPOCH also covered a large part of the research subjects foreseen in the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP) and the World Climate Impact Programme (WCIP).

9.3. Third Framework Programme of Research and Development

The Third Framework Programme of Research and Development (1990-1994) is organised around 15 specific programmes. Three of these programmes are relevant with regard to climate change, namely environment, energy technology and marine science and technology.

Environment

The emphasis on environmental research has increased in the third framework programme: 261 MECU have been devoted to the Environment programme.

The Joint Research Centre (JRC) contributed through its own programme 257 MECU to the Environment programme.

In this programme, attention was paid for the first time to socio-economic environmental research. The Environment programme included four research areas:

- participation in global change programmes;
- environmental technologies and engineering;
- research on economic and social aspects of environmental issues, and
- technological and natural risks.

A significant proportion of the Environment programme is dedicated to research with direct relevance to global climate change. The part of the programme concerning climatology and natural hazards consists of the following research themes:

- natural climate change;
- anthropogenic climate change;
- climate change impacts;
- desertification in the Mediterranean area;
- natural risks.

The research in the area of natural climate change focused mainly with the reconstruction of past climates and past environmental conditions. The two main purposes of the research were to gain more insight into the global climate system by analysing and modelling past climates and climate change, and to help validate and improve climate models by the provision of high quality reconstructions for reference and testing.

The main issues within the theme of anthropogenic climate change were the understanding of the present climate and the prediction of climate change. The theme mainly focused on the development and application of complete climate models to predict future climate.

The research on climate change impacts focused on prediction and quantification of the effects of climate change, including primary physical effects as well as secondary effects on important socio-economic sectors. The main research themes were centred around the consequences of sea level change, and climatic impacts on water resources, forests and agriculture in Europe.

Part of the Environment programme was for example the ECOCRAFT project which originally started in 1991 under the EPOCH programme. The acronym ECOCRAFT is based on "European Collaboration on CO₂ Responses Applied to Forests and Trees". The project was concerned with the impacts of rising carbon dioxide and temperature on the growth processes of trees, the use of models to upscale the responses of the processes to the scale of forests over tens of years and the use of flux measurements to test the models, as well as to measure directly the sequestration of carbon by European forests.

The research on desertification in the Mediterranean area was aimed at a thorough understanding of the desertification phenomenon, its genesis and evolution, and to provide guidelines for management of desertification prone-areas as well as for protecting and rehabilitating such areas.

The research on natural risks was divided into at one hand meteorological and telluric research and at the other hand research on wildfires. Meteorological and telluric research was orientated towards the physical causes, frequency, severity and means of prediction and hazard reduction of natural disasters, such as storms, floods, landslides, earthquakes and volcanic eruptions. A major aim was to assess the European vulnerability to these natural hazards and to improve the scientific basis for disaster reduction. Research on

wildfires was aimed at understanding the factors, natural and human, favouring or hindering the occurrence of wildfires, in order to develop suitable means for forecasting, prevention and risk management.

In order to promote and facilitate coordinated research and to utilise this research for the various policies of the European Community, the Commission has established the European Network for Research in Global CHange (ENRICH). ENRICH's major role is to support policy objectives by acting as a clearinghouse for the exchange of information and by promoting cooperation in research and capacity building. In addition to promoting collaboration in Western Europe, ENRICH also helps to encourage the endogenous research capabilities in developing countries mainly, but not exclusively, in Africa and the Mediterranean Basin, and to support relevant research in the CEECs and the former Soviet Union. An ENRICH Council, Office, Liaison Offices and an Interservice Group have been set up to carry out the functions of the network.

Energy technology

Two successive programmes regarding new energy technologies, JOULE I (1989-1992) and JOULE II (1990-1994), have been established by the Community. Both programmes addressed the development of clean and efficient energy technologies in the three following areas: rational use of energy (in industry, transport and building), advanced technologies for fossil fuels and renewable energies. An additional activity relative to the elaboration of energy-environment models and analysis of RTD strategies was also part of these programmes; such an activity has provided background information for the Community CO₂ strategy through a major study called "CO₂-Crash programme", addressing the cost-effectiveness of the different options and the economic impacts of the taxation. In general terms, the environment dimension which was already an integral part of JOULE I has been strengthened in JOULE II. Furthermore, an accompanying action has been undertaken consisting of associating Eastern countries teams within some research projects of JOULE II. The budget for both programmes was respectively 122 MECU and 258 MECU.

SESAME is a documentary or full text data base containing information on more than 6,000 Community energy projects and 7,000 energy projects administered by the Member States and Norway. The SESAME data base contains administrative and technical information on RTD projects in the following sectors:

- energy saving in buildings, industry, transport and the energy industry;
- solid fuels;
- biomass and energy from waste;
- geothermal energy;
- small hydroelectricity;
- solar energy (photovoltaics and thermal);

- wind energy;
- hydrocarbon technology (oil and gas).

Marine sciences and technology

The European Community's Marine Science and Technology programmes (MAST) aim to introduce the necessary Community dimension to various on-going research activities of the Member States. MAST intends to contribute to establishing a scientific and technological basis for the exploration, exploitation, management and protection of Europe's coastal waters and the seas surrounding the EC's Member States and thereby achieve a better balance in the marine science potential of the various areas of the EC.

MAST II (1991-1994) has superseded the first MAST pilot programme (1989-1992). MAST II's geographical scope has expanded and also included the North Atlantic Ocean and the subpolar Arctic seas. The budget of MAST II amounted to approximately 100 MECU, aimed at supporting collaborative research projects and improving marine research in Europe. The fundamental aim of MAST II is to contribute to knowledge of the marine environment and its variability, in order to improve its management and protection and to predict its change.

The MAST II programme was divided into 5 areas:

- marine sciences;
- coastal zone science and engineering;
- marine technology;
- supporting initiatives;
- large scale targeted projects.

9.4. Fourth Framework Programme of Research and Development

The Fourth Framework Programme of Research and Development (1994-1998) is organised around nineteen specific programmes. Three of these programmes are of direct relevance with regard to climate change, namely environment and climate, clean and efficient energy technologies, marine science and technology. The specific programmes on agriculture and fisheries, transport, the Joint Research Centre and cooperation with third countries and international organisations are more indirectly related to climate change.

Environment and climate

The fourth framework programme includes a specific programme of research and technological development, including demonstration, in the field of environment and climate (1994-1998). For this programme an amount of 532 MECU has been reserved. The programme covers four themes:

- the natural environment, environmental quality and global change;
- environmental technologies;
- space techniques applied to environmental monitoring and research;
and
- human dimensions of environmental change.

A first objective of the programme on environment and climate is to understand the basic processes underlying environmental change, in particular those of the climate system, including the atmosphere, the oceans, the land surfaces, the continental ice masses and the biosphere. Detailed analysis of human and social behaviour and of the patterns of economic development responsible for adverse effects on the environment will be carried out in parallel with the study of natural processes.

A second objective is to improve assessment of the consequences of climate and other environmental change. Consequences for the natural environment and for society will be considered, including ecosystems, societal and economic activities, energy demand and consumption, and the use and management of natural resources, especially water, agriculture, forestry and coastal resources.

A third objective is to contribute to the technological development necessary for environmental observation, monitoring and research, including methodologies and technologies for the monitoring, warning and management of natural hazards. Particular attention will be paid in this respect to applied space technologies.

JRC will also contribute through its own programme of direct activities, to the attainment of the Community RTD objectives in the areas covered by the programme on Environment and climate. In addition, the JRC will make a significant contribution to the implementation of the Centre for Earth Observation (CEO).

The EC is now initiating the implementation of ENRICH in the context of the Fourth Framework programme. ENRICH will provide a basic mechanism for facilitating the coordination of global change research in the EC's programmes, notably those on Environment and climate research, Marine Sciences and Technologies and the Specific Programme on Cooperation with Third Countries and International Organisations. On the international scene, ENRICH would aim to collaborate with the various international entities involved in global change research. The international research effort in this field requires, in turn, harmonised commitments of financial resources.

Clean and efficient energy technologies

A specific programme on non-nuclear energies will be continued under the Fourth Framework Programme. This programme, called "Clean and Efficient Energy

Technologies" (CEET), merges for the first time both the R&D and the Demonstration (for this reason it is also called JOULE-THERMIE by reference to the previous programmes). The motivation of the RTD strategy supporting the new programme is to ensure the energy security, considered in the broadest sense i.e. ensuring reliable energy services at affordable cost and conditions. The main driving force for technological change are the environmental effects due to production and use of energy (in particular the CO₂ issue). Furthermore, the RTD policy must integrate regional dimensions and must build on concertion with other Community policies, including international cooperation.

The budget of the CEET programme is 967 MECU for the period 1994-1998. The main component of the programme is technological development in the same areas mentioned for JOULE and THERMIE; R&D will give more emphasis to the introduction of renewable energy (including third countries), whereas demonstration activities will support more substantially rational use of energy and fossil fuel technologies. A wide range of activities for the RTD strategy definition will be undertaken: global analysis, socio-economic research, energy, environment and economy modelling; these activities will be focused in particular on the Climate Change issue and its relationship with technological change and sustainable development. Exchange of information with third countries and dissemination of tools and results will be part of this activity.

Marine science and technology

The MAST III programme (1994-1998) extends, develops and refocuses the activities carried out under the first two MAST programmes i.e. the pilot phase of 1989-1992 and the MAST II programme 1990-1994. For the period considered, MAST III is a step in a longer term strategy which will enable Europe to make a full contribution to the knowledge and management of the oceans. Its general objective is to foster the scientific knowledge and technological development necessary to understand how marine systems function at basin scales, in order to prepare for sustainable use of the oceans consistent with the preservation of marine environmental quality, and to determine their role in global change.

The programme comprises four areas of activity:

- marine science;
- strategic marine research;
- marine technology;
- supporting initiatives.

The research activities may, where appropriate, liaise with other international programmes such as IGBP, WCRP and HDP, as well as with certain aspects of the development of the Global Ocean Observing System (GOOS).

ETERNE

The EC launched in 1991, together with the US Department of Energy, a joint research project to assess the external costs of fuel cycles. On the European side the project is co-funded by the JOULE programme. It is known as the Externe project. In the first phase, the teams jointly developed the conceptual approach and the methodology and shared scientific information for its application to a number of fuel cycles.

The EC further co-financed the second phase of the project under JOULE-II. It was started in 1993 and has been completed in 1995. The main objectives were to apply the methodology to a wide range of different fossil, nuclear and renewable fuel cycles for power generation and energy conservation options. In addition, the general methodology and accounting framework were extended to address the evaluation of externalities associated with the use of energy in the transport and domestic sectors.

