Belgium's Third

National Communication

under the United Nations Framework Convention on Climate Change

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Ministry for Social Affairs, Health and Environment
Federal Department of the Environment
Studies and Coordination Office
Boulevard Pacheco 19 box 5
B-1010 Brussels
Belgium
Telephone +32 (0)2/ 210 45 32
Fax +32 (0)2/ 210 48 52
http://www.environment.fgov.be
E-Mail: climate@health.fgov.be

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1. EXECUTIVE SUMMARY

1.1. INTRODUCTION

The « National Programme for Reducing CO_2 Emissions », adopted in 1994, was the first concrete integrated initiative taken in Belgium in the area of climate policy. This Programme was a follow-up to the federal Government's decision to reduce CO_2 emissions by 5% from the 1990 level by the year 2000. The measures provided for in this plan have only been partially implemented and CO_2 emissions in 2000 have exceeded their 1990[1] levels by 7.7%. This failure has underscored the necessity to place climate policy higher on the political agenda. This priority is reflected in the federal Government's coalition agreement of June 1999, which includes, *inter alia*, integrated sustainable mobility and energy policies as well as a general tax reform policy aimed at achieving the sustainable development objectives. The *Federal Plan for Sustainable Development* (FPSD), adopted by the federal Government on 20 July 2000, lays down the main features of the policies to be pursued at the national level to meet the objectives of sustainable development. It establishes the framework for political action in the field of climate change, provides for the implementation of sustainable development strategies in the field of energy and favours mobility that is compatible with sustainable development. In addition to measures aimed at some specific sectors, emphasis is placed on scientific research, development cooperation, the use of the flexibility mechanisms, communication tools and voluntary agreements.

In its decision of 14 June 2001, the Council of Ministers reaffirmed its commitment to implement the necessary measures to meet the greenhouse gas emission reduction target of 7.5 %[2] from the 1990 level in 2008-2012 and pledged to draft a *National Climate Plan*[3]. The federal and regional authorities concluded an agreement for the purpose of establishing and implementing a *National Climate Plan*. This agreement will be submitted to the federal and regional parliaments for approval in the course of 2002.

The various Regions have also finalised action programmes on climate change. On 19 July 2001, the Walloon Government adopted the *Plan d'action de la Région wallonne en matière de changements climatiques* (Action Plan of the Walloon Government in the field of Climate Change). The *Klimaatbeleidsplan Vlaanderen* (Climate Policy Plan for Flanders), decided on by the Flemish Government on 20 April 2001, is currently in preparation and is scheduled for adoption by the Flemish Government and Parliament during the first quarter of 2002. The Brussels Capital Region is also preparing an action programme on climate change.

These developments in the national climate policy occur in an international context that has itself been in transition. The political agreement reached during the second part of the Sixth session of the Conference of the Parties (Bonn, July 2001) regarding the implementation of the Buenos Aires Plan of Action, followed by the Marrakech Accords (November 2001), has given a fresh impetus to the real implementation of the Kyoto Protocol. The establishment of a European climate policy has also been speeded up during 2001, particularly as a result of the Belgian Presidency's efforts during the second half of 2001. The entry into force of the Kyoto Protocol before the Johannesburg Summit (Rio+10) is one of Belgium's priority goals. This objective was jointly approved by the federal Government and the Regions in the context of the *Inter-Ministerial Conference on the Environment* (ICE). The ratification has already been approved by the federal Chamber of Representatives (12 July 2001) and Senate (21 June 2001), the Council of the Brussels Capital Region (13 July 2001) and the Flemish Parliament (30 January 2002). The Walloon Government has approved a draft Decree on the approval of the Kyoto Protocol on 21 February 2002; it is scheduled for adoption by the Walloon Parliament during the first quarter of 2002.

[1] The aggregate emissions of the 6 greenhouse gases referred to in Annex A to the Kyoto Protocol have increased in 2000 by 6.3% relative to 1990 (1995 for fluorinated gases)
[2] The reduction of greenhouse gas emissions imposed on the EU in the context of the Kyoto Protocol negotiations has been fixed at 8% for the 2008-2012 period (in comparison with the baseline) ; the EU burden-sharing agreement concluded at the Council of Environment Ministers of 16 and 17 June 1998, sets Belgium a reduction target of 7.5%.
[3] In accordance with the *Federal Plan for Sustainable Development*, section 496

The present report is Belgium's third National Communication to the *Conference of the Parties to the UN Framework Convention on Climate Change*, in accordance with decision 11/CP.4 (National Communications of Annex I Parties). It provides an inventory of Belgium's efforts in the field of greenhouse gas emissions, the actions it undertakes to curb them, the future prospects and the national implications of climate changes. The third National Communication includes : a survey of country-specific circumstances (Section 2), a summary of the national inventory of greenhouse gas emissions and absorptions (Section 3), an account of policies and measures adopted to reduce greenhouse gas emissions (Section 4), the future developments (projections) of these emissions (Section 5), an evaluation of the foreseeable impact of climate changes (vulnerability) and of the adaptation measures (Section 6), a survey of measures to provide financial aid to developing countries and of technology transfers (Section 7), a presentation of research and climate system monitoring activities (Section 8), and an account of education, training and awareness-raising actions in the area of climate change (Section 9).

1.2. COUNTRY PROFILE

GEOGRAPHY – Located in the north-west of Europe, bordered by the North Sea, Belgium covers an area of 32,545 km² ; its highest elevation is 694 m. Belgium has a temperate maritime climate, characterised by moderate temperatures (average : 9.8°C), predominantly westerly winds, cloudy and frequent and regular precipitation (annual average precipitation: 782 mm). Belgium is densely populated (315 persons/km², an annual growth rate of 1,8‰) and has a very dense communications network. It is highly urbanised and its territory is extremely fragmented ; this exerts enormous pressure on the ecosystems. It has few mineral resources of its own, except for some coalmines that are now closed.

INSTITUTIONS – Belgium is a federal state, consisting of three language-based Communities (Flemish Community; Wallonia-Brussels Community, formally called French Community; German-language Community) and three territorial-based Regions (Flemish Region, Walloon Region and Brussels Capital Region). Responsibility for decision-making is shared by the Federal State, the Communities and the Regions, which are all on an equal footing and have specific powers. Environmental policies are predominantly the responsibility of the Regions. However, greenhouse gas emission reduction policies extend beyond the environmental framework as such. This means that all the decision-making tiers are involved in this policy. Various advisory and collaborative bodies ensure adequate coordination between the Federal State and the Regions in the field of climate change.

ECONOMY – Over the past years, Belgium's economy has been steadily growing. In 2000, the GDP reached BEF 9 924 billion (EUR 246 billion) (at current market prices). Services contributed roughly 50%, and the manufacturing industries 20.8%, while the share of agriculture is a mere 1.8%. The per capita GDP lies nearly 10% above average OECD or EU figures. Today, Belgium has a balanced budget ; the ratio between the national debt and the GDP is rapidly decreasing, inflation is under control, and interest rates are approaching those of the neighbouring countries. Belgian foreign trade is highly competitive: the share of exports in the final demand is one of the highest and there is a trade balance surplus. A feature of the Belgian economy is the substantial redistribution of income through taxation and a system of transfers. Consequently, available income is relatively well distributed and the percentage of the population below the poverty line is fairly small in spite of a low employment rate in comparison with the European average. The whole tertiary sector (market and non-market goods and services) currently employs nearly 75% of employees, while employment in agriculture has declined to 2.1% of the labour force. Employment industry has also steeply dropped over the past 30 years (-38%). The living standard in Belgium, which is the result of the convergence of favourable factors in economic, health and educational terms, is high ; in fact, it ranks fifth in UNDP's « Human Development Index » (2001).

ENERGY – Belgium's apparent gross consumption of primary energy stands at 57.4 million tonnes oil equivalent (Mtoe), i.e. approximately 5.62 toe per capita (1999). Nearly 80% of this consumption, which is above the European average, comes from imported fossil fuels. Nuclear energy covers 95% of primary energy production. So far, renewable energy sources are being used only sparingly (1%). The industrial sector remains the largest consumer of energy in Belgium, followed by the residential sector and transport. The latter has grown rapidly over the past 20 years (+62%). The energy market in Belgium has recently been characterised by a gradual shift away from solid fuels towards natural gas as a result of the conversion of electric power stations. The Federal State and the Regions have recently adopted a number of provisions aimed at accelerating the liberalisation process of the internal market in electricity pursuant to European Directive 96/92/EC. Belgium already meets the objective of opening 33% of its electricity market to foreign competition scheduled for 2003.

TRANSPORT – Belgium has a very dense road network and highly developed rail and waterway systems as well as ports and airports. The transport sector is dominated by road transport, both for freight (72% of total tonnage) and passengers (88%). The rail and waterways network account for only 16% and 12% respectively of overall goods transport.

INDUSTRY – Industrial activity in Belgium is dominated by iron and steel and by the chemistry and agri-foodstuff sectors. The extractive industries have almost disappeared with the closure of the last coalmines. The iron and steel sector and textile have remained relatively stable in spite of several closure and restructuring rounds.

WASTES – In 1999, the per capita production of waste from households and commercial activities reached 535 kg, 52% of which was is not recycled. The manufacturing industries are the primary source of waste (13,8 Mt). The three regions have implemented waste management plans, combining prevention, recycling and re-use. Material recovery operations are becoming an important industrial sector in Belgium as they generate many new jobs. They are mainly concerned with recyclable metals, paper, textiles, and building materials.

AGRICULTURE AND FORESTRY – The agricultural sector has gone through many a crisis over the past few years (BSE, dioxin, ...), which has gradually reduced the number of farms although farmland has remained virtually stable (roughly 42.8% of the territory). Farmers already practising organic farming or in the process of converting to this type of farming only account for 1% of the entire sector so far. Forestry has remained stable ; forests cover 32% of the Walloon territory and 10.8% of the Flemish territory. However, sustained efforts are being made to regenerate the woodlands for reasons of biodiversity and sustainability.

1.3. INVENTORIES OF GREENHOUSE GAS EMISSIONS

CARBON DIOXIDE EMISSIONS . In 2000, the CO_2 emissions in Belgium reached 127 040 Gg (excluding sinks), a 7.7 % rise compared with 1990. The manufacturing industry and construction are the primary source of CO_2 in Belgium (26%), followed by the residential and commercial sector (22%), energy production and transformation (21%) and transport (19%). Of these major sources of CO_2, emissions from transport have increased most (+21,5%) over the past decade, following the rapid development of road traffic. On the whole, emissions from the energy sector and from the manufacturing industries and building have declined (by nearly 5%) from their 1990 levels as a result of improved energy efficiency and the more widespread use of gas for the production of electricity.

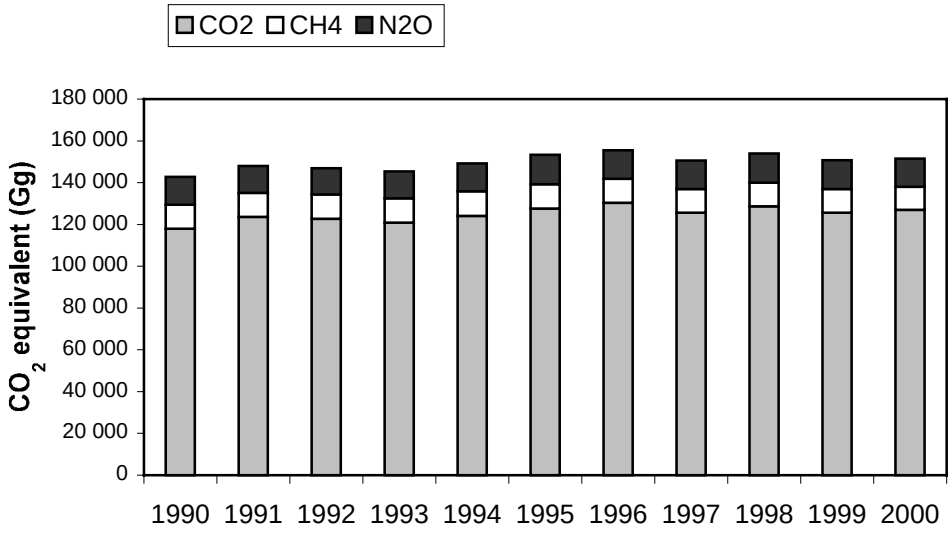


Figure 1-1. Emissions of the three main greenhouse gases in Belgium, 1990-2000.

METHANE EMISSIONS - In Belgium, CH_4 emissions come essentially from agriculture (63%), waste (26%) and from the fugitive emissions from fuels (8%) ; there are large regional disparities. The CH_4 emissions have dropped significantly over the past years, particularly as a result of improved waste management techniques, to 523.6 Gg in 2000 (-4.9% in comparison with 1990).