The third phase of the project has been undertaken within the ECs Fourth Framework Programme and will concentrate on the dissemination of the results and the application of the accounting framework in support of policy issues and decision making.

9.5. Summary

Table 9.1 gives an overview of budgets which have been spent on or are reserved for research programmes in the areas of climate change, non-nuclear energy and marine sciences. The table shows that research budgets in all three areas have been largely increased during the last years. The expenditures on research projects primarily oriented towards climate change are included in the total budgets in Table 9.1; no data are available to specify these expenditures separately.

Table 9.1. Summary of expenditures on EC research programmes relevant to the climate change issue.

| Research programme | Time period | Total budget (MECU) |
|---------------------------|-------------|---------------------|
| Environment and Climate : | | |
| STEP | 1989-1992 | 75 |
| EPOCH | 1989-1992 | 40 |
| Environment | 1991-1994 | 261 |
| Environment and climate | 1994-1998 | 532 |
| Joint Research Center: | 1991-1994 | 150 |
| | 1994-1998 | 320 |
| Non-nuclear energy: | | |
| JOULE I | 1989-1992 | 122 |
| JOULE II | 1990-1994 | 258 |
| CEET | 1994-1998 | 967 |
| Marine sciences: | | |
| MAST I | 1989-1992 | 50 |
| MAST II | 1991-1994 | 118 |
| MAST III | 1994-1998 | 228 |

10. EDUCATION, TRAINING AND PUBLIC AWARENESS

10.1. Introduction

The success of policies and measures addressing the problem of climate change will depend to a large extent on the decisions and actions of the general public. Education, training and increasing public awareness through information campaigns are important tools to enable a change of consumer attitudes and choices. The fifth Action Programme of the EC "Towards Sustainability" emphasizes that it is essential to provide adequate information to the general public on the relation between the activities of individuals and environmental pollution (by e.g. awareness campaigns), and to offer alternatives to the general public to reduce environmental pollution. Also, the active involvement of and participation of non-governmental organisations (NGOs), trade unions and professional associations is highly valued in the fifth Action Programme.

On the basis of existing Community legislation on freedom of access to information on the environment (90/313/EEC), local and regional authorities can facilitate greater public involvement in environmental protection. The objective of this directive is to ensure freedom of access to, and dissemination of, information on the environment held by public authorities and to set out the basic terms and conditions on which such information should be made available (Article 1 of the directive).

This chapter respectively deals with information, education and training programmes (Section 10.2), dissemination of research results (Section 10.3) and research activities regarding education, training and public awareness (Section 10.4).

10.2. Information, education and training programmes

At the EC level, information, education and training programmes concerning climate change and energy use mainly take place within the scope of (sectoral) policy programmes, such as energy supply, transport, urban development and agriculture.

Energy supply

Information for the wider public is a key element of the SAVE, ALTENER and THERMIE/JOULE programmes. These programmes have been described extensively in Chapter 4. This section only describes the relevant parts about the provision of information. SAVE has set up an information exchange network on energy efficiency aimed at all the levels of the EC, the goal being that all EC citizens will ultimately be aware that energy efficiency not only provides financial benefits but brings benefits to

the environment as well. ALTENER has also established an information exchange network and has launched in 1994 a major information programme stressing the benefits of greater levels of renewable energy in the EC's energy mix and the resulting environmental benefits, especially in terms of CO₂ emission levels. THERMIE's dissemination actions include a network of some forty Organisations for the Promotion of Energy Technology (OPET) focusing on distributing and promoting innovative energy technologies across Europe, including Central and Eastern European countries and the former Soviet Union.

An extensive part of the SYNERGY initiative is focusing on training activities (see also Section 8.2) relating to the climate change problem and emissions of greenhouse gases. The following activities may be mentioned in this respect:

- training courses in India;
- training courses in China, for example about clean coal combustion technology;
- seminar on energy and environment in Shanghai;
- courses about energy planning and savings in Latin America;
- training courses on energy saving in Estonia.

Transport

The European Community's evolving strategy for transport is most recently expounded in the White Paper on The Future Development of the Common Transport Policy: A Global Framework for Sustainable Mobility. The strategy includes the promotion of more environmentally rational use of the private car, along with changes in driving rules and habits.

Urban development

The EC supports pan-European environmental campaigns of local authorities aiming at local sustainability, or significant local contribution to global sustainability, such as Sustainable Cities and Towns, the Car Free Cities Club and Cities for Climate Protection.

The Sustainable Cities Project was launched by the Expert Group on the Urban Environment, to run from 1993 to 1995. The expert group was established by the European Commission in 1991 following the publication of the Green Paper on the Urban Environment. The principle aims of the Sustainable Cities Project are to contribute to the development of thinking about sustainability in European urban settings, to foster a wide exchange of experience, to disseminate best practice about sustainability at local level, and, in the longer term, to formulate recommendations to influence policy making at Community, Member State, regional and local level, as called for in the Council resolution of 1991 (Fudge & Mills, 1994).

The planned outputs of the Sustainable Cities Project are a policy report, a good practice guide and a database of relevant practice. The exchange of information and experience is being further encouraged through the European Campaign for Sustainable Cities and

Towns launched in May 1994 during the First European Conference on Sustainable Cities and Towns held in Aalborg, Denmark. At this conference, the Campaign was joined by 80 European local authorities and 253 representatives of international organisations, national governments, scientific institutes, consultants and individuals who signed the Aalborg Charter. According to the Charter, the signatories take responsibility for the global climate. It is stated that the significant risks posed by global warming to the natural and built environments and to future human generations require a response sufficient to stabilize and then to reduce emissions of greenhouse gases into the atmosphere as soon as possible. Renewable energy sources are mentioned as the only sustainable alternatives for the present ones.

A second European Conference on Sustainable Cities and Towns is planned for 1996 in Lisbon, Portugal. This conference will assess progress on sustainability, receive the second draft policy report from the expert group and ensure continuation of the Sustainable Cities and Towns Campaign (Fudge & Mills, 1994).

In June 1992, the Environment Commissioner has proposed to establish a network of car free cities and to organize a conference about the topic. The main purpose of this proposal was to start a discussion about the daily traffic problems in cities, to set up a platform for the exchange of experiences and to find solutions for improvement of the urban environment. This proposal was adopted by the European Commission. Finally, the conference about car free cities was held on 24 and 25 March 1994 in Amsterdam. As a result of the conference a charter was drafted and signed by the representatives of 40 European cities. According to the charter, one of the explicit objectives is to stimulate the efficient use of energy and to diminish emissions by traffic which contribute to ozone and greenhouse problems (Car Free Cities Club, 1994). It is considered necessary to push back the use of private cars and to stimulate the use of less harmful means of transport.

In 1993, the Convention of European Municipal Leaders on Climate Change was organized by the European Secretariat of the International Council for Local Environmental Initiatives (ICLEI), under the auspices of the Commission of the EC and the United Nations Environment Programme (UNEP). The outcome of the Convention was the launching of the Campaign European Cities for Climate Protection. The aim of the joint campaign on saving energy and reducing CO₂ emissions is to help nations implement the goals set at the Rio summit as fast as possible and to support municipalities in their efforts to fight the causes of climate change.

ICLEI, co-sponsored by the European Commission, also organised the second Local Government Leaders' Summit on Climate Change held in Berlin back to back to the first Conference of the Parties to the UN FCCC. This summit on climate change served to exchange information on innovative local policies and practices and explored possible future strategies. The summit, attended by 159 municipal leaders, issued on 29 March

1995 a Communiqué, in which, amongst others, the local authorities are called upon to develop local action plans to reduce CO₂ emissions 20% by 2005.

In the framework of the "Energy Management in Regions and Cities" initiative, the Commission encouraged the setting up of the ENERGY-CITES network which aims at the implementation of a sustainable use of energy in urban areas. Through the creation of Cities Energy Agencies it is hoped that the elected people and citizen will perceive more properly the challenge and the potential of good energy management. This should contribute to reduce consumption in cities and to promote local and new energies which should have impact on the urban and global environment but also on the life quality in urban areas. This approach will be strengthened within the SAVE-II programme.

Agriculture

Concerning agricultural soils, since 1992, efforts are undertaken to promote "integrated control" by in particular training activities to reach an equilibrium between input of nutrients and the absorption capacity of soils and plants. This will lead in the future to a reduction of N₂O emissions from the application of fertilizers.

10.3. Dissemination of research results

Training and education are also important parts of the accompanying measures of the European Community research programmes. Activities with regard to the EPOCH, the Environment and the Environment and Climate programmes (see chapter 9) are pursued through:

- the European School of Climatology and Natural Hazards, through annual or biennial courses on selected relevant topics, to be held in cooperation with various European research institutions;
- sectoral grants for European graduates and post-graduates in fields relevant to climatology and natural hazards;
- the publication of a series of books and monographs dealing with important topics relevant to the research areas of the programme and meeting the needs of different kinds of concerned audiences.

The European School of Climatology and Natural Hazards takes the form of courses dealing with current research issues in the fields of climate and natural hazards. The courses which are organized in cooperation with leading European institutions, are open to graduating or post-graduate students in appropriate fields of research.

Relevant courses in relation to climate change organized by the European School of Climatology and Natural Hazards:

- . Climatic change and impacts: A general introduction, 11-18 September 1988;
- . Climate and global change, 4-12 April 1990;
- . Forest fire risk and management, 27 May-4 June 1992;
- . Desertification in a European context. Physical and socio-economic aspects, 6-13 October 1993;
- . Statistical analysis of climate variability, 30 October-6 November 1993;
- . Foreseen in 1995: Climate change impacts on agriculture, forest and water resources.

10.4. Research activities regarding education, training and public awareness

The Directorate General for Environment, Nuclear Safety and Civil Protection (DGXI) of the Commission of the European Communities commissioned a study to examine the scope for improved education, training and public awareness activities regarding climate change (CEC, 1992). An inventory of activities which are taking place in the individual Member States lead to the following conclusions:

- in their CO₂ reduction programmes, many EC countries are not placing sufficient emphasis on educational and promotional activities to support legislative measures;
- large differences exist in the standard of energy education between EC countries;
- in all EC countries, a need for energy training has been recognized within industry, commerce and educational establishments.

The study showed that an integrated packet of government-run promotions of energy conservation, backed by and linked to financial incentives and legislation is most effective to address climate change.

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ABBREVIATIONS

| | |
|----------|---|
| ALTENER | Programme for the Promotion of Renewable Energy Sources |
| CAP | Common Agricultural Policy |
| CEECs | Central and Eastern European Countries |
| CEET | Programme on Clean and Efficient Energy Technologies |
| CEO | Centre for Earth Observation |
| CIS | Commonwealth of Independent States |
| CORINAIR | CORINE AIR emissions inventory |
| EAGFF | European Agriculture Guidance and Guarantee Fund |
| EC | European Community |
| ECOCRAFT | Project on European Collaboration on CO ₂ Responses Applied to Forests and Trees |
| ECU | European Currency Unit |
| ENRICH | European Network for Research In global Change |
| EUROSTAT | Statistical Office of the European Communities |
| EPOCH | European Programme On Climatology and natural Hazards |
| FEC | Final Energy Consumption |
| FNEC | Final Non Energy Consumption |
| GCOS | Global Climate Observing System |
| GDP | Gross Domestic Product |
| GIC | Gross Inland Consumption |
| GOOS | Global Ocean Observing System |
| GTOS | Global Terrestrial Observing System |
| GVA | Gross Value Added |
| HDP | Human Dimension of global environmental change Programme |
| IGBP | International Geosphere-Biosphere Programme |
| INC | Intergovernmental Negotiating Committee |
| IPCC | Intergovernmental Panel on Climate Change |
| JOULE | Programme on Joint Opportunities for Unconventional or Longer-term Energies |
| JRC | Joint Research Centre |
| OECD | Organisation for Economic Cooperation and Development |
| OPET | Network of Organisations for the Promotion of Energy Technologies |
| PACE | Action programme for improving the efficiency of energy use |
| PERU | Planning of Energy at Regional and Urban level |
| PHARE | Programme on Poland and Hungary Assistance to the Restructuring of the Economy |

| | |
|---------|---|
| R & D | Research and Development |
| RTD | Research, Technological development and Demonstration |
| SAVE | Programme on Specific Actions for Vigorous Energy efficiency |
| STEP | Programme on Science and Technology for Environmental Protection |
| SYNERGY | Programme for energy cooperation with all non-Community countries |
| TACIS | Programme on Technical Assistance to the Commonwealth of Independent States |
| THERMIE | Energy Technology Support Programme |
| UN FCCC | United Nations Framework Convention on Climate Change |
| UNO | United Nations Organisations |
| WCIP | World Climate Impact Programme |
| WCRP | World Climate Research Programme |

Chemical formulae and references

| | |
|------------------|--|
| CO | Carbon Monoxide |
| CO ₂ | Carbon Dioxide |
| CH ₄ | Methane |
| NMVOC | Non-Methane Volatile Organic Compounds |
| N ₂ O | Nitrous Oxide |
| NO _x | Nitrogen Oxides |
| Gg | Gigagram (1 Gg = 1 kilotonne) |
| toe | tonne of oil equivalent |

ANNEX I

NATIONAL GREENHOUSE GAS EMISSION INVENTORIES

Estimates of greenhouse gases in Austria - 1990 (Gg).

| AUSTRIA | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NM VOC |
|-------------------------------|-------------------|-----------------|------------------|-----------------|--------------|------------|
| 1 All energy | 57100 | 116 | 1.4 | 216 | 1391 | 269 |
| 1a Fuel combustion | 57100 | 24 | 1 | 216 | 1391 | 253 |
| 1a1 Energy & transformation | 16500 | <1 | <1 | 12 | 6 | <1 |
| 1a2 Industry | 12300 | 1 | 1 | 47 | 27 | 24 |
| 1a3 Transport | 16200 | 15 | <1 | 145 | 582 | 130 |
| 1a4 Commercial/institutional | 12100 | 8 | <1 | 12 | 776 | 99 |
| 1a5 Residential | IE | IE | IE | IE | IE | IE |
| 1a6 Agriculture/forestry | IE | IE | IE | IE | IE | IE |
| 1a7 Other | IE | IE | IE | IE | IE | IE |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 0 | 92 | 1 | 0 | 0 | 16 |
| 1b1 Oil & gas | | | | | | |
| 1b2 Coal mining | | | | | | |
| 2 Industrial processes | 2100 | 0 | 0 | 6 | 241 | 8 |
| 2a Iron & steel | | | | | | |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | | | | |
| 2d Organic chemicals | | | | | | |
| 2e Non-metallic minerals | | | | | | |
| 2f Other | | | | | | |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 130 |
| 3a Paint application | | | | | | |
| 3b Degreasing & Dry cleaning | | | | | | |
| 3c Chemical prods manuf/proc | | | | | | |
| 3d Other | | | | | | |
| 4 Agriculture | 0 | 259 | 20 | 0 | 60 | 12 |
| 4a Enteric fermentation | | 230 | | | | |
| 4b Animal wastes | | 28 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 0 | 228 | 0 | 0 | <1 | 26 |
| 6a Landfills | | | | | | |
| 6b Wastewater | | | | | | |
| 6c Other | | | | | | |
| Total emissions | 59200 | 603 | 4 | 222 | 1692 | 445 |
| Marine bunkers | 0 [#] | | | | | |
| Aviation bunkers | 1200 ⁾ | | | | | |
| FNEC | 4600* | | | | | |

IE = Included Elsewhere

NE = Not Estimated

[#] CORINAIR figures used

⁾ Reconciliation of CORINAIR and EUROSTAT transport emission estimates

^{*} Eurostat figures used

Sources:

- National Climate report of the Austrian Federal Government. In Compliance with the obligations under Art. 4.2 and Art. 12 of the Framework Convention on Climate Change (Federal Law Gazette No. 414/1994). Vienna, 1994.
- Eurostat
- CORINAIR

Estimates for all greenhouse gases are taken from the National Report, unless indicated otherwise.

Estimates of greenhouse gases in Belgium - 1990 (Gg).

| BELGIUM | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|--------------------|-----------------|------------------|-----------------|---------------|--------------|
| 1 All energy | 106400 | 71 # | 8 # | 330 # | 1085 # | 216 # |
| 1a Fuel combustion | 106400 | 25 | 8 | 330 | 1085 | 203 |
| 1a1 Energy & transformation | 33800 | <1 | 2 | 56 | 2 | <1 |
| 1a2 Industry | 25500 | 5 | 3 | 67 | 110 | 6 |
| 1a3 Transport | 20600 | 14 | 1 | 195 | 918 | 291 |
| 1a4 Commercial/institutional | 26500 | 6 | 2 | 12 | 55 | 7 |
| 1a5 Residential | IE | IE | IE | IE | IE | IE |
| 1a6 Agriculture/forestry | IE | IE | IE | IE | IE | IE |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 0 | 46 | 0 | 0 | 0 | 13 |
| 1b1 Oil & gas | | | | | | |
| 1b2 Coal mining | | | | | | |
| 2 Industrial processes | 7200 | 14 | 5 | 5 | 108 | 54 |
| 2a Iron & steel | | | | | | |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | | | | |
| 2d Organic chemicals | 2600 | | | | | |
| 2e Non-metallic minerals | 4600 | | | | | |
| 2f Other | | | | | | |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 90 |
| 3a Paint application | | | | | | |
| 3b Degreasing & Dry cleaning | | | | | | |
| 3c Chemical prods manuf/proc | | | | | | |
| 3d Other | | | | | | |
| 4 Agriculture | 0 | 270 | 9 | 0 | 0 | 1 |
| 4a Enteric fermentation | | | | | | |
| 4b Animal wastes | | | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 900 | 5 | 0 | 3 | 16 | 0 |
| 6a Landfills | | | | | | |
| 6b Wastewater | | | | | | |
| 6c Other | 900 | | | | | |
| Total emissions | 114500 | 359 | 22 | 338 | 1219 | 361 |
| Marine bunkers | 13300 # | | | | | |
| Aviation bunkers | 2000 ^{a)} | | | | | |
| FNEC | 10200 * | | | | | |

IE = Included Elsewhere

NE = Not Estimated

= CORINAIR figures used

^{a)} Reconciliation of CORINAIR and EUROSTAT transport emission estimates

* = Eurostat figures used

Sources:

- Belgian National Reduction Programme CO₂ emissions. Under the "Council Decision concerning a mechanism of monitoring of CO₂ emissions and other greenhouse gases in the Community. June 1994.
- Eurostat (indicated with *)
- CORINAIR (indicated with #)

CO₂ estimates are taken from National Report, unless indicated otherwise. Figures for non-CO₂ gases are CORNAIR estimates.

Estimates of greenhouse gases in Denmark - 1990 (Gg).

| DENMARK | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|------------|------------|
| 1 All energy | 50900 | 23 | 2 | 269 | 770 | 129 |
| 1a Fuel combustion | 50200 a | 12 c | 2 c | 269 c | 737 c | 119 c |
| 1a1 Energy & transformation | 25700 | 2 | 1 | 96 | 39 | 2 |
| 1a2 Industry | 6000 | 1 | <1 | 17 | 6 | 1 |
| 1a3 Transport | 11200 | 3 | 1 | 138 | 547 | 106 |
| 1a4 Commercial/institutional | 1500 | 0 | 0 | 1 | 1 | 0 |
| 1a5 Residential | 5000 | 6 | <1 | 5 | 139 | 8 |
| 1a6 Agriculture/forestry | 800 | 0 | 0 | 13 | 5 | 2 |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 700 # b | 11 | 0 | 0 | 33 | 10 |
| 1b1 Oil & gas | 700 | 8 | | | | |
| 1b2 Coal mining | | 3 | | | | |
| 2 Industrial processes | 1200 | 0 | 0 | 1 | 0 | 4 |
| 2a Iron & steel | | | | | | |
| 2b Non-ferrouw metals | | | | | | |
| 2c Inorganic chemicals | | | | 1 | | |
| 2d Organic chemicals | | | | | | |
| 2e Non-metallic minerals | 1200 | | | | | |
| 2f Other | | | | | | |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 34 |
| 3a Paint application | | | | | | 26 |
| 3b Degreasing & Dry cleaning | | | | | | |
| 3c Chemical prods manuf/proc | | | | | | 2 |
| 3d Other | | | | | | 7 |
| 4 Agriculture | 0 | 262 | 9 | 0 | 0 | 2 |
| 4a Enteric fermentation | | 137 | | | | |
| 4b Animal wastes | | 125 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | 9 | | | 2 |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 0 | 122 | 0 | 0 | 0 | 0 |
| 6a Landfills | | 120 | | | | |
| 6b Wastewater | | 2 | | | | |
| 6c Other | | | | | | |
| Total emissions | 52100 | 406 | 11 | 270 | 770 | 165 |
| Marine bunkers | 3000 | 0 | 0 | 5 | 1 | <1 |
| Aviation bunkers | 1900 | <1 | <1 | 66 | 17 | 3 |
| FNEC | 1000 * | | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Climate Protection in Denmark. Ministry of the Environment. Danish Environmental Protection Agency. Denmark, 1994. (National Communication under the UN FCCC).
- Eurostat (indicated with *)
- CORINAIR (indicated with #)

Estimates for all greenhouse gases are taken from National Report, unless indicated otherwise.