NITROUS OXIDE EMISSIONS - N_2O emissions (43.29 Gg in 2000) have increased slightly (+1,5%) since 1990. In the Walloon and Flemish regions, agriculture (denitrification in soils) and industrial processes (production of manure nitrogen) are the two major sources of N_2O. In Brussels, the N_2O emissions are caused primarily by combustion processes related to residential heating, transport (combustion engines) and waste incineration.

FLUORINATED GASES – Emissions of fluorinated gas (HFCs, PFCs, SF_6) have increased substantially since 1995, thus reflecting the current regulations governing ODS substitution, particularly for refrigeration and the manufacture of synthetic foams. However, they only contribute marginally to the overall greenhouse gas emissions in Belgium.

OVERALL DEVELOPMENTS IN GREENHOUSE GAS EMISSIONS - Total greenhouse gas emissions in Belgium are estimated at 152,365 Gg CO_2 eq. for the year 2000, that is a 6.3% increase over 1990 emissions (1995 for fluorinated gases). 83.4% of these emissions come from carbon dioxide (CO_2), 7.2% from methane (CH_4), 8.8% from nitrous oxide (N_2O) and 0.6% from the new gases (HFCs, PFCs, SF_6). This distribution has changed little over a ten-year period. Changes in greenhouse gas emissions in Belgium correlate with emissions of CO_2. Over 75% of greenhouse gas emissions in Belgium are related to the consumption of energy in Belgium. The share of industrial processes, agriculture and waste treatment is 10.2%, 9.2% and 3.2% respectively of overall emissions. Absorption by sinks (less than 1%) doesn't compensate for overall emissions at all.

1.4. POLICIES AND MEASURES

The general framework for drafting policies and measures to curb greenhouse gas emissions in Belgium is a set of master plans, established by the federal and regional authorities, laying down the political objectives as well as the strategies to achieve these objectives. At the federal level, the *Federal Plan for Sustainable Development 2000-2004*, which was prepared pursuant to the Act of 5 May 1997 relating to the coordination of the federal sustainable development policy and adopted by the federal Government on 20 July 2000, is the general framework for the policies to be pursued at the federal level to achieve the sustainable development objectives. It lays down the political action in the field of climate change in

the section dealing with « energy, transport, ozone and climate change ». Its main features are the rational use of energy, the promotion of renewables, the management of energy supply and demand, technological developments, product policy, energy taxation, the promotion of sustainable mobility (control of increasing mobility needs), making travelling safer, modal shift). The Federal Plan to Combat Acidification and Ozone (31 May 2000) as well as the *National Climate Plan* that is currently being prepared, fit in with these goals.

The regions prepare their own master plans and action programmes. In the Flemish Region, the main features of the environment policy are laid down in a five-year plan, the *Environment Policy Plan 1997-2001* (MiNa-plan 2). This plan provides for a number of climate change initiatives, including the implementation of the "*CO_2 – Rational Use of Energy Plan"*[4], the development of measures designed to reduce CH_4, N_2O, HFC and PFC emissions, and prospecting for potential carbon sinks. In addition, the C*limate Policy Plan of the Flemish Region*, scheduled for adoption in the course of 2002, is currently being drafted.

The Walloon Government adopted the *Climate Change Action Plan of the Walloon Region* (19 July 2001). This plan is part of a larger programme to combat air pollution (« *Plan de l'Air »*).

In the Brussels Capital Region, various aspects of climate policy are treated in the context of the *Regional Development Plan* (a master programme designed to favour the rational management of resources and the reduction of nuisance), the *Mobility Plan* (IRIS Plan), which aims at stabilising by 2005 the number of car journeys during the morning rush hour to the 1991 level, and the *Programme to structurally improve air quality* (« Plan Air »), which comprises a series of measures related to the demand for energy, especially in buildings.

There are synergies between these different plans and programmes of the federal Government and the three regions. All the above measures combined make up the *National Climate Plan* that is currently in preparation. The main actions that are implemented (or have been adopted) to reduce the greenhouse gas emissions in the various sectors are listed below by sector :

Energy

- liberalisation of the electricity market: a system of « green certificates » assures an increasingly larger proportion of electricity produced by renewable energy sources; this system goes in tandem with a guaranteed price policy, and the eligibility of producers and consumers of « green » electricity to have access to the liberalised segment of the electricity market.
- Investment support: investments designed to improve energy efficiency, to increase the use of renewable sources of energy or cogeneration, and to promote the rational use of energy are encouraged by tax deductions or subsidies granted to companies and/or individuals.
- Voluntary agreements: the public authorities introduce a system of voluntary agreements for energy-intensive industries in order to optimise energy efficiency in these sectors.

These measures are complemented by a series of provisions, in particular about energy pricing, energy audits, insulation standards for buildings, the promotion of renewable energy sources, new infrastructures (notably wind power plants).

TRANSPORT

In the transport sector, the actions undertaken by the federal and regional authorities focus basically on checking the growth of car traffic and on pushing for a « modal shift » (towards rail and waterway) :

- Better public transport systems: improvements in infrastructure, more frequent services, better connections and integration of ticketing (train, tram, bus, metro) and, improved personal security, passenger information systems, etc.

[4] « CO2-REG beleidsplan »

- Promotion of alternative means of transport: a series of – mainly tax – measures aimed at encouraging people to use public transport, car-pooling, bicycling or walking for everyday journeys; business transport plans.
- Large infrastructure works: multiannual railway investment plan (capacity extension, improving rolling stock, works for high speed passenger train (« TGV ») network, enhancing mobility in Brussels) ; improving the transport infrastructure around the port of Antwerp (new multimodal platform, better access through additional railway track); *Regional Express Network* in the Brussels area.
- Reduction of pollution from vehicles: taxation according to the performance of vehicles in terms of pollution.

INDUSTRY

The measures aimed at reducing the industrial non-energy-related greenhouse gas emissions are part of the regulations governing environmental permits (restriction of the use of fluorinated gases, introduction of novel technologies, etc..), of the voluntary agreements negotiated between the regional authorities and the industrial federations (iron, steel, chemistry, paper). Both instruments aim at implementing the *Best Available Technology* (BAT).

AGRICULTURE AND FORESTRY

The actions undertaken in the agricultural sector focus primarily on reducing the factors of production (establishing new land application standards of animal manure, limiting the growth of the livestock population) and on improving farming practices (treatment, storage and spreading of manure, recovery of waste, combating soil degradation, etc..). Reforestation and forest conservation are encouraged through a system of grants. Research projects on the use of wood as a source of energy and on carbon sequestration are also being conducted.

WASTE

The policies pursued to reduce the volume of wastes and to optimise their treatment are based on environmental taxation (favouring re-usable packagings), on tightening regulations (ban on landfill, compulsory treatment of landfill gases, standards for incinerators) and on the development of specific channels for treating and recovering waste materials.

1.5. PROJECTIONS

The medium-term projections (2010) of greenhouse gas emissions in Belgium indicate that the reduction target laid down in the Kyoto Protocol and in the EU burden-sharing agreement (-7.5%) cannot be met with current measures and not even with the fiscal and non-fiscal measures currently envisaged (Table 1-1, Figure 1-2).

Table 1-1. Total emissions and sequestration of greenhouse gases in the medium term (2010) (excluding bunker fuels)

	Historical emissions		**With measures**			**With additional measures**		
	1990	1995	2000	2005	2010	2000	2005	2010
CO2	118,3	125,1	131,1	136,0	140,0	131,1	128,8	126,2
CH4	14,1	13,2	12,3	11,4	10,5	12,3	11,4	10,5
N2O	12,1	12,6	13,2	13,7	14,3	13,2	13,7	14,3
HFC, PFC, SF6		0,538	1,3	1,7	2,6	1,3	1,7	2,6
Sinks	-2,1	-2,5	-2,3	-2,2	-2,0	-2,3	-2,2	-2,0
Total (CO2 eq.)	**142,5**	**149,1**	**155,6**	**160,6**	**165,3**	**155,6**	**153,5**	**151,5**
Trend index	**100,0**	**104,6**	**109,2**	**112,7**	**116,0**	**109,2**	**107,7**	**106,4**

Sources: Federal Planning Bureau, Econotec, VITO, Perrin *et al*.

As a matter of fact, the scenario 'with additional measures' (fiscal[5] and non-fiscal) shows an overall increase in greenhouse gas emissions by 6.4% from the 1990 level by 2010 (without such additional measures they would grow by 16%). Consequently, there is a gap of 13.9% between the emissions estimated for 2010 in the 'with additional measures' scenario and the Kyoto objective. This gap can only be closed in two ways : either by adopting new measures that are implemented promptly for their effects to be felt during the first commitment period of the Kyoto Protocol (2008-2012) or by heavily relying on the flexibility mechanisms. The level of a CO_2/energy tax that would be required to meet the Kyoto target was estimated by using the Markal optimisation model : this tax should not be less than EUR 20,5 (90) / ton CO_2. It should be noted, however, that these figures are based on economic growth estimates that do not take account of the current economic decline. The inclusion of these parameters would substantially fill the gap between the projections and the Kyoto objective.

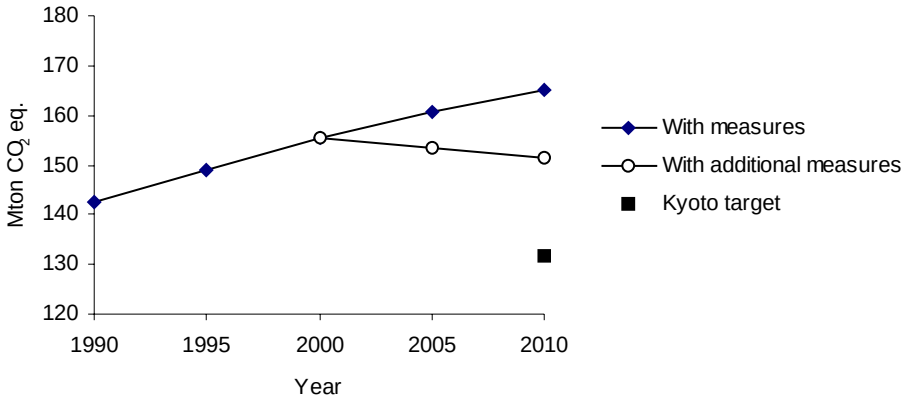


Figure 1-2. Projections of total greenhouse gas emissions for the medium term (2010)
Source: Federal Planning Bureau, Econotec

1.6. VULNERABILITY ASSESSMENT, IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

Projected climate changes are expected to have only a limited effect in Belgium due to the stable socio-economic situation and the flexibility of the sectors involved. However, some caution is required because not much information is available and because of the uncertainties surrounding the scale of the expected changes to the climate. The hydrological regimes and the coastal area appear to be most vulnerable to climate change (changes in water flow and water reserves). If appropriate adaptation measures are taken in the coastal area, the impact may be minimal. Moreover, agriculture, public health and tourism are sectors that could face consequences of climate change. The main effects will become apparent under extreme conditions (increase in storminess, heavy rainfall and flooding, periods of extremely high temperatures, soil water stress, etc.). It is essential that these effects be taken into account early in order to be able to develop appropriate adaptation policies.

1.7. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

As a whole, the Belgian Official Development Assistance (ODA) disbursements for the year 2000 amounted to BEF 35.528 billion, representing 0.36 % of GDP. This percentage, which is already 20 % higher than the previous year is expected to increase further in 2001. The Directorate General for International Cooperation (DGIC) of the Ministry of Foreign Affairs is in charge of over 68 % of these

[5] carbon tax of 1.3 EUR(90)/ton CO2 from 2002 onwards, slowly increased to the level of 11.5 EUR(90)/ton CO_2 in 2010

resources, the rest being shared by other federal ministries, the regional governments, provinces and municipalities.

Multilateral aid mainly consists in the contribution to the successive replenishments of the *Global Environment Facility* (GEF). Belgium also substantially contributes to the *Multilateral Fund under the Montreal Protocol*, as well as to the *Special Programme for Africa* through the *International Fund for Agricultural Development* (IFAD) and to the Core Budget of the *Convention to Combat Desertification* (CCD).

In the bilateral aid programmes, climate change issues are mainly dealt with through initiatives of Belgian universities and scientific institutions, supported by federal and/or regional authorities. Furthermore, most bilateral aid programmes of both the Federal Government and the Regional Governments always include aspects of technology transfer and capacity building, through training segments, either in the developing country itself, in Belgium or both.

1.8. RESEARCH AND SYSTEMATIC OBSERVATION

Research activities cover the climate system and the effects of climate change, the socio-economic aspects as well as technological aspects (energy). Belgian scientists notably participate actively in the following international research programmes:

- EC 5th R&D Framework Programme
- International Geosphere and Biosphere Programme (IGBP)
- World Climate Research Programme (WCRP)
- IGBP/International Human Dimensions Programme (IHDP)
- European Ice Sheet Modelling Initiative (EISMINT)
- European Project for Ice Coring in Antarctica (EPICA)
- Consortium for Ocean Drilling (ECOD)
- European Network of Earth system Modelling (ENES)
- Network for the Detection of Stratospheric Change (NDSC)
- several International Space Programmes, in the context of ESA, ECMWF,...
- several projects of the International Energy Agency (IEA), etc.