Footnotes:

- a. Denmark included CO₂ emissions from oil/gas extraction (including flaring) in its estimate. Based on CORINAIR figures, these emissions have been subtracted. Denmark corrected its fuel combustion emissions for electricity import/export. This correction (6300 Gg of CO₂) has been ignored for reasons of comparison.
- b. Denmark included CO₂ emissions from oil/gas extraction (including flaring) in category 1A. Therefore, CORINAIR estimates have been used.
- c. Correction for electricity import/export has been ignored for reasons of comparison and consistency with other Member States.

Estimates of greenhouse gases in Finland - 1990 (Gg).

| FINLAND | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|--------------------|-----------------|------------------|-----------------|------------|------------|
| 1 All energy | 52600 | 19 | 7 | 291 | 484 | 156 |
| 1a Fuel combustion | 52600 | 19 | 7 | 291 | 484 | 142 |
| a1 Energy & transformation | 19500 | 1 | 1 | 64 | 9 | 0 |
| 1a2 Industry | 13700 | 2 | 1 | 41 | 32 | 0 |
| 1a3 Transport | 11500 | 8 | 5 | 160 | 368 | 79 |
| 1a4 Commercial/institutional | IE | IE | IE | IE | IE | IE |
| 1a5 Residential | 5800 | 6 | | 8 | 61 | 51 |
| 1a6 Agriculture/forestry | 2100 | 2 | | 18 | 14 | 12 |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 100 | 0 | 0 | 0 | 0 | 14 |
| 1b1 Oil & gas | | | | | | |
| 1b2 Coal mining | | | | | | |
| 2 Industrial processes | 1200 | 0 | 3 | 4 | 3 | 15 |
| 2a Iron & steel | 100 | | | | | 1 |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | 3 | | | |
| 2d Organic chemicals | | | | | | 12 |
| 2e Non-metallic minerals | 1100 | | | | | |
| 2f Other | | | | | | 2 |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 48 |
| 3a Paint application | | | | | | |
| 3b Degreasing & Dry cleaning | | | | | | |
| 3c Chemical prods manuf/proc | | | | | | |
| 3d Other | | | | | | |
| 4 Agriculture | 0 | 94 | 12 | 0 | 0 | 0 |
| 4a Enteric fermentation | | 83 | | | | |
| 4b Animal wastes | | 11 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 0 | 139 | 0 | 0 | 0 | 0 |
| 6a Landfills | | 105 | | | | |
| 6b Wastewater | | 34 | | | | |
| 6c Other | | | | | | |
| Total emissions | 53900 | 252 | 22 | 295 | 487 | 219 |
| Marine bunkers | 2800 | | | | | |
| Aviation bunkers | 1400 ^{o)} | | | | | |
| FNEC | 6000* | | | | | |

IE = Included Elsewhere

NE = Not Estimated

* Eurostat figures used

CORINAIR figures used

^{o)} Reconciliation of EUROSTAT and CORINAIR transport emission estimates

Sources:

- Finland's National Report under the United Nations Framework Convention on Climate Change. Ministry of the Environment, January 1995.
- Eurostat
- CORINAIR

Estimates for all greenhouse gases are taken from the National Report, unless indicated otherwise.

Estimates of greenhouse gases in France - 1990 (Gg).

| FRANCE | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|--------------|-------------|
| 1 All energy | 349800 | 495 | 12 | 1675 | 10047 | 1667 |
| 1a Fuel combustion | 349700 | 184 | 12 | 1671 | 10047 | 1530 |
| 1a1 Energy & transformation | 60800 | 5 | 2 | 163 | 29 | 6 |
| 1a2 Industry | 71100 | 6 | 2 | 154 | 596 | 8 |
| 1a3 Transport | 128100 | 23 | 4 | 1194 | 7062 | 1199 |
| 1a4 Commercial/institutional | 23700 | 3 | 1 | 18 | 18 | 1 |
| 1a5 Residential | 58200 | 126 | 3 | 68 | 1895 | 250 |
| 1a6 Agriculture/forestry | 7800 | 21 | 0 | 74 | 447 | 67 |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 200 | 311 | 0 | 4 | 0 | 137 |
| 1b1 Oil & gas | | 106 | | 4 | | 137 |
| 1b2 Coal mining | | 204 | | | | |
| 2 Industrial processes | 16700 | 3 | 103 | 23 | 668 | 86 |
| 2a Iron & steel | 600 | | | 3 | 623 | 3 |
| 2b Non-ferrous metals | 500 | | | | 43 | |
| 2c Inorganic chemicals | 2500 | 3 | 47 | 20 | 2 | 18 |
| 2d Organic chemicals | | | 55 | | | 27 |
| 2e Non-metallic minerals | 12700 | | | | | |
| 2f Other | 500 | | | | | 39 |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 640 |
| 3a Paint application | | | | | | 253 |
| 3b Degreasing & Dry cleaning | | | | | | 72 |
| 3c Chemical prods manuf/proc | | | | | | 74 |
| 3d Other | | | | | | 240 |
| 4 Agriculture | 0 | 1640 | 61 | 4 | 223 | 18 |
| 4a Enteric fermentation | | 1444 | | | | |
| 4b Animal wastes | | 159 | | | | |
| 4c Rice cultivation | | 10 | | | | |
| 4d Agricultural soils | | 19 | 61 | | | 10 |
| 4e Agricultural waste burning | | 8 | | 4 | 223 | 8 |
| 4f Savannah burning | | | | | | |
| 6 Waste | 8000 | 748 | 1 | 20 | 9 | 13 |
| 6a Landfills | 1800* | 716 | | | | 5 |
| 6b Wastewater | | 15 | 1 | | | |
| 6c Other | 6200 | 18 | | 20 | 9 | 8 |
| Total emissions | 366500 | 2896 | 176 | 1722 | 10947 | 2424 |
| Marine bunkers | 8100 | * b | | | | |
| Aviation bunkers | 9000 | * c | | | | |
| FNEC | 39800 | * | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Program National de Prevention du changement de climat. Republique Francaise, Fevrier, 1995.
- Eurostat (indicated with *)
- CORINAIR (indicated with #)

Estimates for all greenhouse gases are taken from National Report, unless indicated otherwise.

Footnotes:

- a. It has been assumed that the estimate of 1800 Gg for Landfills applies to emissions from non-organic/non-recyclable material.
- b. The national report of France does not provide estimates of bunker emissions.
- c. Reconciliation of Eurostat and CORINAIR transport estimates

Estimates of greenhouse gases in Germany - 1990 (Gg).

| GERMANY | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NM VOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|--------------|-------------|
| 1 All energy | 984000 | 1767 | 33 | 2923 | 10104 | 1679 |
| 1a Fuel combustion | 983000 | 228 | 33 | 2921 | 10078 | 1474 |
| 1a1 Energy & transformation | 436000 | 12 | 15 | 672 | 921 | 11 |
| 1a2 Industry | 169000 | 16 | 4 | 217 | 899 | 15 |
| 1a3 Transport | 159000 | 69 | 9 | 1732 | 5990 | 1252 |
| 1a4 Commercial/institutional | 65000 a | 5 | 2 | 35 | 183 | 10 |
| 1a5 Residential | 129000 | 91 | 3 | 73 | 1483 | 96 |
| 1a6 Agriculture/forestry | 5000 | 1 | 0 | 2 | 35 | 2 |
| 1a7 Other | 21000 | 3 | 0 | 183 | 224 | 60 |
| 1a8 Biomass | - | 31 | 0 | 7 | 234 | 28 |
| 1b Fugitive fuel | 1000 | 1539 | 0 | 2 | 26 | 205 |
| 1b1 Oil & gas | 1000 | 317 | 0 | 2 | 26 | 205 |
| 1b2 Coal mining | | 1222 | 0 | 0 | 0 | 0 |
| 2 Industrial processes | 29000 | 11 | 100 | 21 | 664 | 129 |
| 2a Iron & steel | | 6 | | 3 | 549 | 9 |
| 2b Non-ferrous metals | 1000 | | | | 113 | |
| 2c Inorganic chemicals | 3000 | | 14 | 13 | 2 | |
| 2d Organic chemicals | | | 86 | | | 59 |
| 2e Non-metallic minerals | 25000 | 2 | | 5 | | |
| 2f Other | | 3 | | | | 61 |
| 3 Solvent use | 0 | 0 | 6 | 0 | 0 | 1170 |
| 3a Paint application | | | | | | 480 |
| 3b Degreasing & Dry cleaning | | | | | | 110 |
| 3c Chemical prods manuf/proc | | | | | | 200 |
| 3d Other | | | 6 | | | 380 |
| 4 Agriculture | 0 | 2043 | 80 | 0 | 0 | 0 |
| 4a Enteric fermentation | | 1420 | | | | |
| 4b Animal wastes | | 623 | 11 | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | 69 | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | IE | 2397 | 4 | IE | IE | IE |
| 6a Landfills | | 2318 | | | | |
| 6b Wastewater | | 79 | 4 | | | |
| 6c Other | IE b | IE | IE | IE | IE | IE |
| Total emissions | 1013000 | 6218 | 223 | 2944 | 10768 | 2978 |
| Marine bunkers | 8000 | 0 | NE | 155 | 37 | 16 |
| Aviation bunkers | 11000 | 0 | NE | 50 | 58 | 9 |
| FNEC | 68400 | * c | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

Sources:

- Environmental Policy. Climate Protection in Germany. First report of the Federal Republic of Germany Pursuant to the United Nations Framework Convention on Climate Change. September 1994.
- Eurostat (indicated with *)

Estimates are taken from National Report, unless indicated otherwise.

Footnotes:

- a. Indicated as "Small consumers" in Germany's report.
- b. Germany indicated in its National Report that CO₂ emissions from waste incineration are included in energy related emissions.
- c. FNEC emissions were not included in Germany's National Report. Hence, Eurostat figures have been used.

Estimates of greenhouse gases in Greece - 1990 (Gg).

| GREECE | | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOG |
|------------------------|-----------------------------|-----------------|-----------------|------------------|-----------------|--------------|--------------|
| 1 | All energy | 77400 | 369 # | 8 # | 502 # | 777 # | 189 # |
| 1a | Fuel combustion | 77400 | 6 | 8 | 502 | 777 | 185 |
| 1a1 | Energy & transformation | 43800 | a 1 | 7 | 111 | 6 | 1 |
| 1a2 | Industry | 9700 | a <1 | <1 | 3 | <1 | <1 |
| 1a3 | Transport | 15600 | * b 5 | 1 | 386 | 770 | 184 |
| 1a4 | Commercial/institutional | 8300 | * b <1 | <1 | 1 | 1 | <1 |
| 1a5 | Residential | IE | IE | IE | IE | IE | IE |
| 1a6 | Agriculture/forestry | IE | IE | IE | IE | IE | IE |
| 1a7 | Other | | | | | | |
| 1a8 | Biomass | | | | | | |
| 1b | Fugitive fuel | 0 | 364 | 0 | 0 | 0 | 4 |
| 1b1 | Oil & gas | | | | | | |
| 1b2 | Coal mining | | | | | | |
| 2 | Industrial processes | 8100 # | 1 | 3 | 34 | 25 | 22 |
| 2a | Iron & steel | | | | | | |
| 2b | Non-ferrous metals | | | | | | |
| 2c | Inorganic chemicals | | | | | | |
| 2d | Organic chemicals | | | | | | |
| 2e | Non-metallic minerals | 5900 | | | | | |
| 2f | Other | | | | | | |
| 3 | Solvent use | 0 | 0 | 0 | 0 | 0 | 82 |
| 3a | Paint application | | | | | | |
| 3b | Degreasing & Dry cleaning | | | | | | |
| 3c | Chemical prods manuf/proc | | | | | | |
| 3d | Other | | | | | | |
| 4 | Agriculture | 0 | 363 | 13 | 7 | 341 | 32 |
| 4a | Enteric fermentation | | | | | | |
| 4b | Animal wastes | | | | | | |
| 4c | Rice cultivation | | | | | | |
| 4d | Agricultural soils | | | | | | |
| 4e | Agricultural waste burning | | | | | | |
| 4f | Savannah burning | | | | | | |
| 6 | Waste | 600 # | 202 | 0 | 0 | 0 | 0 |
| 6a | Landfills | | | | | | |
| 6b | Wastewater | | | | | | |
| 6c | Other | 600 | | | | | |
| Total emissions | | 86100 | 936 | 24 | 543 | 1143 | 325 |
| | Marine bunkers | 8200 | * | | | | |
| | Aviation bunkers | 2000 | * c | | | | |
| | FNEC | 1800 | * | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Climate Change. The Greek Action Plan for the abatement of CO₂ and other greenhouse gas emissions. February 1995.
- Eurostat (indicated with *)
- CORINAIR (indicated with #)

CO₂ estimates are taken from National Report, unless indicated otherwise. Figures for non-CO₂ gases are CORINAIR estimates.

Footnotes:

- a. Taken from the CO₂ emission tables as an update to the 1992 national report
- b. CO₂ emission estimates provided in the Greek report are higher than Eurostat/CORINAIR figures. The report explains that estimates for Energy & Transformation are higher due to a higher emission factor for lignite. However, it provides no explanation why estimates for the other combustion categories are higher. Therefore, Eurostat figures have been used.
- c. Reconciliation Eurostat and National Programme bunker estimates.

Estimates of greenhouse gases in Ireland - 1990 (Gg).

| IRELAND | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|------------|--------------|
| 1 All energy | 29100 | 15 | 2 | 111 | 390 | 74 |
| 1a Fuel combustion | 29100 | 5 | 2 | 111 | 390 | 71 |
| 1a1 Energy & transformation | 10900 | 0 | 1 | 46 | 3 | <1 |
| 1a2 Industry | 5400 | <1 | <1 | 11 | 1 | <1 |
| 1a3 Transport | 4900 | 1 | <1 | 45 | 305 | 63 |
| 1a4 Commercial/institutional | 1400 | <1 | <1 | 1 | 4 | <1 |
| 1a5 Residential | 5800 | 3 | 1 | 5 | 76 | 8 |
| 1a6 Agriculture/forestry | 700 | <1 | <1 | 3 | 1 | <1 |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 0 | 10 | 0 | 0 | 0 | 3 |
| 1b1 Oil & gas | | 10 | | | | 3 |
| 1b2 Coal mining | | <1 | | | | |
| 2 Industrial processes | 1600 | 0 | 0 | 2 | 0 | 1 |
| 2a Iron & steel | | | | | | |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | | 2 | | |
| 2d Organic chemicals | | | | | | 1 |
| 2e Non-metallic minerals | | | | | | |
| 2f Other | | | | | | |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 21 |
| 3a Paint application | | | | | | 6 |
| 3b Degreasing & Dry cleaning | | | | | | 5 |
| 3c Chemical prods manuf/proc | | | | | | 5 |
| 3d Other | | | | | | 5 |
| 4 Agriculture | 0 | 644 | 40 | 1 | 38 | 83 |
| 4a Enteric fermentation | | 551 | | | | |
| 4b Animal wastes | | 52 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | 39 | 40 | | | 78 |
| 4e Agricultural waste burning | | 2 | | 1 | 38 | 4 |
| 4f Savannah burning | | | | | | |
| 6 Waste | 50 | 136 | 0 | 0 | 1 | <1 |
| 6a Landfills | | 136 | | | | |
| 6b Wastewater | | | | | | |
| 6c Other | 50 | | | | 1 | |
| Total emissions | 30720 | 796 | 42 | 114 | 429 | 197 |
| Marine bunkers | 0 | * # | | | | |
| Aviation bunkers | 1100 | 100 | 160 | 5345 | 2187 | 364 |
| FNEC | 1500 | * | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Ireland. Communication under the UN FCCC. Prepared for the Conference of the Parties in accordance with Article 12 of the Framework Convention on Climate Change. Department of the Environment, Ireland. October 1994.
- Eurostat (indicated with *)
- CORINAIR (indicated with #)

Estimates for all greenhouse gases are taken from National Report, unless indicated otherwise.

Footnotes:

- a. Ireland's national communication does not provide emissions from marine bunkers.

Other notes:

Ireland provides in its national communication an estimate of NMVOC emissions from land use change and forestry. However, since only few Member States have provided emissions and/or removals from land use change and forestry, this category has not been included in the EU emission inventory at all.

Estimates of greenhouse gases in Italy - 1990 (Gg).

| ITALY | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|-------------|-------------|
| 1 All energy | 401400 | 413 | 42 | 1981 | 7155 | 1276 |
| 1a Fuel combustion | 401400 | 66 | 42 | 1981 | 7155 | 1137 |
| 1a1 Energy & transformation | 138400 | 8 | 20 | 462 | 41 | 27 |
| 1a2 Industry | 91300 | 10 | 10 | 377 | 656 | 19 |
| 1a3 Transport | 95600 | 27 | 4 | 967 | 5645 | 996 |
| 1a4 Commercial/institutional | 26300 | 2 | 3 | 22 | 27 | 2 |
| 1a5 Residential | 41200 | 5 | 5 | 34 | 55 | 8 |
| 1a6 Agriculture/forestry | 8100 | 3 | <1 | 109 | 535 | 69 |
| 1a7 Other | 500 | | | 8 | 3 | 1 |
| 1a8 Biomass | | 10 | | 2 | 193 | 15 |
| 1b Fugitive fuel | 0 | 347 | 0 | 0 | 0 | 140 |
| 1b1 Oil & gas | | 337 | | | | 140 |
| 1b2 Coal mining | | 10 | | | | |
| 2 Industrial processes | 27600 | 4 | 15 | 7 | 371 | 73 |
| 2a Iron & steel | 400 | 2 | | 3 | 173 | 3 |
| 2b Non-ferrous metals | 1500 | | | | 182 | <1 |
| 2c Inorganic chemicals | 2300 | 2 | | 3 | 2 | 9 |
| 2d Organic chemicals | 0 | | 15 | | 14 | 41 |
| 2e Non-metallic minerals | 23000 | | | | | |
| 2f Other | 400 | | | | 20 | |
| 3 Solvent use | 0 | 0 | 0 | <1 | 0 | 538 |
| 3a Paint application | | | | | | 238 |
| 3b Degreasing & Dry cleaning | | | | | | 49 |
| 3c Chemical prods manuf/proc | | | | | | 64 |
| 3d Other | | | | | | 187 |
| 4 Agriculture | 0 | 1860 | 59 | 32 | 1704 | 492 |
| 4a Enteric fermentation | | 654 | | | | |
| 4b Animal wastes | | 887 | | | | 381 |
| 4c Rice cultivation | | 64 | 1 | | | |
| 4d Agricultural soils | | 158 | 57 | | | 14 |
| 4e Agricultural waste burning | | 97 | 1 | 32 | 1704 | 97 |
| 4f Savannah burning | | | | | | |
| 6 Waste | 7300 | 1611 | <1 | 14 | 29 | 22 |
| 6a Landfills | 5100 | 1526 | | | | 22 |
| 6b Wastewater | | 34 | | | | |
| 6c Other | 2200 | 51 | | | 29 | <1 |
| Total emissions | 436300 | 3889 | 116 | 2034 | 9258 | 2401 |
| Marine bunkers | 8600 | * | | | | |
| Aviation bunkers | 4800 | ** | | | | |
| FNEC | 30200 | * | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- First Italian National Communication to the Framework Convention on Climate Change. Ministry of the Environment, January 1995.
- Eurostat
- CORINAIR

Italy's national programme does not provide estimates according to the IPCC format. Nationally reported tables are given in terms of fuel and end use. Therefore, Eurostat and CORINAIR figures have been used for CO₂ emissions, for the non-CO₂ gases CORINAIR estimates have been used.

Footnotes:

- * Reconciliation of Eurostat and CORINAIR transport estimates.