Furthermore, Belgian experts participate in international expert panels, assessment and integration activities, such as:

- the Intergovernmental Panel on Climate Change (IPCC);
- the Scientific Assessment Panel on Ozone Depletion;
- the European Ozone Research Co-ordination Unit (EORCU).

The federal Government's climate change research mainly takes place in the framework of the *Scientific support plan for a sustainable development policy* (PODO/PADD). One third of the total budget of EUR 57.88 million for the second stage of this plan (PODO/PADD II, 2000-2005) has been earmarked for research activities as support to implementation of the Climate Change Convention. Within the framework of a cooperation agreement, the Regions and the Communities take part in the definition of research priorities of this plan.

In addition, the Regions make available large sums for R&D projects that focus on some specific priorities:

- In the field of energy, the Walloon Region allocated EUR 8.676 million in 1999 to R&D projects in the area of energy conservation, the production and distribution of electricity and renewable sources of energy. Cogeneration and novel energy technologies are among their priorities. Moreover, a series of scientific studies that are directly linked with the implementation of policies and measures have been conducted over the past few years (carbon sequestration potential of forest ecosystems, estimation of air pollution emissions from agriculture, projections of GHG emissions).
- The R&D budget of the Flemish Region earmarked for research into energy was EUR 14 million in 1999, essentially for energy conservation, renewable energy sources, and demonstration projects. In addition, the Flemish Government funds research related to decision-making support through

its *Policy Oriented Research* (PBO[6]) programme, initiated in 1997. This programme covers climate-related research aimed at finding solutions to specific questions in the following political domains : economy, agriculture and environment.

- The Brussels Capital Region focuses on research into transport and into methodologies relating to the calculation of energy balances and emission inventories.

1.9. EDUCATION, TRAINING AND PUBLIC AWARENESS

Education, training and public awareness-raising are among the priority areas in the *Federal Plan for Sustainable Development*, which aims at generating support for the measures in the field of energy consumption control and at changing consumer behaviour through the dissemination of information. In the field of transport, the *Plan* stresses the promotion of cultural models favouring public transport and the alternative means of transport (biking and walking) through awareness-raising campaigns. These priorities are also reflected in the *Climate Change Action Plan*[7] of the Walloon Region as well as in the Flemish Region's *Environmental Policy Plan*[8].

Environmental education has been recognised as a priority mission of schools. Accordingly, a number of initiatives have been taken by the three language Communities (which are responsible for education) in order to integrate climate change problems into school curricula. They have also developed educational projects relating to such environmental topics as air, water, energy, mobility and waste, both inside and outside school settings, have published educational materials and set up websites. Climate change problems are increasingly being discussed in colleges and universities.

Various other initiatives have been targeted to other groups, notably teachers and some categories of professionals in order to inform them about new rules and regulations, particularly on insulation and residential heating.

Some awareness-raising campaigns intended for the public at large have also been launched, notably a large public survey on the occasion of the publication of the *Federal Plan for Sustainable Development* ; EUR 50 000 was granted to some 20 NGOs to set up awareness-raising actions during the survey. Various campaigns have been conducted in the newspapers and on radio and television on such topics as the rational use of energy and renewables and there were some special « events » (week of mobility, of energy, ,...) targeted at the general public.

Finally, new sources of information have been made available to the public and to professionals regarding climate issues, energy and transport so as to enable the dissemination of information on as large a scale as possible and to assist both individuals and businesses to take action.

[6] Programma Beleidsgericht Onderzoek
[7] Plan d'action de la Région wallonne en matière de changements climatiques
[8] MiNa-plan 1997-2001

2. NATIONAL CIRCUMSTANCES

Box 2-1. A brief overview of Belgium	
Regime	constitutional monarchy
Head of State	HM King Albert II
Surface area	32,545 km2
Population	10,239,085 inhabitants (1/1/2000)
Density of the population	315 inhabitants per km²
National languages	French, Dutch and German
Federal Capital	Brussels
Principal urban areas (thousands inhab.):	Brussels: 959.3
	Antwerp: 932.1
	Liège: 585.7
	Ghent: 495.4
Greatest distance between two points	280 km
Highest Point	the 'Signal de Botrange' (694 m)
Average temperature	11.2 degrees Celsius (2000)
Precipitation	852 mm (annual average - 2000)
Hours of sunshine	1.392 hours (annual average -2000)
GDP (2000, at current market prices)	BEF 9,924 billion; EUR 246.0 billion
Annual growth rate (1999)	2.7 %
Currency	From the 1st January 1999, the Belgian franc has been replaced by the Euro as the official currency in Belgium:
	1 Euro (EUR) = 40.3399 Belgian francs (BEF).
Weights and measures	the metric system

2.1. INSTITUTIONAL PROFILE

2.1.1. BELGIUM, A FEDERAL STATE

Belgium is a constitutional monarchy that, as the result of four successive revisions of the Constitution (in 1970, 1980, 1988-89 and 1993), has become a Federal state (Figure 2-1) composed of three communities (the Flemish Community, the Wallonia-Brussels Community, the German-speaking Community) and three regions (the Flemish Region, the Walloon Region and the Region of Brussels-Capital). The communities correspond to population groupings, based on their language (Dutch, French and German, all three recognised as official languages) and their cultural identity. The regions are defined on a territorial basis. Brussels is the capital of Belgium, of the Flemish Region, and of Brussels-Capital Region. Namur is the capital of the Walloon Region. The Flemish Region and the Flemish Community have fused into a single entity (the Flemish Community) which has a single parliament, a single administration and a single budget. The power to make decisions is shared between the Federal State, the Communities and the Regions, who take action on an even footing, but are distinguished by their spheres of competence.

The **Federal State** is responsible for justice (including the Federal police), social security (including pensions), finance, foreign policy, national defence, certain areas of the economy such as the prices and incomes policy, together with an important part of the public health, internal affairs, co-operation for development. The Federal State is also responsible for everything that does not expressly come under the authority of Communities and the Regions. Finally, the Federal State assumes all Belgium's responsibilities and those of its federated entities with regard to the European Union, NATO and the UN.

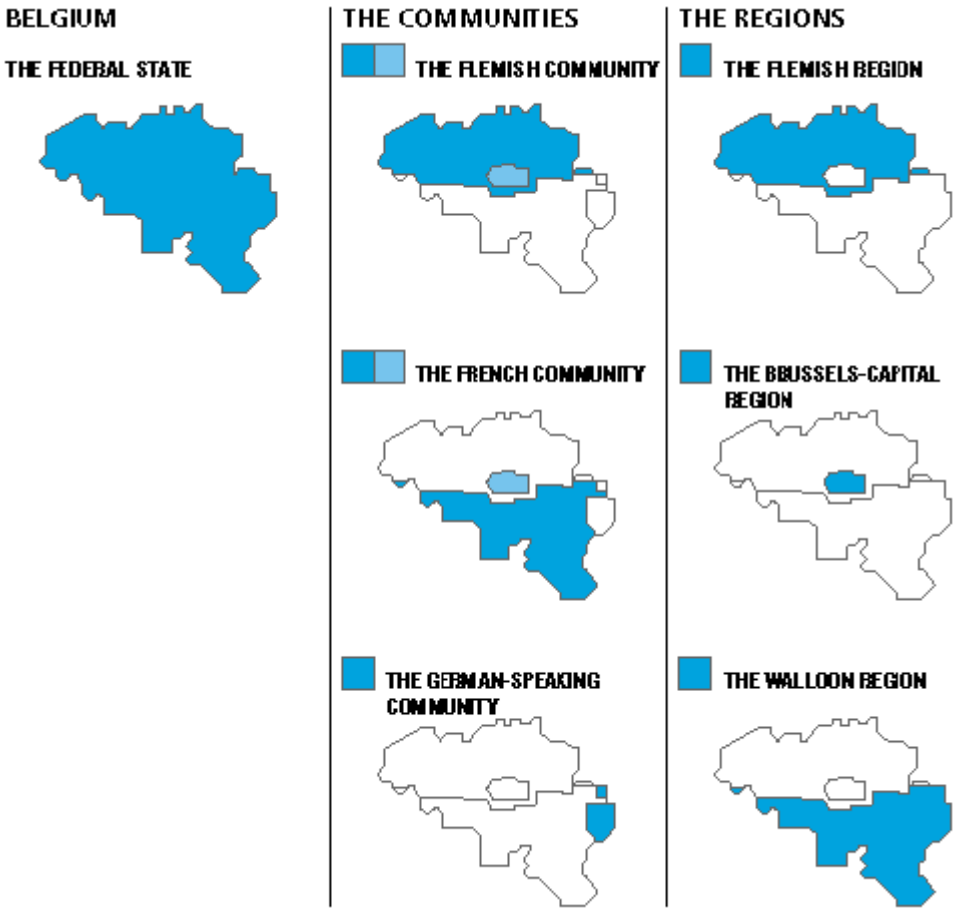


Figure 2-1. Belgium, a federal State : 3 Communities, 3 Regions

The **Communities** are responsible for education, cultural affairs, the use of languages and matters regarded as “personnalisable”. These include on the one hand, the health policy (preventive and curative medicine) and, on the other hand, services that help people (child protection, social workers, family assistance, the reception of immigrants, etc.). The Communities are also responsible for scientific research and international relations in the areas that come under their authority.

The **Regions** have authority in areas that affect the occupation of the "land" in the broad sense of the term. Their principal responsibilities concern the economic sphere. Thus, the Flemish Region, Brussels-Capital Region and the Walloon Region exercise their authority over economic development, employment, agriculture, water policy, housing, energy, public works and transport (with the exception of the railways), the environment, town and country planning, rural revitalisation, nature conservation, credit, foreign trade, provincial, municipal and inter-municipal administration. They are also responsible for scientific research and international relations in the above-mentioned areas.

The lower administrative rung is occupied by the **Provinces**. They must act in deference to the Federal, Community or Regional authorities and are subordinate to all the higher authorities. At the bottom of the edifice are found the **Municipalities**, which are the seat of power closest to the citizen. They too, like the Provinces, have to give way to higher authorities. According to the powers exercised, they are answerable to either the Federal State, the Community, or the Region. They are financed and controlled mainly by the Regions.

2.1.2. INSTITUTIONAL STRUCTURE RELATING TO THE ENVIRONMENTAL AND CLIMATE POLICY

2.1.2.1. Division of powers

The legal power for environmental policy goes back essentially to the regions. They determine their own objectives, establish the appropriate policies and measures and ensure that they are enforced. However, the Federal Government remains responsible for matters which, for technical or economic reasons, require being treated uniformly at the national level. This division of authority is summarised in Table 2-1, for matters relating to the environemnental policy, as well as for other matters having a direct link with the action policy in the area of climate change (energy, transport, town and country planning, education and public awarenes).

2.1.2.2. Consultation and co-ordination structures

Different structures have been developed in order to promote consultation and co-operation between the Federal State and the federated entities. Sixteen so-called interministerial conferences each relating to a particular policy area were set up to this end. The interministerial conferences are specialised committees on which are seated the ministers concerned from the different governments. The *Interministerial Conference for the Environment* (ICE) is composed of the State Secretary or the Federal Minister of the Environment, the environment ministers of each of the three Regions (Brussels-Capital, Flanders and Wallonia) and the Federal Minister for Science Policy. The Federal State Secretary for Energy and Sustainable Development, a function created under the current Government, is also a member.

The ICE is devoted to matters for which intergovernmental co-operation is required for implementing environmental polices. It has a central role to play in the climate policy. The ICE decisions are prepared and executed by different working parties, answerable to the *Co-ordination Committee for International Environmental Policy* (CCIEP), and on which are seated representatives of the various departments of the federal and regional public administrations involved. The CCIEP is the principal organ for co-ordinating international environmental policy, with the exception of matters relating to the European environmental policy, which is under the responsibility of the “European Affairs” department of the Federal Ministry of Foreign Affairs. The ICE and the CCIEP operate according to the principle of consensus, which rules out unilateral decisions.

The principal structure in relation to climate policy is the *Greenhouse effect co-ordination Group*. This is subordinate to the CCIEP regarding international matters, and to the ICE for the internal affairs. This structure is illustrated by Figure 2-2. The mission of the Greenhouse effect co-ordination Group consists in providing consultation and encouraging collaboration between the federal, regional and community institutions involved in the climate policy, with the objective of fulfilling Belgium’s national and international obligations. Regarding international matters, the Greenhouse effect co-ordination Group plays the role of national focal point for the United Nations Framework Convention on Climate Change.

Box 2-2. Legislative context

The Belgian Constitution provides, in article 23, “the right to the protection of a healthy environment” to people living within its borders.
Article 130 of the treaty founding the European Economic Community itself provides that the policy of the Community in the area of the environment contributes to the pursuit of the following objectives:

- preserving, protecting and improving of the quality of the environment;
- protecting human health;
- the prudent and rational utilisation of natural resources;
- promoting measures at international level to deal with regional or world-wide environmental problems

Community policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.

Table 2-1. Division of authority for the matters related to climate change policy

Environment	
Federal State:	Establishment of product standards Protection against ionising radiation Management of radioactive waste Waste transit Marine environmental protection Co-ordination of the international environmental policy
Regions:	Environmental protection (air, water, the ground, the lower layers of the ground) Waste management Legislation on dangerous or harmful installations Water policy Nature and hunting conservation Forest management
Provinces and Municipalities:	Operation permits / environmental permits Compliance with environmental legislation (police)
Energy	
Federal State:	Guidelines for the means of electricity production (Regulates and collaborates with the Energy Adm.) Cycling of nuclear fuels Major infrastructure for the storage, transport and production of energy Tariffs
Regions:	Local distribution and transport of electricity (≤70000 volts) Public distribution of gas Long distance heat distribution networks New sources of energy (with the exception of nuclear energy) Energy recovery The rational use of energy The use of firedamp, of gas from blast furnaces and putting slag heaps to good use
Municipalities:	Local distribution of electricity and gas
Public works and transport	
Federal State:	National airport Railways Regulating the traffic Taxes on vehicles and fuels Fixing the technical standards for vehicles
Regions:	Construction and maintenance of highway infrastructure Seaports, piloting, waterways Regional airports Urban and regional public transport School transport Taxis
Municipalities:	Urban network Traffic rules (police) Mobility plans
Town and country planning	
Regions:	Town and country planning Industrial estates and areas
Education, training and public awareness	
Federal, Regions, Provinces, Municipalities	Training and public awareness in the areas that are part of their respective competence
Communities:	Education Medias

As such, it relays information from the Convention secretariat, and communicates to them the pertinent national information to do with the Convention. The co-ordinating group ensures that Belgium's reporting obligations in accordance with articles 4 and 12 of the Convention are honoured. It is notably responsible for the preparation, drafting and co-ordination of national communications. Likewise, it guarantees that article 3 (Inventory and communication of data) of the Decision of the Council of the European Union regarding a monitoring mechanism of Community CO_2 and other greenhouse gas emissions (1999/296/EC) is implemented. The Greenhouse effect co-ordination Group is also given the task of preparing the positions that are taken by the Belgian delegations in the international environmental institutions, whenever matters associated with climate change are debated there.

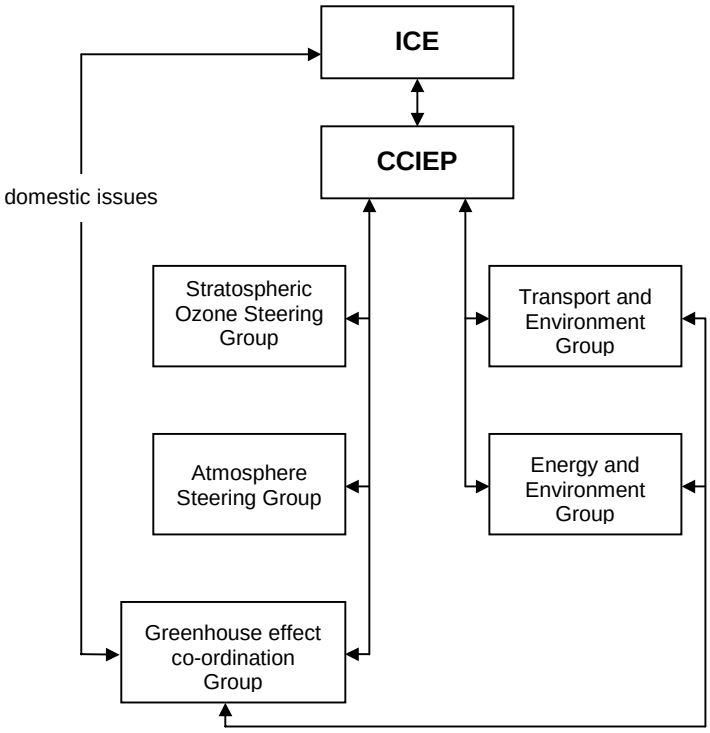


Figure 2-2. Diagram of the different decision and coordination bodies involved in climate policy

Another important mechanism of co-ordination is the Interregional Cell for the Environment (IRCEL/CELINE). This permanent structure is essentially responsible for providing the management of networks of atmospheric measurements, the collection of regional data, and for maintaining a common scientific base regarding the recording and interpretation of data and the preparation of reports on atmospheric pollution. The regions are furthermore obliged to consult employers' and trade union organisations and environmental groups about all proposed environmental policies. This consultation is inter alia performed via the regional environmental advisory councils. A council has also been created at federal level in 1993 (the Federal Council for Sustainable Development).

These various structures ensure the coherence of action of the Belgian State and its components in the environmental area, in particular regarding climate matters. They secure active Belgian participation in the international arena (particularly within the European Union), while acknowledging the principle of subsidiarity that requires that decisions and measures affecting the management of activities are taken at the appropriate administrative level and also at a level as near as possible to the citizens. However it is advisable to note that these institutions, plus the fact that the context of the policy action in environmental and climate matters is to a great extent constrained by supra-national decisions (in particular European Community legislation), may limit the individual governments' room for manoeuvre regarding the choice of policies to be implemented. For example, a regional government may not raise a tax on a product by itself, but must get this measure adopted at the national level. This government may therefore favour the choice of another type of instrument, possibly less efficient, but whose

implementation will not be subject to the agreement of the other governments. These institutional constraints have to be taken into consideration in evaluating the choice of action policy undertaken by the different federated entities of the Belgian State.

2.2. DEMOGRAPHIC PROFILE

On 1 January 2000, the official number of inhabitants of Belgium was 10,239,085. The population density is 315 inhabitants per km² (this makes Belgium the 3rd most densely populated country in the OECD, after the Netherlands and Korea, and equal with Japan). The Flemish Region numbers 5.9 million inhabitants, and has a population density of 434 inhab./km². The Walloon Region has 3.3 million inhabitants (196 inhab./km²), and Brussels-Capital Region has a little less than 1 million. Belgium contains 15 urban conglomerations of more than 80 000 inhabitants, where 53% of the population and 63% of the employment are concentrated. The country is further characterised by a large number of quasi-urban conglomerations dispersed in the rural area. The 5 largest cities of the country (Brussels, Antwerp, Ghent, Liège and Charleroi) make up the core of more extensive conurbations, each exceeding a million inhabitants. The extension of urban areas has partly been caused by the growing demand for building land, resulting from the population growth, the reduction in size of families and the increased standard of living.

The average rate of annual population growth is 1.8 per thousand, resulting from a weak natural increase and a positive balance of immigration. The structure of the population is presented in Figure 2-3. Over the last decade, the average life expectancy in Belgium has increased by two months per year, to reach 74.6 for men, and 81.1 for women (over the last century, 30 years have been gained). The demographic perspectives for the coming decades are a relative stabilisation of the total population, but also a significant ageing of the population. Thus, the proportion of people aged over 60 years will rise to 23.5% in 2010 and 31.7% in 2050. The recent evolution also shows that the share of people living alone is constantly growing. Large families continue to dwindle in number. Nevertheless, 7.3 % of all private households continue to be made up of 5 or more people.

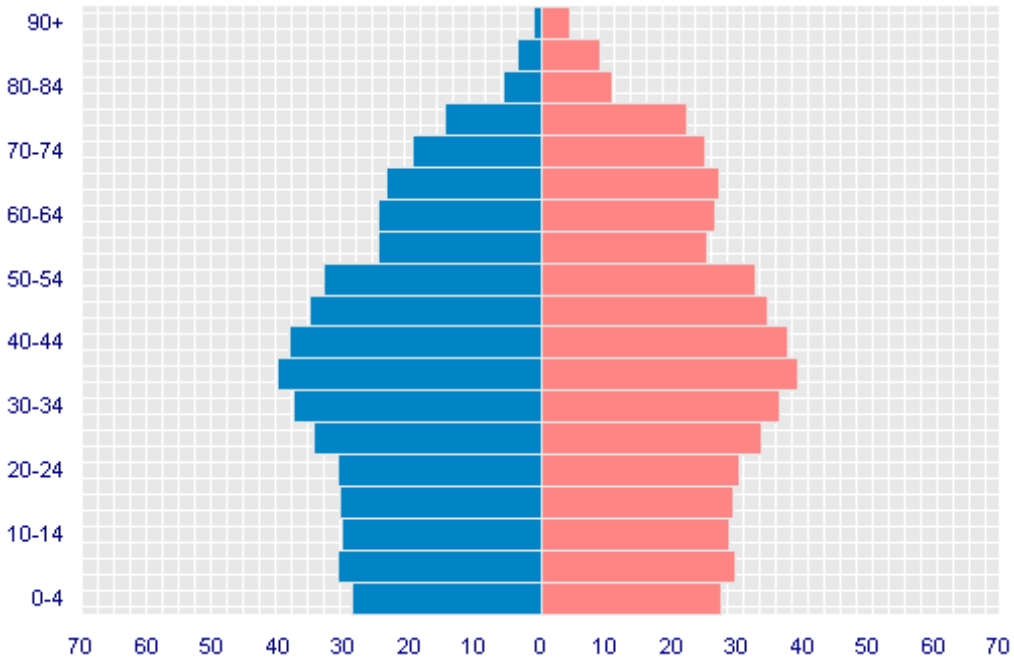


Figure 2-3. Structure of the population, per 5 years age categories, for 1 000 inhabitants (1 January 2000)

2.3. GEOGRAPHIC PROFILE

Belgium is situated on the south-east side of the North Sea, in the north-west of Europe, along a line extending from England to the North of Italy, densely populated and very developed since the Middle Ages. Its territory extends to 2 degrees in latitude, (49°30' to 51°30') and to less than 4 degrees in longitude (2°33' to 6°24'). It is bounded by frontiers with the Netherlands, Germany, Luxembourg, France, and the maritime frontier with the North Sea (Figure 2-4), and covers a surface area of 32,545 km^2. The detail of the surface areas per region is presented in Table 2-2. Almost the entire country is situated in the valleys of 2 rivers: the Scheldt and the Meuse, which take their source in France and flow along a north-east axis towards the Dutch frontier.

Figure 2-4. Map of Belgium

Table 2-2. Surface area of the Kingdom of Belgium and regions (2001)

	Surface area in km²
Belgium [(a)]	32,545
Brussels-Capital Region	162
Flemish Region [(a)]	13,522
Walloon Region	16,844
- of which the German-speaking Community accounts for	854
North Sea	2,017

(a) on 29 May 2000, 2,000 m² have been added to Belgium; the Netherlands have ceded Belgium a strip of land along the Ghent-Terneuzen canal at Zelzate.

Source: National Geographical Institute.

Geographically, three zones may be distinguished:

- lower Belgium (less than 100 m in altitude) which extends from the flat and fertile polders in the west to the sandy, poor soils of Campine in the east;
- middle Belgium (from 100 to 200 m) which rises progressively towards the valleys of the Sambre and the Meuse and whose clayey low plateaux constitute the most fertile land in Belgium; this part of the country holds the strongly urbanised areas around Brussels;
- upper Belgium (from 200 to above 500 m), which starts at the south of the Sambre and Meuse fold with fertile plateaux and extends to the Famenne, the Fagnes and the Ardennes, regions less favourable to agriculture where plateaux and heavily wooded deep valleys succeed one another; this part of the country is the least densely populated.

The highest point in the country is 694 m, at the 'Signal de Botrange'.

The land-use is divided as follows (Figure 2-5): permanent meadows and cultivation (29%), arable ground (29%), forests (20.1%), other (33%). The built-up area occupies 17% of the country. Belgium is cut by a very dense network of roads (144 000 km, including 1 727 km of motorways), railways (3 400 km) and navigable waterways (2 000 km) which connect the principal rivers with Antwerp, 4th largest port in the world.