Estimates of greenhouse gases in Luxembourg - 1990 (Gg).

| LUXEMBOURG | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|------------|--------------|
| 1 All energy | 12600 | 2 | <1 | 23 | 154 | 14 |
| 1a Fuel combustion | 12600 | 0 | | 23 | 154 | 12 |
| 1a1 Energy & transformation | 1900 | 0 | | <1 | <1 | |
| 1a2 Industry | 6600 | | | 11 | 98 | <1 |
| 1a3 Transport | 2900 | | | 11 | 48 | 11 |
| 1a4 Commercial/institutional | 300 | | | 0 | 1 | |
| 1a5 Residential | 800 | | | 1 | 5 | 1 |
| 1a6 Agriculture/forestry | 100 | | | | 1 | |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 0 | 2 | 0 | 0 | 0 | 2 |
| 1b1 Oil & gas | | 2 | | | | 2 |
| 1b2 Coal mining | | | | | | |
| 2 Industrial processes | 600 | 0 | 0 | 0 | 17 | 1 |
| 2a Iron & steel | 600 | | | | 17 | 1 |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | | | | |
| 2d Organic chemicals | | | | | | 1 |
| 2e Non-metallic minerals | | | | | | |
| 2f Other | | | | | | |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 4 |
| 3a Paint application | | | | | | 1 |
| 3b Degreasing & Dry cleaning | | | | | | <1 |
| 3c Chemical prods manuf/proc | | | | | | 1 |
| 3d Other | | | | | | 2 |
| 4 Agriculture | 0 | 18 | <1 | 0 | 0 | <1 |
| 4a Enteric fermentation | | 16 | | | | |
| 4b Animal wastes | | 2 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 100 | 4 | 0 | <1 | 0 | 0 |
| 6a Landfills | <1 | 4 | | | | |
| 6b Wastewater | | <1 | | | | |
| 6c Other | 100 | 1 | | | | |
| Total emissions | 13300 | a 24 | <1 | 23 | 171 | 19 |
| Marine bunkers | 0 | * | | | | |
| Aviation bunkers | 300 | b | | | | |
| FNEC | 0 | * | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Rapport National du Luxembourg en vue de la 1^e Conference des Parties a la Convention-Cadres des Nations-Unies sur les Changement Climatiques. Ministere de l'Environnement, Mars, 1995.
- Eurostat
- CORINAIR (CORINAIR 1990 - Luxembourg, final report)

CO₂ estimates are taken from Luxembourg's National Report, unless indicated otherwise. Figures for non-CO₂ gases are CORINAIR estimates.

Footnotes:

- a. Luxembourg's national communication provides an estimate for emissions from "nature". These have not been included in total CO₂ emissions.
- b. Reconciliation of Eurostat and CORINAIR transport estimates.

Estimates of greenhouse gases in the Netherlands - 1990 (Gg).

| THE NETHERLANDS | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|---------------------------|-----------------|-----------------------|-----------------|-------------|------------|
| 1 All energy | 14900 | 177 | 6 | 570 | 800 | 231 |
| 1a Fuel combustion | 14900 ^a | 28 | 6 ^c | 570 | 800 | 231 |
| 1a1 Energy & transformation | 51400 | | <1 | 92 | 6 | 19 |
| 1a2 Industry | 33400 | | <1 | 86 | 10 | 1 |
| 1a3 Transport | 26900 | | 5 | 337 | 716 | 195 |
| 1a4 Commercial/institutional | 9500 | | <1 | 31 | 68 | 16 |
| 1a5 Residential | 19200 | | IE | IE | IE | IE |
| 1a6 Agriculture/forestry | 8600 | | IE | 24 | IE | IE |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 0 | 149 | 0 | 0 | 0 | 0 |
| 1b1 Oil & gas | | 149 | | | | |
| 1b2 Coal mining | | | | | | |
| 2 Industrial processes | 1900 | 0 | 16 | 0 | 229 | 77 |
| 2a Iron & steel | 700 | | | | | |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | | | | |
| 2d Organic chemicals | | | | | | |
| 2e Non-metallic minerals | 800 | | | | | |
| 2f Other | 400 | | | | | |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 145 |
| 3a Paint application | | | | | | |
| 3b Degreasing & Dry cleaning | | | | | | |
| 3c Chemical prods manuf/proc | | | | | | |
| 3d Other | | | | | | |
| 4 Agriculture | 0 | 508 | 22 | 0 | 0 | 3 |
| 4a Enteric fermentation | | 402 | | | | |
| 4b Animal wastes | | 106 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | 22 | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 900 | 382 | 15 | 5 | 0 | 3 |
| 6a Landfills | | 377 | | | | |
| 6b Wastewater | | 5 | 4 | | | |
| 6c Other | 900 | | 11 | d | | |
| Total emissions | 151800 | 1067 | 59 | 575 | 1029 | 459 |
| Marine bunkers | 35900 | | | | | |
| Aviation bunkers | 4500 | | | | | |
| FNEC | 28600 ^b | | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Netherlands' national communication on Climate Change Policies. Prepared for the Conference of the Parties under the Framework Convention on Climate Change. The Netherlands, August 1994.
- Eurostat
- CORINAIR

Estimates for all greenhouse gases are taken from National Report, unless indicated otherwise.

Footnotes:

- a. Netherlands' national communication provides estimates for actual emissions from feedstocks (14800 Gg) and statistical differences (1000 Gg). For reasons of consistency with emission inventories from other countries these have not been included. Also, the Netherlands applied a correction for temperature influences. This correction has been ignored for reasons of comparison.
- b. The Netherlands provides in its national communication an estimate of 28600 Gg CO₂ emissions for potential emissions from feedstocks. To be consistent with emission inventories from other countries, this estimate is used for emissions from FNEC.
- c. The Netherlands provides in its national communication an estimate for emissions from polluted inland and coastal waters. These emissions have not been included here, since this source is not identified in the draft IPCC guidelines for national greenhouse gas inventories and other countries did not provide estimates.
- d. N₂O emissions from polluted inland and coastal waters.

Estimates of greenhouse gases in Portugal - 1990 (Gg).

| PORTUGAL | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|-------------|------------|
| 1 All energy | 38700 | 13 | 5 | 210 | 1072 | 117 |
| 1a Fuel combustion | 38700 | 11 | 5 | 210 | 1072 | 109 |
| 1a1 Energy & transformation | 19400 | 2 | 3 | 60 | 68 | 11 |
| 1a2 Industry | 6100 | 2 | 1 | 18 | 264 | 3 |
| 1a3 Transport | 9900 # a | 1 | 1 | 108 | 614 | 81 |
| 1a4 Commercial/institutional | 1000 | 3 | | 2 | 63 | 6 |
| 1a5 Residential | 900 | 3 | | 1 | 54 | 5 |
| 1a6 Agriculture/forestry | 1300 | | | 21 | 9 | 3 |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | 5 | 1 | 8 | 436 | 13 |
| 1b Fugitive fuel | NE | 2 | 0 | 0 | 0 | 8 |
| 1b1 Oil & gas | | | | | | 8 |
| 1b2 Coal mining | | 2 | | | | |
| 2 Industrial processes | 3400 | <1 | 2 | 4 | 11 | 15 |
| 2a Iron & steel | <100 | | | | 11 | <1 |
| 2b Non-ferrous metals | <100 | | 2 | | | |
| 2c Inorganic chemicals | 300 | | | 2 | | |
| 2d Organic chemicals | | | | | | 1 |
| 2e Non-metallic minerals | 3100 | | | 2 | | 5 |
| 2f Other | <100 | | | | | 9 |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 67 |
| 3a Paint application | | | | | | 26 |
| 3b Degreasing & Dry cleaning | | | | | | 2 |
| 3c Chemical prods manuf/proc | | | | | | 6 |
| 3d Other | | | | | | 32 |
| 4 Agriculture | 0 | 176 | 4 | 0 | 0 | 0 |
| 4a Enteric fermentation | | 105 | | | | |
| 4b Animal wastes | | 58 | | | | |
| 4c Rice cultivation | | 13 | | | | |
| 4d Agricultural soils | | | 4 | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 400 # | 35 | 0 | 0 | 0 | 0 |
| 6a Landfills | | 33 | | | | |
| 6b Wastewater | | 2 | | | | |
| 6c Other | 400 | | | | | |
| Total emissions | 42500 | 227 | 11 | 214 | 1083 | 199 |
| Marine bunkers | 2100 * | | | | | |
| Aviation bunkers | 1800 b | | | | | |
| FNEC | 6600 * | | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Portuguese report in accordance with Article 12 of the United Nations Framework Convention on Climate Change. Ministry of the Environment and Natural Resources, Lisbon, 1994.
- Eurostat
- CORINAIR

CO₂ estimates are provided by Portugal in reply to the request of the Council of Ministers, unless indicated otherwise. Figures for non-CO₂ gases are CORINAIR estimates.

Footnotes:

- a. Nationally reported estimates of CO₂ emissions from transport amount to 8700 Gg, while Eurostat estimates amount to 10200 Gg and CORINAIR estimates amount to 9800 Gg. Most likely, the nationally reported estimates do not include all transport sources, and therefore CORINAIR estimates have been used.
- b. Reconciliation of Eurostat estimates and nationally reported estimates.

Estimates of greenhouse gases in Spain - 1990 (Gg).

| SPAIN | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|-------------|-------------|
| 1 All energy | 222900 | 758 | 21 | 1158 | 4032 | 634 |
| 1a Fuel combustion | 222900 | 74 | 21 | 1158 | 4032 | 568 |
| 1a1 Energy & transformation | 78400 | 11 | 11 | 270 | 20 | 11 |
| 1a2 Industry | 52300 | 6 | 5 | 144 | 401 | 9 |
| 1a3 Transport | 63300 | 14 | 2 | 723 | 2721 | 489 |
| 1a4 Commercial/institutional | 28900 | 44 | 3 | 21 | 890 | 59 |
| 1a5 Residential | IE | IE | IE | IE | IE | IE |
| 1a6 Agriculture/forestry | IE | IE | IE | IE | IE | IE |
| 1a7 Other | | | | | | |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | 0 | 684 | 0 | 0 | 0 | 66 |
| 1b1 Oil & gas | | | | | | |
| 1b2 Coal mining | | | | | | |
| 2 Industrial processes | 35300 | 4 | 10 | 15 | 248 | 70 |
| 2a Iron & steel | | 3 | 0 | 2 | 188 | 4 |
| 2b Non-ferrous metals | 900 | <1 | 0 | 0 | 60 | <1 |
| 2c Inorganic chemicals | 600 | <1 | 10 | 8 | 0 | 3 |
| 2d Organic chemicals | | 0 | 0 | 0 | 0 | 16 |
| 2e Non-metallic minerals | 15100 | 0 | 0 | 0 | 0 | 0 |
| 2f Other | 18600 | <1 | 0 | 5 | <1 | 48 |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 302 |
| 3a Paint application | | | | | | 87 |
| 3b Degreasing & Dry cleaning | | | | | | 38 |
| 3c Chemical prods manuf/proc | | | | | | 38 |
| 3d Other | | | | | | 138 |
| 4 Agriculture | 0 | 875 | 55 | 6 | 397 | 95 |
| 4a Enteric fermentation | | 346 | | | | |
| 4b Animal wastes | | 426 | | | | |
| 4c Rice cultivation | | 11 | | | | |
| 4d Agricultural soils | | 70 | | | | 74 |
| 4e Agricultural waste burning | | 22 | 55 | 6 | 397 | 22 |
| 4f Savannah burning | | | | | | |
| 6 Waste | 2500 | 494 | 0 | 29 | 272 | 10 |
| 6a Landfills | 1800* | 470 | | 28 | 261 | 2 |
| 6b Wastewater | | | | | | <1 |
| 6c Other | 700 | 23 | | 1 | 12 | 7 |
| Total emissions | 227300 | 4531 | 94 | 1189 | 4725 | 1120 |
| Marine bunkers | 12200 | * b | | | | |
| Aviation bunkers | 4100 | * c | | | | |
| FNEC | 18800 | * | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Report by Spain on the United Nations Framework Convention on Climate Change. Provisional Version. National Climate Committee. Spain.
- Eurostat (indicated with *)
- CORINAIR (indicated with #)

Estimates for all greenhouse gases are taken from National Report, unless indicated otherwise.