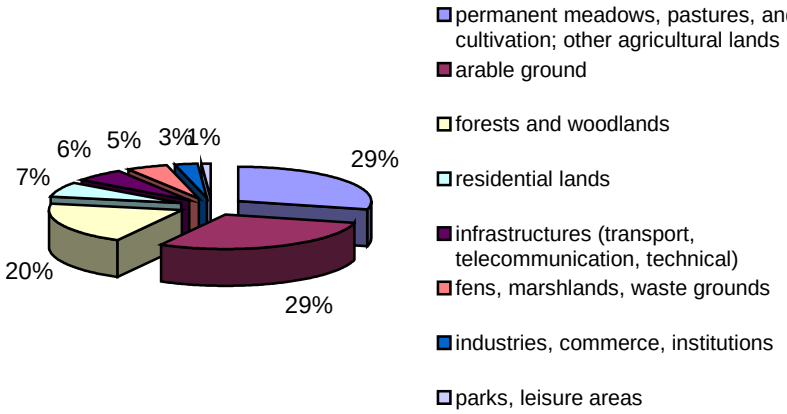


Figure 2-5. Land use in Belgium (1998)

Source : NIS calculations, based on data from Ministry of Finance (land register) and NIS (agricultural census)

Despite the small size of the country and the gentle topographical gradient, the climatic and geological conditions have generated different ecosystems: the Atlantic (dunes, moors, marshes, peat bogs, meadows, deciduous forests), southern (chalky meadows, small woods, forests) and northern (peat bogs, deciduous forests) may be distinguished. Urbanisation and fragmentation continue to exert great pressure on these systems throughout the country. Between 1 January 1990 and 1 January 2000, the built-up surface area in Belgium increased by 23%. The total surface area of plots that have been built on increased by 43,137 ha in Flanders (+24%) and 20,420 ha in Wallonia (+21%). During this decade, the country's wooded area decreased from 609,744 ha to 607,192 ha. In Flanders, 1,095 ha of wood have been lost, against 1,464 ha in Wallonia. Proportionally, the amount lost is greater (-1.0%) in Flanders than in Wallonia (-0.3%).

Belgium has few mineral resources, except its coal reserves. Mineral (coal) mining, formerly a major industrial activity, has been suspended. Only a very small quantity of gas is currently extracted.

2.4. CLIMATE PROFILE

Belgium enjoys a temperate oceanic climate characterised by moderate temperatures. The prevailing wind blows from the west, it is quite cloudy and it rains frequently and regularly. The average annual precipitation is 782 mm; the end of winter and the start of spring are the driest period of the year, while the strongest precipitation is observed in autumn in the coastal region and in winter on the peaks of the Ardennes. The primary meteorological data are presented in Table 2-3. The five warmest years since the beginning of the observations in Brussels (Uccle) in 1833 took place between 1989[9] and 2001. Moreover, last years were characterised by intense precipitations. Annual precipitation for the year 2001 is the highest ever recorded since regular observations starded in 1833.

Table 2-3. Primary meteorological data (1997-2000)

Variables measured	Normal Values
Length of hours of sunshine (in hours)	1,555
Average real temperature (0-24h)	9.8°C
Average maximum temperature	13.5°C
Average minimum temperature	6.3°C
Total precipitation (in mm)	780
Number of days of precipitation (rain >= 0.1 mm)	203
Number of days of frost (min < 0°C)	52.6
Number of days of winter (max < 0°C)	9.9
Number of days of summer (max >= 25°C)	21.3
Number of days of heatwave (max >= 30°C)	3.3

Readings taken at Uccle (Brussels).
Source: Royal Meteorological Institute.

2.5. ECONOMIC AND SOCIAL PROFILE

2.5.1. MACRO-ECONOMIC CONDITIONS

In recent years, Belgium has experienced sustained economic growth. In 2000, the GDP rose to BEF 9,924 billion (measured at current market prices). The GDP per inhabitant is approximately 10% higher than the OECD or EU averages. The distribution of the GDP per branch of activity is presented in Table 2-4. The retail services sector contributes nearly 50% to the GDP and manufacturing industry 20.8% (Figure 2-6). Agriculture (including forestry, hunting and fishing) contributes 1.8 % only.

The policy of budgetary restriction pursued over the last decade, strengthened during the end of the period of the convergence programme, has borne fruit. Belgium currently has a balanced budget, the ratio of the national debt to the GDP is rapidly decreasing, inflation is under control, and the interest rates are converging towards the levels of the neighbouring countries. The reduction in the national debt, accompanied by a noticeable reduction in the interest rates, has enabled a considerable reduction in the size of the interest payments on the State deficit.

The performance of Belgian foreign trade denotes strong competitiveness: the proportion of goods exported in the final analysis is one of the highest in the world, and the balance of trade is positive. Parts of the market have however been eroded in recent years. This is connected with the relatively restrained part of “high-tech” exports play in total exports, and with the emergence of new industrial economies. The development of Belgium’s fundamental macro-economic data is summarised in Table 2-5.

[9] 1989 constitutes the warmest year of the century, with an average annual temperature of 11,3°C

Table 2-4. Distribution by industrial sector of the GDP and employment (1999)

	Share of the GDP[(1)] (%)	Share of employment (%)
Primary sector (agriculture and fishing)	1.8	2.1
Mining industry	0.1	0.1
Manufacturing industry	20.8	16.9
- food, tobacco	2.5	2.5
- textile industry and clothing	1.5	1.5
- paper and card, publishing and printing	1.5	1.3
- chemical industries	3.8	1.8
- non-metallic mineral products	1.0	0.9
- Metallurgy, machines and equipment	4.5	3.8
Electricity, gas and water	3.2	0.7
Construction	4.8	6.0
Retail services	46.3	37.9
Total retail sector	77.0	63.7
Non-retail sector	23.0	36.3

(1) at 1995 prices

Source: Institute of National Accounts, National Bank of Belgium, OECD (taken from "OECD Economic Surveys, Belgium – 2001)

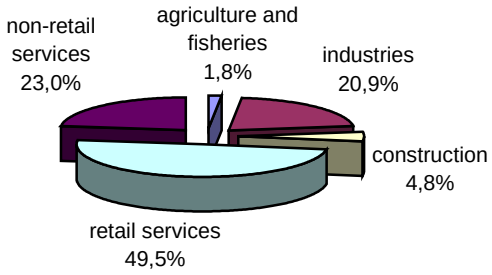


Figure 2-6. Gross domestic product per branch of activity (% of the total GDP – 1999)

Source : Institute of National Accounts, 2001

Table 2-5. Key figures of the economy (1996-2000)

Indicators	1996	1997	1998	1999	2000[(a)]
Evolution of the real gross domestic product	+1.2%	+3.4%	+2.4%	+2.7%	+4.0%
Growth of internal demand	+0.9%	+2.6%	+3.9%	+2.1%	+3.4%
Growth of net exports [(b)]	+0.3%	+0.9%	-1.2%	+0.7%	+0.8%
Inflation	+2.1%	+1.6%	+1.0%	+1.1%	+2.6%
State deficit (%GDP)	-3.8%	-1.9%	-0.9%	-0.7%	-0.1%
Employment rate [(c)]	56.4%	56.8%	57.5%	57.9%	58.8%
Unemployment rate [(d)]	9.7%	9.4%	9.5%	9.0%	8.5%

(a) Provisional figures (except inflation and unemployment rate).
(b) Contribution to the evolution of the GDP.
(c) As a % of the population of working age
(d) Standardised unemployment rate

Source: Institute of National Accounts and Ministry of Economic Affairs

2.5.2. EMPLOYMENT

The situation of the job market is scarcely satisfactory in Belgium (as generally within the EU), although it is improving. The Belgian job market remains characterised by a low rate of employment and a high unemployment rate (Table 2-6) by comparison with the United States and Japan. Despite a sustained increase in the employment rate during the 1990s, this rate remains lower than the European average. This results in a very low rate of employment in the 55-64-age band due to early retirement, a relatively low rate of employment among women, and a marked level of unemployment. In terms of unemployment rate, Belgium is in slightly better position than the European average. But the proportion of long-term unemployed is in contrast among the highest. This is connected with a high unemployment rate among very poorly qualified people (under the upper secondary school level). It is interesting to note however that, despite a high unemployment rate in Belgium, the proportion of the population that lives below the poverty line (defined as half the average disposable income) remains limited. This is due to a distinctive feature of the Belgian economy, which is the marked redistribution due to the tax system and the transfer systems. Consequently, the disposable income appears to be relatively well distributed.

Table 2-6. Employment and unemployment in Belgium (2000)

	Men	Women
Rate of employment of people aged from 15 to 64 years[(1)]	69.5%	51.5%
Unemployment rate compared with the working population [(2)]	7.9%	12.9%

[(1)] Source: NIS (National Institute of Statistics), Workforce survey.
[(2)] Source: RVA/ONEM (National Employment Office).

The biggest source of employment in Belgium is the tertiary sector, which in total occupies nearly 75% of the workers, spread almost evenly between the retail and non retail services (Table 2-4, Figure 2-6). Employment in the farming sector has dropped markedly in recent decades (-52% in 1999 compared to 1970), and now only occupies 2.1% of the workforce. The industrial sector has also undergone a net decrease in employment (-38% over the period 1970-1999), while in the same time the tertiary sector has seen the number of employees increase by nearly 46%.

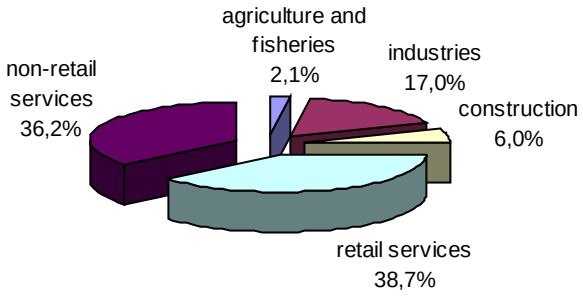


Figure 2-7. Employment per activity sector (% of the total employment)
Source : OECD, 2001

2.5.3. HUMAN DEVELOPMENT

The standard of living in Belgium is high, as shown the 5th place in the world ranking of the UNDP "human development index" (report 2001). This high standard of living results from a convergence of favourable factors, especially in terms of the economy, health and education. Some indicators of standards of living are listed in Table 2-7.

Table 2-7. Indicators of living standards (year 1998)

Private consumption per inhabitant (USD) [1]	12738
Passenger vehicles (per 1000 inhab.)	449
Adult population (25-59 years) who have achieved at least the upper secondary level of education (%)[3]	60.2
Internet hosts (per 1000 inhab.) [2][3]	30
Television (per 1000 inhab.)	340
Doctors (per 1000 inhab.)	3.6
Hospital beds (per 100 000 inhab.) [4]	744
Infant mortality (per 1000 births) [4]	7

[1] based on current parities of purchasing power
[2] defined as any computers with an Internet address
[3] 1999 data
[4] 1995 data

Source: OECD Economic Surveys - Belgium (2001), Eurostat Yearbook 2001

2.6. PROFILE BY SECTOR

2.6.1. ENERGY

2.6.1.1. Structure of production and consumption of energy

In 1999, Belgium's apparent gross consumption of primary energy rose to 57.4 MTOE[10], i.e. approximately 5.62 TOE per inhabitant[11]. This level is higher than the consumption per inhabitant in neighbouring countries, above the European average. Nearly 80% of Belgium's energy needs are met by the import of fossil fuels (Fig. 2-8) (45.9 MTOE in 1999). This was made up of 7.4 MTOE of coal, 23.4 MTOE of oil (crude and petroleum products), and 15.0 MTOE of gas. In 1999, the primary production of energy, 95% of which was derived from nuclear fuels (whose use provided 58% of the electricity produced), amounted to 11.5 MTOE. Although the hydroelectric potential is vigorously exploited in Belgium, its share in the production of energy remains negligible given the topography of the country. Although the hydroelectric potential is largely exploited in Belgium, its share in the production of energy remains negligible given the topography of the country. The production of wind energy is also very limited, due to the lack of open spaces exposed to the wind which greatly constrains the potential for the development of on-shore wind energy.

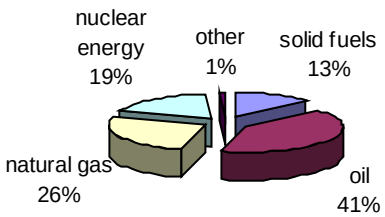


Figure 2-8. Consumption of primary energy, per energy source (1999)

Source : Energy statistics (MEA – Energy Administration)

[10] million tonnes of oil equivalent
[11] source : Ministry of Economic Affairs – Energy Administration

Nevertheless, wind energy from offshore wind farms, could contribute significantly to the objective of 3% for the production of electricity from renewable energy sources in 2004. The use of other renewable sources of energy, in particular biomass, which is currently insignificant, could overall represent at least 5% of the primary energy production, assuming regional objectives are met.

The industrial sector remains the largest overall consumer of energy in Belgium (Figure 2-9), ahead of the residential sector and transport. However it is in this last sector that the most spectacular increase has been recorded over last 20 years (+62%). During the same period, the iron and steel industry alone has experienced a reduction of 25.8% in its overall energy consumption while the industrial sector as a whole saw its overall consumption decrease by 8.1%. Structural and technological changes have undeniably played a dominant role in this evolution. At the same time, the overall consumption of the residential sector has remained relatively stable.

The recent evolution of the energy market in Belgium is furthermore marked by a very strong reduction in the consumption of solid fuels, mainly on the part of industry (cokes, iron and steel). The primary consumption of gas is increasing sharply, especially because of a stronger demand for electricity generation.

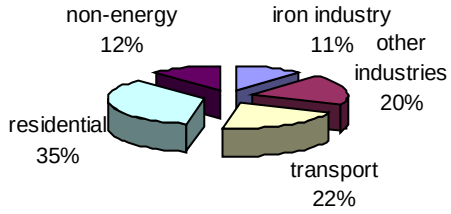


Figure 2-9. Final energy consumption : distribution per sectors (1999)
Source : Energy statistics (MEA – Energy Administration)

2.6.1.2. Energy Intensity

The intensity of primary energy (the relationship between primary energy consumption and GDP), decreased strongly between 1980 and 1990, as the result of major structural changes in industry. This improvement in energy efficiency is due to the high energy price . This trend has slightly decreased since 1990. Various factors have influenced the evolution of energy intensity. The relative contribution of energy-intensive activities to the GDP is evidently a predominant feature. Two other elements that have affected this evolution are the growth in demand for transport, and changes in climatic conditions, which have a direct impact on the consumption for heating. Since 1996 however, energy intensity is again decreasing, indicating a decoupling of economic growth and energy consumption.

2.6.1.3. The price of energy

The price of energy for the industrial sector is relatively low in Belgium. This is partly due to the fact that in Belgium the industrial consumption of gas and electricity is not subject to taxation. Moreover, the prices (without tax) of electricity, and particularly of natural gas, are lower than the EU average. The price of natural gas is of course directly influenced by the price of oil products on the world market, but Belgium benefits from a strategic position at the centre of a natural gas transport network. In contrast, households pay a relatively high price for their consumption of electricity, plus heavy taxes on gas and electricity[12]. Before the liberalisation of the markets, energy prices in Belgium were established through

[12] Benchmarking study, Federal Planning Bureau

negotiations within the Gas and Electricity controlling Committee. They are strongly linked to the production structure and to the price of transforming sources of primary energy.

2.6.1.4. Liberalisation of the energy market

The federal law regarding the operation of the electricity market, adopted on 29 April 1999, establishes the basis for the transposition of the European Directive 96/92/CE of 19 December 1996 concerning common rules for the internal market in electricity. The objective of this directive is to establish common rules for the production, transmission and distribution of electricity. Following the Directive, the electricity market has to gradually become open to competition: 25% in 1999, 28% in 2000, 33% in 2003 (Belgium has already reached the threshold laid down for 2003). Since the new federal law came into force, all consumers of more than 100 GWh are eligible to participate in the opening of the electricity market in Belgium. The Belgian Government has decided to accelerate the process of liberalisation: the meeting of the Interministerial Conference for the Economy and Energy of 5 May 2000 decided that clients whose consumption exceeded 10 GWh would be eligible by 31 December 2002 at the latest.

Given the structure of Belgian institutions, the Regions also have to take the legal steps to transpose the European directive, in their areas of competence. The Regions are mainly involved in the areas of distribution and the promotion of renewable energy. The Flemish Parliament approved the decree regarding the liberalisation of the electricity market in the Flemish Region on 5 July 2000. The Walloon Government adopted its decree on the regional operation of the electricity market on 12 April 2001.

2.6.2. TRANSPORT

2.6.2.1. Structure of transport in Belgium

Belgium is provided with a very dense road (4.7 km/km²) and rail (112 m/km²) network. These densities of road and rail networks should be looked at in conjunction with the very high density of population in Belgium: Relative to the number of inhabitants the infrastructure is close to the European average.

The port of Antwerp is very important for Belgium. It is the second European seaport, and one of the 5 largest in the world. The port of Antwerp benefits from excellent connections to the hinterland and the large French and German industrial basins by waterway (1500 km of navigable routes). It has also been decided to strengthen the rail infrastructure giving access to the port of Antwerp.

Road transport is the means of transport the most generally used in Belgium, both for the transport of goods and passengers, generating severe traffic congestion. Even though congestion is lower than in the neighbouring countries, the number of road accident victims is very high, but is going down. Damages to the environment resulting from fuel use in road traffic are considerable.

Goods are transported, on average, over a longer distance by railway (125.3 km in 1998) than by navigable waterways (58.4 km), but the gap between these two modes of transport has lessened in recent years.

2.6.2.2. Transport of goods

In Belgium, more than 50% of the 'tonnes-kilometres' of freight transport by road is international. In 1997, the road hauliers transported 72% of the total tonnage of goods (Figure 2-10). The remainder was transported by rail (16%) or by navigable waterways (12%).

Crude or processed ore and construction materials represent 37% of the total tonnage of goods transported by road, while these same commodities, by way of comparison, make up less than 4% of the total tonnage of goods transported by railway.

Between 1992 and 1998, the volume of goods loaded and unloaded at Brussels National airport rose by 90%, to reach 600 000 tonnes, hoisting the airport to 5th place among European airports, for the traffic of goods. Liège airport also gained in importance (164000 tonnes loaded and unloaded in 1998). In 1998, 120 millions of tonnes of goods were loaded or unloaded at the port of Antwerp[13].

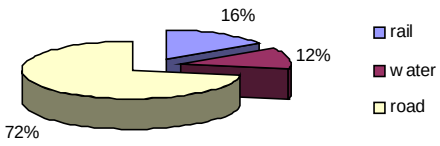


Figure 2-10. Transport of goods : major means of transport (1997)
Source : NIS

2.6.2.3. Passenger transport

Passenger transport in Belgium (as in the rest of the EU countries) is dominated by private transport (by motor car). In 1997, transport by motor car represented 88% of passenger transport, and the number of cars per 1000 inhabitants reached 430. The annual average number of kilometres was 14676 km in 1997[14].

The growth of the Brussels National airport has been strong since the start of the 1990s. Between 1992 and 1998, the number of passengers that embarked and disembarked at the airport has more than doubled. This growth is the strongest amongst the large European airport In 2000, the number of flights arriving at and departing from Brussels National rose to 326 050, for a total of 21 637 003 passengers[15].

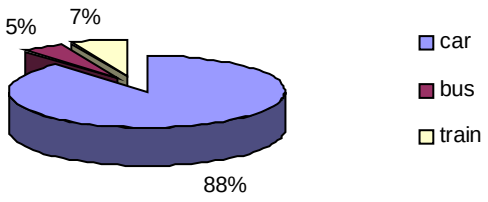


Figure 2-11. Structure of the passengers transport (% of the total trafic in passengers.km, 1997)
Source : NIS

2.6.3. INDUSTRY

The structure of the industrial sector has undergone profound changes over recent decades. The mining industries have practically disappeared with the closure of the last coal mines. The metallurgy and textile sectors have been relatively stable, after several waves of closures and restructuring. The metallurgy industry nevertheless remains one of the key sectors of Belgian industry, both in terms of employment and turnover (Table 2-8). The two other key sectors of industrial activity are the chemical industry and the food processing industry, which contribute respectively 3.8% and 2.5% to the GDP (Table 2-4).

[13] source: http://www.portofantwerp.be
[14] source: MCI
[15] source : Brussels Airport

Table 2-8. Turnover and volume of employment of the main industrial sectors (1998)

Sector	Turnover (billion BEF)	Employment [1]
Mining industries	28	3,448
Agricultural and food industries	1,101	102,473
Textile industry and clothing	377	58,612
Leather and shoe industry	13	2,668
Woodwork and manufacture of wooden articles	95	14,335
Paper and card industry; publishing and printing	356	52,373
Coking, refining and nuclear industries	347	5,464
Chemical industry	968	64,971
Rubber and plastics industry	273	28,991
Manufacture of other non metallic mineral products	266	35,681
Metallurgy and metalwork	813	103,253
Manufacture of machines and equipment	348	43,533
Manufacture of electrical and electronic equipment	380	52,933
Manufacture of transport equipment	687	62,776
Other manufacturing industries	197	33,058

[1] Includes all the salaried and self-employed workers of the company, with the exception of volunteer workers.

Source: NIS, Survey on company structure.

2.6.4. WASTE

The production of waste arising from the residential sector and from commercial activities ('municipal waste') amounted to 535 kg per inhabitant in 1999 (Table 2-9), 52% of which was not recycled. Manufacturing industry is the largest source of waste (13.8 Mt). The three regions have implemented waste management plans. The objectives and actions of the Flemish Region for waste are defined in the *MiNa [Flemish Environmental Policy Plan] plan 1997-2001*[16]. The *Wallonia waste plan 'Horizon 2010'*, adopted in 1998, contains a series of 70 actions targeted on the prevention, the recycling and the recovery of energy, and the elimination of waste. The *Waste Prevention and Management Plan in Brussels-Capital Region 1998-2002* also subscribes to this double strategy of waste prevention and recovery.

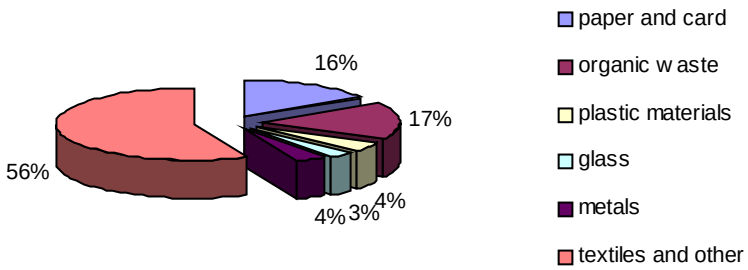


Figure 2-12. Waste composition (1997)

Source : OECD, 1998

[16] Environment policy plan 1997-2001

In addition, a body (FOST Plus) has been created by the private sector to finance, co-ordinate and promote the selective collection, the sorting and recycling of household packaging waste. FOST Plus was created to enable industry to respond in a global and concrete way to the legislation on packaging and, more specifically, to the introduction of European Directive 94/62/EC of 20/12/1994, and the Co-operation Agreement between the Regions of 5/3/97 relating to the prevention and management of waste from household packaging.

The recovery of used materials is becoming a major industry in Belgium. This industry in total generates an annual turnover of BEF 41 billion. The recovery of recyclable metallic materials is the principal component. In 2000, it represented a turnover of BEF 20.2 billion. The recycling of paper brought in BEF 4 billion, that of textile BEF 2.5 billion, that of chemicals BEF 13.3 billion and that of construction materials BEF 0.9 billion. The recycling sector also creates plenty of employment: approximately 4,000 people make their living in it. The industries most intensive in manpower are: textile recycling, the recycling of paper and that of construction materials.

Table 2-9. Production, composition and recycling of waste (1999)

Production of municipal waste (1) (quantity in kg/inhabitant)	535
- of which non recycled household waste (quantity in kg/inhabitant) (2)	279
Waste from manufacturing industry (NACE D) (quantity in 1000 t)	13,800
Composition of municipal waste	
- paper and card	16%
- food and garden waste, etc.	17%
- plastic materials	4%
- glass	3%
- metals	4%
- textiles and other	56%
Proportion of recycled waste as a percentage of the apparent consumption	
- paper and card	38%
- glass	75%

(1) products from households, service and commercial companies
(2) Household waste incinerated or dumped. NIS estimate.

Source: OECD, EEA and NIS.

2.6.5. AGRICULTURE AND FORESTRY

2.6.5.1. Agriculture

The land used for agriculture extends to 1,394,083 hectares (Table 2-10), or 42.8% of Belgium. In 2000, the number of agricultural and horticultural businesses amounted to 61,926. This number had dropped by 15% in 5 years, especially in the wake of successive crises that have hit the agricultural sector (BSE [*Bovine Spongiform Encephalitis*], dioxin). Nevertheless the land area used for agricultural purposes remained identical during this period. Wallonia has 54% of the land used for agriculture, but 66% of agricultural businesses are situated in Flanders. The land area used for farming is on average 15 ha per farm in the Flemish Region and 35 ha per farm in the Walloon Region[17]. The main types of rearing and cultivation business and their numbers are represented in Table 2-10.

Organic farming and the businesses in transition towards this type of farming only represent 1% of the total. The evolution of the Belgian agricultural sector is of course directly related to the Common Agricultural Policy of the European Union.

[17] NIS data

Table 2-10. Agricultural and horticultural census (2000)

Number of agricultural and horticultural businesses	61,926
Size of agricultural land used (in ha)	1,394,083
Number of agricultural tractors	96,271
Permanent workforce	65,858
Non-permanent workforce	42,083
Animals (x 1,000):	
- Number of cattle	3,042 (of which milking cows: 594)
- Pigs	7,369
- Laying hens	12,396
- Poultry hens	24,498
Cultivated areas (in ha):	
- Grains (exc. maize)	277,703
- Sugar beet	90,858
- Maize	202,119
- Potatoes	63,979

Situation as of 15 May 2000.