Footnotes:

- a. Spain provided an estimate of 1800 Gg CO₂ emissions. It has been assumed that these emissions are from non-organic/non-recyclable material.
- b. Emissions from bunkers have not been provided in Spain's National Report.
- c. Reconciliation of Eurostat and figures provided in Spain's National Report.

Estimates of greenhouse gases in Sweden - 1990 (Gg).

| SWEDEN | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-----------------|-----------------|------------------|-----------------|-------------|------------|
| 1 All energy | 55200 | 33 | 4 | 362 | 1606 | 375 |
| 1a Fuel combustion | 55100 | 33 | 4 | 362 | 1606 | 375 |
| 1a1 Energy & transformation | 7000 | 1 | 1 | 20 | 8 | 4 |
| 1a2 Industry | 13400 | 4 | 2 | 39 | 6 | 11 |
| 1a3 Transport | 23100 | 17 | | 285 | 1503 | 201 |
| 1a4 Commercial/institutional | 11500 | 10 | 1 | 19 | 69 | 141 |
| 1a5 Residential | IE | IE | IE | IE | IE | IE |
| 1a6 Agriculture/forestry | IE | IE | IE | IE | IE | IE |
| 1a7 Other | IE | IE | IE | IE | IE | IE |
| 1a8 Biomass | | | | | | |
| 1b Fugitive fuel | <100 | 0 | 0 | 0 | 0 | 18 |
| 1b1 Oil & gas | <100 | | | | | 18 |
| 1b2 Coal mining | 0 | | | | | |
| 2 Industrial processes | 5000 | 0 | 3 | 11 | 6 | 67 |
| 2a Iron & steel | 1600 | | | 1 | 2 | 2 |
| 2b Non-ferrous metals | 700 | | | 1 | | |
| 2c Inorganic chemicals | | | 3 | 2 | | |
| 2d Organic chemicals | | | | | | 5 |
| 2e Non-metallic minerals | 2500 | | | 7 | | |
| 2f Other | 200 | | | | 4 | 59 |
| 3 Solvent use | 300 | 0 | 0 | 0 | 0 | 98 |
| 3a Paint application | 100 | | | | | 40 |
| 3b Degreasing & Dry cleaning | 50 | | | | | 15 |
| 3c Chemical prods manuf/proc | 50 | | | | | 7 |
| 3d Other | 100 | | | | | 36 |
| 4 Agriculture | 500 | 196 | 8 | 0 | 0 | 0 |
| 4a Enteric fermentation | 500 | 188 | | | | |
| 4b Animal wastes | IE | 8 | | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | 8 | | | |
| 4e Agricultural waste burning | | | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 300 | 100 | 0 | 0 | 0 | 0 |
| 6a Landfills | 300 | 100 | | | | |
| 6b Wastewater | | | | | | |
| 6c Other | | | | | | |
| Total emissions | 61300 | 329 | 15 | 373 | 1612 | 540 |
| Marine bunkers | 4200 | | | | | |
| Aviation bunkers | IE | | | | | |
| FNEC | 5700* | | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Sweden's National Report under the United Nations Framework Convention on Climate Change. Ministry of the Environment and Natural Resources - September 1994.
- Eurostat
- CORINAIR

Estimates for all greenhouse gases are taken from the National Report, unless indicated otherwise.

Estimates of greenhouse gases in United Kingdom - 1990 (Gg).

| UNITED KINGDOM | CO ₂ | CH ₄ | N ₂ O | NO _x | CO | NMVOC |
|-------------------------------|-------------------------|-----------------|------------------|-----------------|-------------|-------------------------|
| 1 All energy | 566000 | 1316 | 6 | 2710 | 6317 | 1396 |
| 1a Fuel combustion | 560400 | 78 | 6 | 2628 | 6284 | 1306 |
| 1a1 Energy & transformation | 231300 | 5 | 3 | 823 | 57 | 13 |
| 1a2 Industry | 96700 | 7 | | 180 | 65 | 2 |
| 1a3 Transport | 120600 | 11 | 3 | 1498 | 5884 | 115 |
| 1a4 Commercial/institutional | 30200 | 2 | | 56 | 8 | 1 |
| 1a5 Residential | 78900 | 46 | | 68 | 269 | 37 |
| 1a6 Agriculture/forestry | 2700 | <1 | | 4 | 1 | |
| 1a7 Other | | 3 | 3 | | | |
| 1a8 Biomass | | 4 | | | | |
| 1b Fugitive fuel | 5700 | 1238 | 0 | 82 | 33 | 90 |
| 1b1 Oil & gas | 5700 | 482 | | 82 | 33 | 90 |
| 1b2 Coal mining | | 756 | | | | |
| 2 Industrial processes | 7400 | 5 | 93 | 21 | 220 | 455 |
| 2a Iron & steel | | | | | | |
| 2b Non-ferrous metals | | | | | | |
| 2c Inorganic chemicals | | | 13 | 9 | | |
| 2d Organic chemicals | | 5 | 80 | | | 417 |
| 2e Non-metallic minerals | 7400 | | | | | |
| 2f Other | | | | 12 | 220 | 38 |
| 3 Solvent use | 0 | 0 | 0 | 0 | 0 | 674 |
| 3a Paint application | | | | | | 237 |
| 3b Degreasing & Dry cleaning | | | | | | 61 |
| 3c Chemical prods manuf/proc | | | | | | 72 |
| 3d Other | | | | | | 304 |
| 4 Agriculture | 0 | 1141 | 11 | 0 | 0 | 0 |
| 4a Enteric fermentation | | 1004 | | | | |
| 4b Animal wastes | | 125 | 4 | | | |
| 4c Rice cultivation | | | | | | |
| 4d Agricultural soils | | | 7 | | | |
| 4e Agricultural waste burning | | 12 | | | | |
| 4f Savannah burning | | | | | | |
| 6 Waste | 4800^b | 2078 | 0 | 0 | 0 | 19 |
| 6a Landfills | 2800 | 2007 | | | | 19 |
| 6b Wastewater | | 71 | | | | |
| 6c Other | 2200 ^c | | | | | |
| Total emissions | 577000 | 4531 | 108 | 2740 | 6682 | 2540^f |
| Marine bunkers | 7200 ^d | | | | | |
| Aviation bunkers | 1400 ^e | | | | | |
| FNEC | 36700 [*] | | | | | |

IE = Included Elsewhere

NE = Not Estimated

* = Eurostat figures used

= CORINAIR figures used

Sources:

- Climate Change. The UK report. United Kingdom's Report under the Framework Convention on Climate Change. January, 1994. Figures have been updated for consistency reasons with the latest UK emission data in the 17th Digest of Environmental Protection and Water Statistics.
- Eurostat
- CORINAIR

Estimates for all greenhouse gases are taken from the UK's National Report, as revised by the UK Department of the Environment for consistency with the updated emission inventory in the 17th Digest of Environmental Protection and Water Statistics, unless indicated otherwise.

Footnotes:

- a. Not included in emission totals.
- b. Based on UK's nationally reported estimates of 2500 Gg for landfills, and 6051 Gg for incineration. In the UK's report, the latter has been presented in category 2F.
- c. CO₂ emissions from incineration.
- d. UK estimate of international marine bunker emissions.
- e. UK estimate of international aviation bunker emissions.
- f. NMVOC emissions from land use change (80 Gg) have not been included as part of the total.

ANNEX 2

SCENARIOS

Conventional Wisdom Scenario: energy indicators

| SCENARIO | CONVENTIONAL WISDOM |
|--|---|
| <p>General Description:</p> | <p>The 'business as usual' scenario denoting a conventional wisdom view of the most likely evolution of events. Economic growth gradually weakens in the long term. Although some progress is made, many of the world's structural social and economic problems remain. Energy policy remains fragmented, the result of unresolved conflicting objectives for competitiveness, environment and security of supply as well as differing national aims.</p> |
| <p>Macro-economics:</p> | <p>EU GDP annual growth rates of 2.9% from 1995 to 2000; 2.4% to 2005; 2.2% to 2010; 1.9% to 2015; and 1.8% to 2020. Discount rate 8% real.</p> |
| <p>Taxation:</p> | <p>No reform: Already high tax rates leave little room for further increases to contain public deficits; no inclusion of external costs.</p> |
| <p>Environment:</p> | <p>Although high on EU agenda, environmental approach limited by conflicting economic objectives. Progress is made in a number of areas, particularly SO₂, NO_x, etc. Measures to meet global warming continue only on a mild precautionary basis.</p> |
| <p>Energy Prices: Crude (\$1993) Gas Coal</p> | <p>Increasing smoothly. Rising in real terms as world demand increasingly met by Middle East producers. \$17.6/bbl in 1995, \$21/bbl in 2000, \$29/bbl in 2010 and \$31/bbl in 2020. Deregulation and growing network bring lower prices relative to oil after 2000, reinforced by increasing as to gas price competition. International process increasing slightly, reflecting expected long-run marginal production costs. Delivered prices flat as cheap imports displace expensive domestic supplies.</p> |
| <p>Technology:</p> | <p>Some penetration of new, more efficient demand and supply technologies, partly driven by public standards and partly by industrialists aiming at increased industrial competitiveness.</p> |
| <p>Energy Demand Issues: Oil Gas Coal Electricity</p> | <p>Continuation of current actions with some concern on increasing efficiency. Gross consumption expected to increase modestly and ever more slowly. Very little growth expected as oil is increasingly limited to transportation. However, it remains the predominant fuel overall. Fastest growing of all primary fuels with increasing share in all end-use sectors, particularly power generation. Gains could slow post-2000 as coal becomes more attractive in power sector. Share declines to 2000 as a result of competition from gas in electricity generation. Increasingly competitive prices could mean later recovery of market share in the power sector. Electricity likely to gain share in residential, commercial and industrial sectors in the medium term although market saturation and efficiency gains could slow the growth towards 2020.</p> |