Source: NIS, Agricultural statistics.

2.6.5.2. Forestry

Wooded surface area occupies 32% of the land area in the Walloon Region, 10.8% in the Flemish Region, and 15% in the Brussels-Capital Region. Coniferous species dominate forest cultivation in the Walloon Region, while deciduous trees predominate in the Flemish Region. The main species that make up Belgian forests are presented in Table 2-11.

Table 2-11. Forest resources and principal species in the Walloon and Flemish Regions

	Walloon Reg.	**Flemish Reg.**
Forested areas (% of the total land surface)	32%	10.8%
Deciduous trees (% of wooded surfaces)	52.3%	50%
of which:		
- oak	36.5%	20%
- beech	18.8%	14%
- poplar	-	30%
- various deciduous trees (alder, willow, noble deciduous trees)	44.7%	-
Resinous trees (% of the wooded surfaces)	47.7%	36%
of which:		
- spruce	75.8%	5.5%
- Pine (black pine, Scots pine)	9.1%	87%
- other	15.1%	-
Mixed cultivation (% of the wooded surfaces)	-	11%

Sources:

- Europe and the Forest - Volume 3 (European Parliament, Publications DG IV)
- Walloon environmental statement 2000
- Boskartering (*Woodland survey*)2000
- Bosinventaris (*Woodland inventory*)2000

In the Walloon Region, specialisation in forest management is leading to the conversion almost everywhere of small groups of trees into timber plantations. Coniferous plantations, generally are single species standard timber plantations. Standard timber plantations is also the rule in the Flemish Region for both coniferous plantations and deciduous trees.

The annual afforestation/reforestation campaign has grown in size considerably over recent years. In the Walloon Region, the areas planted with deciduous trees are increasing, as well as their ratio in the annual afforestation/reforestation effort. The regeneration of clumps of trees has, more than in the past, had the objective of diversification of the species according to the local ecology so that the tree chosen is best suited to the position that it occupies.

In the Flemish Region, multifunctionality and sustainability are two priority themes of forest management, as well as safeguarding the forest ecosystem.

2.6.6. THE INFORMATION AND COMMUNICATIONS TECHNOLOGY INDUSTRY (ICT)

Despite the growing place occupied by Information and Communications Technology in everyday life, the spread of these technologies is relatively slow in Belgium. The number of telephone lines, mobile phone subscriptions, computers, Internet servers and Internet users is lower than the average of neighbouring countries. On average, nearly 30% of the Belgian population had a computer at their disposal in 1999. For this same year, it is estimated that 10% of people aged over 15 years old had Internet access. This is lower than the European average. E-commerce is not well developed in Belgium, either in terms of value of the transactions or of their number. One of the reasons for Belgium's poor performance in these areas is the high cost of Internet access.

Mobile phones are the principal growth sector in the area of telecommunications. Between 1998 and 1999, the number of subscribers to a mobile phone service in Belgium practically doubled, reaching 30%. This number is constantly growing.

3. GREENHOUSE GAS INVENTORY INFORMATION

3.1. METHODOLOGY

In the Belgian federal context, the major part of environmental responsibilities lies with the Regions (see § 2.1.2). Compiling greenhouse gas inventories is one of these responsibilities. Each Region implements the necessary means to establish their own emission inventory in accordance with the FCCC guidelines for the common reporting format. The emission inventories of the three Regions are subsequently combined to form the national greenhouse gas emission inventory. Since 1982, the three Regions have been developing different methodologies (depending on various external factors) for compiling their atmospheric emission inventories. Obviously, this requires some coordination to ensure the consistency of the data and the establishment of the national inventory. This coordination is one of the permanent duties of the Working Group on « Emissions » of the *Co-ordination Committee for International Environmental Policy* (CCIEP). The *Interregional Environment Unit* (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three Regions and for compiling the national inventory to be submitted to the Conference of the Parties to the United Nations Framework Convention on Climate Change and to the EC, under the Council Decision 1999/296/EC of 26 April 1999 for a Monitoring Mechanism of Community CO_2 and other greenhouse gas emissions.

The methodologies used by the three Regions for compiling their greenhouse gas emission inventories from basic data are briefly described below.

In Flanders, the emission inventory is set up by the *Flemish Environment Agency* (VMM). The calculation of CO_2 emissions is made in collaboration with the *Flemish institute for technological research* (VITO). The emission inventory of the Flemish Region is since 1980 based on information about key contaminants and fuel use provided voluntarily by companies. Reporting by companies (mainly class I and class II industries, for emissions exceeding a given threshold value) has been compulsory since 1993. Concerning the classification of the sectors for the emission inventory, the NACE-code, accepted at the international level, is used. Since CORINAIR emission inventories came into force, SNAP codes are recorded in the emission inventory. As companies do not report greenhouse gas, CO_2 emissions are calculated on the basis of the energy balance, which is annually established by the VITO for the Flemish Region. This is based on available statistical data and models and on a survey among energy suppliers, federations and individual consumers. The methodology is described in the annual reporting document and is fine-tuned whenever necessary. Starting from this energy balance, the CO_2 emissions are calculated using CO_2 emission factors. These are the default IPCC emission factors from the Revised 1996 Guidelines, except for some special products (refinery gas, waste products). The other CO_2 emissions (non-energy consumption, waste incineration, and steel production) are also calculated using the IPCC methodology. Given that CO_2 sinks in Flanders are small compared to Belgium, no data on sinks are available so far. The CH_4 emissions in Flanders are calculated partly on the basis of the results of the emission inventory and partly estimated using statistical data in combination with emission factors. The calculation of the emissions from cattle breeding and waste disposal is based on the methodology developed by VITO. The N_2O emissions in Flanders are mainly calculated from statistical data combined with emission factors.

The emission inventories of the Walloon Region are compiled by the *General Directorate for natural resources and environment* (DGRNE) using the CORINAIR methodology (or IPCC for some sectors). In general, the CO_2 emissions are calculated by multiplying an activity variable by an emission factor. The Walloon handbook of energy statistics, published by the *Walloon Institute* on behalf of the *Directorate General for Technology, Research and Energy* (DGTRE) shows energy consumption by sector (in ktoe[18]) by fuel type) and is the main reference used for quantifying the « activities ». For process emissions, the activity is estimated on the basis of production volumes. The main emissions of CO_2, CH_4 and N_2O are

[18] kilo tonnes oil equivalent

calculated from the emission factors presented in the « Atmospheric Emission Inventory Guidebook » (EMEP/Corinair) as well as in other reference works (IPCC Guidelines, specific bibliographies), but for various sectors the Walloon Region has funded a number of research projects in order to specify the emission factors taking account of particular local conditions. It has been possible for various industries to determine a local emission factor using chimney emission measurements, particularly in the context of impact studies or sectoral agreements. A study was recently led in order to estimate CH_4 and N_2O emissions from agriculture. Figures relating to CO_2 sinks are calculated using the IPCC methodology on the basis of the data of the Walloon forests inventory and of various conversion factors of wood into biomass, then into carbon and into CO_2.

Since 1990, the Brussels Capital Region has had an air emissions inventory, which gives an annual value to each pollutant and each source for the whole Region. This regional inventory is based on the work carried out as part of the CORINAIR project of the *European Environment Agency* (EEA). It is compiled by the *Brussels Institute for Environmental Management* (IBGE-BIM). Basically, the detailed urban inventory combines the “top-down” and “bottom-up” approaches:

- for the energy-related atmospheric emissions (residential, transport, commercial / institutional, industry), emissions records from the regional-scale inventory are spatially and temporally distributed in a way to provide relevant information at the local scale (top-down)
- for emissions related to specific industrial processes, considered as major sources, field surveys are conducted; the annual overall value of the relevant sector for the whole Region is calculated by adding the emissions from the various industries listed in the detailed urban inventory (bottom-up approach).

Emissions of ozone-depleting substances which also act as greenhouse gas are estimated on the basis of the use of the different substances for each application, the export, and the rate of elimination, recuperation or recycling in Belgium. This methodology is based on the IPCC guidelines.

3.2. SUMMARY TABLES

The summary tables from the national GHG inventory are shown in the Annex A of this report. They are extracted from the most recent national inventory[19]. This inventory includes recalculated emission data for the years 1990 to 1999, what constitutes a major update on the inventories reported previously. It also contains a provisional estimate of the emissions by sources and absorptions by sinks for the year 2000.

The tables extracted from the national GHG inventory (*common reporting format*) presented in Annex A include:

- Tables 10s1, 10s2, 10s3: CO_2, CH_4, and N_2O emission trends (Gg), by sector, 1990-2000;
- Table 10s4: HFCs, PFCs, SF_6 emission trends (CO_2 eq., Gg), 1995-2000 (data not available for the years prior to 1995);
- Table 10s5: Emission trends (summary) by gas and by sector (CO_2 eq., Gg), 1990-2000;
- Emission trends of ozone precursors (NO_X, CO, NMVOCs) and SO_2 emissions (Gg), by sector, 1990-2000.

The figures shown in the annexes are commented hereafter (§ 3.3 – Descriptive summary). Emission trends for each GHG are discussed, as well as factors underlying these trends, both at national and regional levels.

[19] Annual inventory of GHG emissions in Belgium submitted to the European Commission in December 2001 in the context of Council Decision 1999/296/EC for a monitoring mechanism of Community CO2 and other greenhouse gas emissions

3.3. DESCRIPTIVE SUMMARY

Overall emissions of greenhouse gases in Belgium are estimated at 152365 Gg CO_2 eq. in 2000, i.e. a 6.3% increase relative to 1990 emissions (1995 for fluorinated gases) (Table 3-1, Figure 3-1). Carbon dioxide (CO_2) accounts for 83.4% of these emissions, methane (CH_4) for 7.2%, and nitrous oxide (N_2O) for 8,8%. F-gases (HFCs, PFCs, SF_6) account for 0.6% of total emissions. Absorption by sinks offers only a tiny compensation for these emissions (1,2%).

Table 3-1. GHG emission trends in Belgium (1990-2000)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1]
	CO_2 equivalent (Gg)										
Net CO_2 emissions/removals	116 366	121 971	120 896	119 011	122 139	125 736	128 478	123 712	126 762	123 816	125 217
CO_2 emissions (without LUCF)	117 966	123 571	122 714	120 887	124 072	127 647	130 367	125 579	128 607	125 639	127 040
CH_4	11 557	11 596	11 661	11 610	11 745	11 594	11 507	11 399	11 410	11 269	10 996
N_2O	13 218	12 891	12 592	12 851	13 441	14 068	13 640	13 548	13 881	13 822	13 422
HFCs						332	418	527	631	804	804
PFCs						0	0	0	0	0	0
SF_6						206	206	206	96	96	104
Total (net emissions/removals)	**141 141**	**146 457**	**145 149**	**143 472**	**147 326**	**151 937**	**154 249**	**149 392**	**152 779**	**149 807**	**150 542**
Total (without CO_2 from LUCF)	**142 741**	**148 057**	**146 967**	**145 348**	**149 259**	**153 848**	**156 138**	**151 259**	**154 624**	**151 630**	**152 365**

[1] data for 2000 are provisional

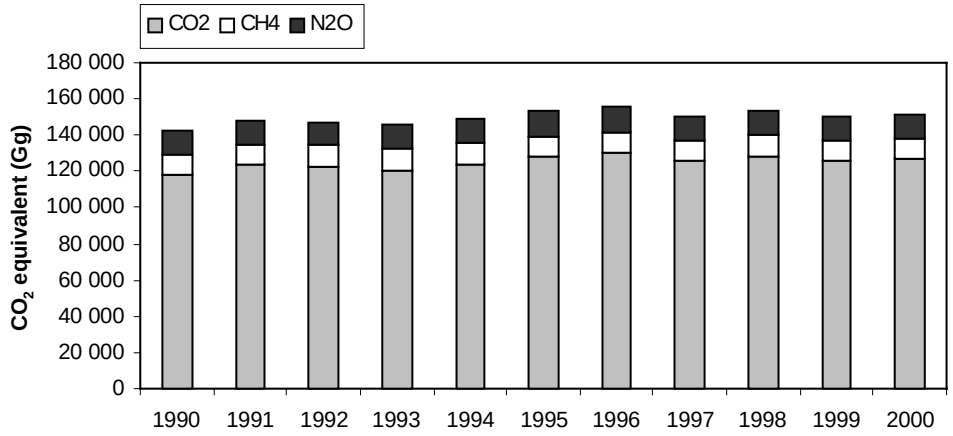


Figure 3-1. Emissions of the three main greenhouse gases in Belgium, 1990-2000
Source : National inventory of GHG emissions, 2002

Emissions of CO_2 and N_2O increased respecitvely 7.7% and 1.5% during 1999-2000, while CH_4 emissions have dropped 4.9% during the same period (Figure 3-2). Energy consumption is responsible for 77% of greenhouse gas emissions in Belgium (see Annex A, Table 10s5); Industrial processes, agriculture, waste treatment respectively account for 10.7%, 9.0% and 3.1% of the total emissions. The share of regional emissions in total national emissions of CO_2, CH_4, N_2O, as well as their trends in the period 1990-99, is given in Table 3-2.