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| Energy Supply Issues: | Import dependency accelerates, potentially increasing from 50% at present to two thirds or more by 2020. |
| Oil | Domestic production not expected to decline significantly until beyond 2010. Import dependency remains relatively close to today's levels. |
| Gas | Although domestic production likely to be maintained, strong demands rise means rapid increase in imports. Liberalisation and infrastructure developments essential in expanding penetration of gas in Europe. |
| Coal | Deregulation and reduced subsidies will result in substantial decline in domestic EU hard coal production and escalating imports. |
| Electricity | No public policy on nuclear or security of supply of fossil fuel imports. No limits for use of each primary source. |
| Renewables | Supply could increase strongly but from very low base. Overall contribution of renewables likely to remain small. |

Battlefield Scenario: energy indicators

| SCENARIO | BATTLEFIELD |
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| General Description: | <p><i>Contradictions and instabilities in the global system make economic integration very difficult. Globalisation is seen as too ambitious. The geo-political system fragments into blocs, with tensions and friction between and also within the blocs. This leads to a "Europe à la carte".</i> Energy policies are aimed at reducing import dependency; supply side measures such as protectionism of domestic energy production industries, likely to be more successful than demand side measures.</p> |
| Macro-Economics: | <p>EU GDP annual growth rates of 3.1% from 1995 to 2000; 1.1% to 2005; -1.8% to 2010; 1.4% to 2015; and 1.3% to 2020. Discount rate 7% real.</p> |
| Taxation: | <p>No tax reform: harmonisation of VAT and excises as it stands today, without equality of treatments across fuels; some inclusion of external costs (transport sector); taxation levels continue to be set aiming at Government revenue levels.</p> |
| Environment: | <p>Precautionary principles on CO₂ to 2005, but CO₂ proven as a contributor to global warming thereafter. Nonetheless, environmentalism an excuse for protectionism and effectiveness frequently compromised.</p> |
| <p>Energy Prices:</p> <p>Crude (\$1993)</p> <p>Gas</p> <p>Coal</p> | <p>Increasing dependency on fewer major suppliers leads to an oil price shock.</p> <p>Rising from \$16/bbl in 1995 to \$24/bbl by 2004. Price shock to \$40/bbl in 2005, falling to \$18/bbl in 2009 then rising again to \$28/bbl in 2020.</p> <p>Remain tied to oil, so reflecting the price shock but lagging in response.</p> <p>International prices flat until the price shock of 2005, although falling back thereafter to pre-shock levels. European prices track international prices but inflated by the cost of maintaining domestic production.</p> |
| Technology: | <p>As Conventional Wisdom - Some penetration of new, more efficient demand and supply technologies, partly driven by public standards and partly by industrialists aiming at increased industrial competitiveness.</p> |

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| <p>Energy Demand Issues:</p> <p>Oil</p> <p>Gas</p> <p>Coal</p> <p>Electricity</p> | <p>In spite of attempts to introduce alternative fuels, tension and conflict inhibit efficiency gains. Energy demand likely to rise, then to fall back in response to the energy price shock and subsequent economic recession before rising again.</p> <p>Impact of price shock expected to be considerably, particularly in substitutable sectors. Transport growth likely to be checked but could rise again later, albeit increasingly constrained by social and environmental concerns.</p> <p>Underlying strong demand growth but interruption by the price shock expected.</p> <p>Coal increasingly perceived as a more stable and secure energy source allowing it to fight back against gas post-2000, particularly in power generation.</p> <p>Some penetration of new, more efficient demand supply technologies partly driven by public standards and partly by industrialists aiming at increased industrial competitiveness.</p> |
| <p>Energy Supply Issues:</p> <p>Oil</p> <p>Gas</p> <p>Coal</p> <p>Electricity</p> <p>Renewables</p> | <p>Policy dominated by unresolved conflicts of competitiveness, environment and geopolitical considerations.</p> <p>Policy aimed at maintaining European production as high as possible in response to security of supply concerns, aided by increasing real prices.</p> <p>As with oil, policies such as benign upstream taxation aim to enhance and extend domestic production to minimise imports.</p> <p>Production declines steadily but state aids moderate rate of decline.</p> <p>Efforts to maintain current level of nuclear capacity in Europe; Setting of limits for the use of each primary source (oil, coal, gas) for security reasons.</p> <p>Public attempts to develop renewables meet with only limited success.</p> |

Forum Scenario: energy indicators

| SCENARIO | FORUM |
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| <p>General Description:</p> | <p><i>The process of global economic integration produces new imperatives for collective public action. National, European and international institutions are gradually restructured so as to be able to deal more effectively with broader, more complex shared problems and interests.</i></p> <p>Energy policies most significantly affected by concern for the environment. A global unity of purpose allows positive action across the energy spectrum.</p> |
| <p>Macro-Economics:</p> | <p>EU GDP annual growth rates of 2.3% from 1995 to 2000; 2.5% to 2005; -2.5% to 2010; 2.6% to 2015; and 2.4% to 2020. Discount rate 5% real.</p> |
| <p>Taxation:</p> | <p>General taxation reform: harmonisation of VAT and excises and equality of treatment across fuels on an energy basis; external costs included - on a "precautionary" approach to 2005 and under a CO₂ driven world thereafter, leads to general fuel tax increases in real terms.</p> |
| <p>Environment:</p> | <p>The ecologically driven scenario. The proven case against CO₂ from 2005 reinforces strong environmental concerns throughout society and results in major policy shifts.</p> |
| <p>Energy Prices: Crude (\$1993)</p> <p>Gas</p> <p>Coal</p> | <p>Stable throughout.</p> <p>Flat at \$16/bbl to 2020 representing an average which captures a variation within the range of \$10 to \$20/bbl. Weak demand prevents producers from controlling the market. Consumers governments extract much of the economic rent.</p> <p>Rising relative to oil as environmental pressures put premium on clean fuels.</p> <p>International prices constant in real terms in face of environmental pressures and thus weak demand. Average EU prices fall substantially with phase-down of expensive domestic production.</p> |
| <p>Technology:</p> | <p>Strong penetration of new, more efficient demand and supply technologies mainly driven by public standards on a world-wide scale - high level of technology transfer.</p> |

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| <p>Energy Demand Issues:</p> <p>Oil</p> <p>Gas</p> <p>Coal</p> <p>Electricity</p> | <p>Radical policy changes and major technology developments aimed at limiting energy demand growth. Aiming at rapid decline, although difficult in transport. Goal is for transport fuel demand to flatten to early 2000s then fall thereafter with some growth in more efficient diesel, decline in gasoline and increasing penetration of non-oil clean technologies towards 2020.</p> <p>Environmental advantages likely to ensure significant increases in share although lower overall energy requirements could limit volume increases.</p> <p>Limited by environmental disadvantages but RTD develops to meet environmental challenge.</p> <p>Strongly influenced by public conservation policies and utilities demand-side management.</p> |
| <p>Energy Supply Issues:</p> <p>Oil</p> <p>Gas</p> <p>Coal</p> <p>Electricity</p> <p>Renewables</p> | <p>Fundamental policy changes and major RTD push to limit emissions, notably CO₂.</p> <p>While enhanced recovery technologies ensure more than adequate supplies to meet lower demand, low prices hinder production from higher cost reserves.</p> <p>Domestic production strong, aided by technology. Well-head conversion to hydrogen for new energy technologies appears towards 2020.</p> <p>Domestic production rapidly phased out.</p> <p>No nuclear phase-out with re-launch in some countries (France, Japan, NICs); Opportunities for new technologies enhanced.</p> <p>Strong growth in share of renewables, accelerating towards the period end as new technologies and radical changes in agricultural policy are pushed forward.</p> |

Hypermarket Scenario: energy indicators

| SCENARIO | HYPERMARKET |
|---|---|
| General Description: | <i>Global economic integration is self-reinforcing and continues. The force driving this scenario is continued application of the market mechanism which is seen as the best way to produce wealth and handle complexity in uncertainty. Liberalisation and privatisation deliver results and produce new market entrants who demand more of the same. Strong belief in free market principles result in energy policy driven by desire to minimise government control and maximise efficient operation of free markets, nonetheless achieving desired standards.</i> |
| Macro-Economics: | EU GDP annual growth rates of 3.2% from 1995 to 2000; 2.8% to 2005; 2.3% to 2010; 2.1% to 2015; and 1.9% to 2020. Discount rate 10% real. |
| Taxation: | Some tax reform: harmonisation of VAT and excises taxes towards current limits, without equality of treatment across fuels; no inclusion of external costs. |
| Environment: | Precautionary principles on CO ₂ to 2005, after which the case against CO ₂ is proven. Governments cannot be indifferent to environmental problems but look first and foremost to the market for solutions and only secondly to public policy. Public concern reinforces the need for the creation of markets for environmental protection. |
| Energy Prices: Crude (\$1993) Gas Coal | <p>Increasing smoothly</p> <p>Rising in real terms as world demand increasingly met by Middle East producers. \$17.6/bbl in 1995, \$21/bbl in 2000, \$29/bbl in 2010 and \$31/bbl in 2020.</p> <p>Deregulation and growing network bring lower prices relative to oil, reinforced by increasing gas-to gas price competition.</p> <p>International prices slightly increasing reflecting expected long-run marginal production costs. Domestic prices flat as cheap imports displace expensive domestic supplies.</p> |
| Technology: | Penetration of new, more efficient demand and supply technologies substantially dependent on market forces and international competition; little Government action. |

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| <p>Energy Demand Issues:</p> <p>Oil</p> <p>Gas</p> <p>Coal</p> <p>Electricity</p> | <p>High economic growth and hands-off public policy mean efficiency gains made only for competitive reasons; strong energy demand growth likely.</p> <p>Oil up against strong competition from cheap deregulated gas and imported coal, although transport sector likely to limited only by saturation effects.</p> <p>The dash for gas becomes a stampede, although there is increasing competition from low cost coal imports post-2000</p> <p>Likely to decline steeply in the near term but competitive prices present potential for strong recovery in the power sector thereafter.</p> <p>Little public influence in terms of conservation policies.</p> |
| <p>Energy Supply Issues:</p> <p>Oil</p> <p>Gas</p> <p>Coal</p> <p>Electricity</p> <p>Renewables</p> | <p>No special concerns on security of supply. Domestic energy production only develops where viable on internationally competitive basis with no special government support.</p> <p>Imports rise but downstream investments by producer countries allay security of supply worries. Domestic production develops in response to rising prices.</p> <p>Import dependency increases but mutual commercial interests of producers and consumers reduce security risks.</p> <p>Withdrawal of subsidies and deregulation lead to phase-out of domestic supply.</p> <p>No public policy on nuclear. No limits for use of each primary source.</p> <p>With little public RTD investment or incentives, renewable growth limited to commercially viable opportunities only.</p> |

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