Table 3-2. Trend in total emissions of CO_2, CH_4, N_2O in the three Regions in the period 1990-99 (Gg CO_2 eq)

	CO_2			CH_4			N_2O		
	1990	1999	% change	1990	1999	% change	1990	1999	% change
Flemish Region	67 873	74 920	+10.4%	7 741	7 842	+1.3%	7 606	8 257	+8.6%
Walloo²n Region	46 096	46 354	+0.6%	3 768	3 384	-10.2%	5 386	5 388	0.0%
Brussels-Capital Region	4 009	4 365	+8.9%	48	43	-10.0%	226	176	-22.1%

Source : Regional inventories of GHG emissions, 2001

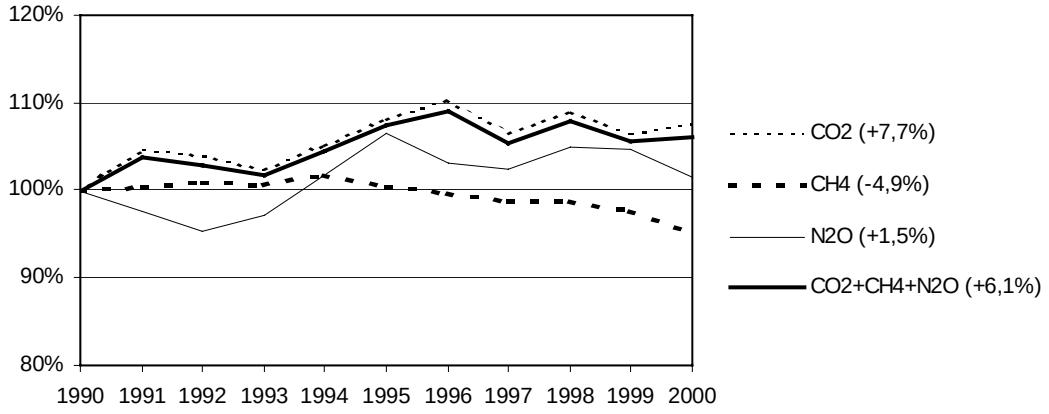


Figure 3-2. Emission trends of CO_2, CH_4, N_2O (% change vs. 1990)
Source : National inventory of GHG emissions, 2002

3.3.1. CARBON DIOXIDE EMISSIONS

The carbon dioxide (CO_2) emissions in Belgium increased 7.7% during 1999-2000 (Figure 3-2) to 127 040 Gg. In 2000, CO_2 accounted for 83.4% of total greenhouse gas emissions. This percentage has changed little over time (Figure 3-1). Accordingly, greenhouse gas emissions in Belgium are closely connected with the emissions of CO_2.

The sectoral distribution of CO_2 emissions and how they developed in Belgium and in the three Regions separately is shown in Figure 3-3. Industry and construction are the primary source of CO_2 in Belgium (26%), followed by the residential and commercial sector (22%), energy industries (21%) and transport (19%). Among the primary sources of CO_2, the emissions caused by transport have grown most rapidly (+21,5%) over the decade. This growth continues unabated at the end of this period. The emissions from the energy sector and from the manufacturing industries and construction have generally been on the decline since 1990 (-5%) as a result of improved energy efficiency and of the increased use of gas for the production of electricity.

The primary source of CO_2 emissions in the Flemish Region is the burning of fossil fuels: the energy industries alone generate 31% of overall emissions, followed by the residential and commercial sector (22%), transport (19%), and manufacturing industry and construction (18%). A smaller part is due to industrial processes (9%) and waste incineration (1%). In 1999, total CO_2 emissions in Flanders rose by 10.4% against the base year of 1990 (Table 3-2). The highest growths occurred in the transport sector (+2745 Gg), industrial processes (+2700 Gg), residential and commercial sector (+2391 Gg).

Industry is the main source of CO_2 emissions in the Walloon Region (37% in 1999). The other sectors contribute to a lesser extent: residential and commercial (19%), road transport (18%), industrial processes (15%) (basically cement and steel production), energy transformation (10%). The CO_2 emissions hardly changed in the Walloon Region between 1990 and 1999 (+0.6%), while the increase in emissions from road transport (+20.4%), industrial processes (+6.7%) and combustion in the domestic and tertiary sector (+2.7%) is compensated for by cuts in the energy industries (-28.8%), which is increasingly doing better. With nearly 4% of CO_2 emissions in the Walloon Region, forests are a clear carbon sink.

In the Brussels Capital Region, two thirds of CO_2 emissions are generated by combustion related to space heating (domestic/tertiary sector) (Figure 3-3) ; in general, these emissions have grown by 12% between 1990 and 1999. Obviously, these heating-related emissions strongly depend on temperatures, which may vary greatly from one year to another : the CO_2 emissions caused by the residential and commercial sectors, for example, reached a peak in 1996 (3375 Gg CO_2), a particularly cold year, and an all-time low in 1990 (2609 Gg CO_2), an extremely mild year. Transport causes 19% of CO_2 emissions in the Brussels Capital Region, followed by waste incineration (12%). The increase in transport-related emissions (+6,4% over 1990) is caused by the growth in traffic, estimated at 9.89% between 1990 and

1998[20]. Nevertheless, this growth is still smaller than in the other Regions (21% in Flanders and 26% in Wallonia).

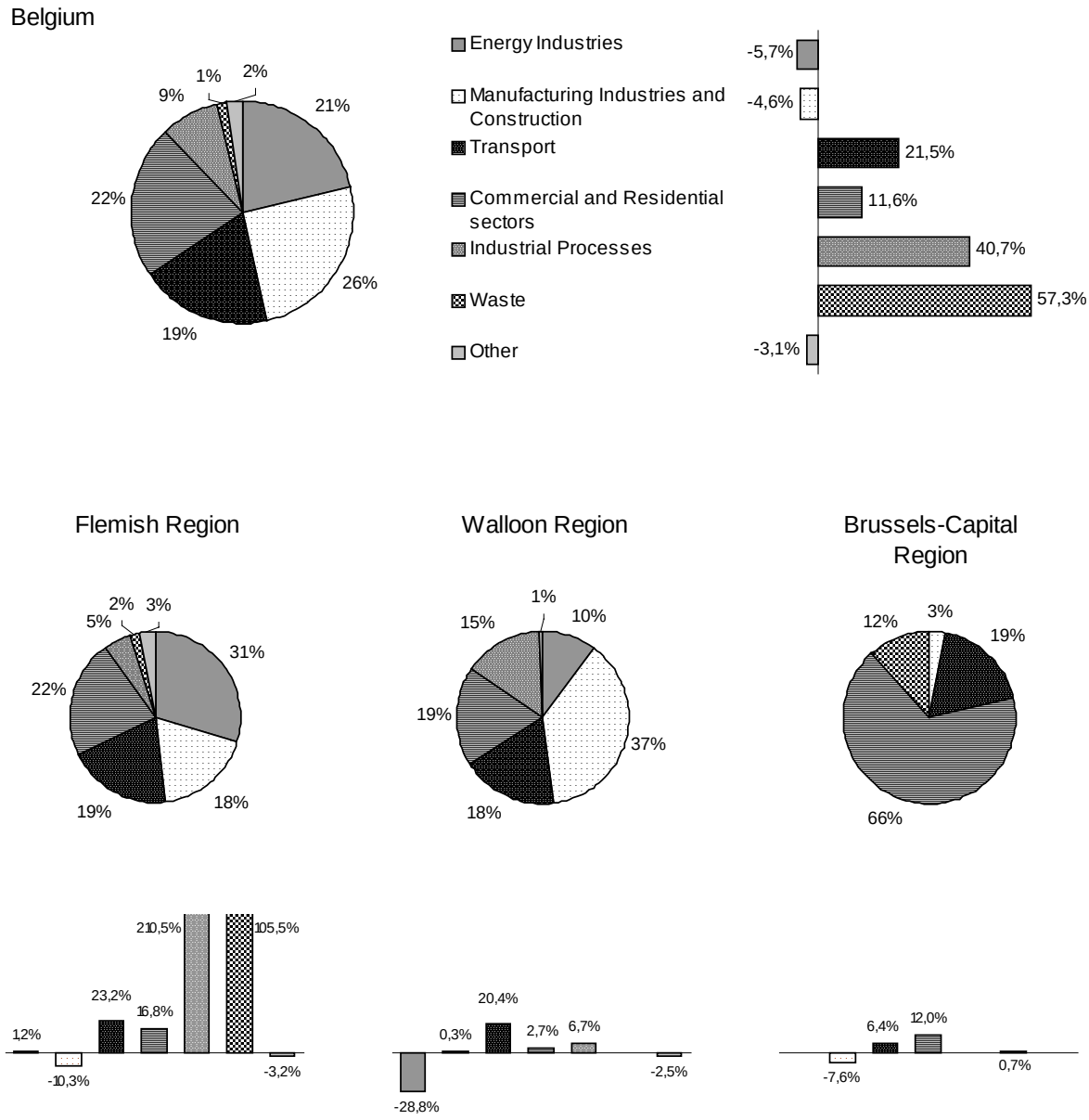


Figure 3-3. CO_2 emissions by source categories, in % of total CO2 emissions (1999) ; trend in CO_2 emissions, per sector, in the period 1990-1999

Source : National inventory of GHG emissions, 2002

[20] Source : Ministry of Communications and Infrastructure

3.3.2. METHANE EMISSIONS

Methane (CH_4) emissions have remained fairly stable during 1990-1996 (Figure 3-2) at about 550 Gg, and then have substantially decreased from 1996 to 2000 (-4.9% in comparison with 1990). In 2000, they accounted for 7.2% of greenhouse gas emissions in Belgium (Figure 3-1). The major source of CH_4 is agriculture (63%), followed by waste (26%) and fugitive fuel emissions (8%) (Figure 3-4). There are great variations among the Regions:

In the Flemish Region, the CH_4 emissions remained virtually stable between 1990 and 1999 (+1,3%). Agriculture is responsible for over 60% of emissions (Figure 3-4), followed by landfill waste (25%) and fugitive emissions (9%).

The majority of CH_4 emissions in the Walloon Region are also due to agriculture (enteric fermentation in livestock) (63%). Landfilled waste and waste treatment plants are the second source of these emissions (28%). The fugitive emissions from the transport of natural gas are responsible for 6% of the emissions. Overall CH_4 emissions have diminished by 10.2% (Table 3-2) between 1990 and 1999 as a result of the increased use of flaring.

In the Brussels Capital Region, fugitive emissions from fuels caused by the distribution of gas are the major part of the CH_4 emissions (70% in 1999) (Figure 3-4). These emissions rose by nearly 19% between 1990 and 1999, reflecting the developments of gas imports into the Brussels Capital region, which are mainly intended for space heating (domestic and tertiary sector). The other sources of CH_4 emissions in Brussels are energy consumption (high percentage of gas heating in the residential sector) and road transport, which in 1999 accounted for 17% and 11% respectively of total CH_4 emissions. These emissions have dropped sharply in the course of the decade, leading to an overall reduction of 10% of CH_4 emissions in Brussels between 1990 and 1999 (Table 3-2).

3.3.3. NITROUS OXIDE EMISSIONS

The nitrous oxide (N_2O) emissions account for 8.8% of total greenhouse gas emissions in Belgium (2000). They have slightly increased (+1.5%) between 1990 and 2000 (Figure 3-2). The two major sources of N_2O are agriculture (50%) and industrial processes (32%) (Figure 3-5). In the Walloon Region, the primary source of these emissions is agriculture, followed by emissions from industrial activities. The reverse applies to Flanders. In Brussels, the residential and commercial sector (heating) dominate the other sources of N_2O.

N_2O emissions in the Flemish Region increased during the 1990-1999 period (+8.6%). The production of nitric acid (42%), and nature and farming land (38 %) in particular, are responsible for these emissions. Although they have more than doubled in 10 years, N_2O emissions caused by transport accounted for only 5% of total N_2O emissions in Flanders in 1999.

In the Walloon Region, agriculture (denitrification and nitrification of nitrogen in the soil associated with the application of mineral and organic manure) is responsible for the large majority of the N_2O emissions (70%), followed by the industrial processes (21%) (chiefly the production of ammonia, nitric acid, and ammonia nitrate). Generally, the N_2O emissions remained stable between 1990 and 1999 (Table 3-2).

The most important sources of N_2O emissions in the Brussels Capital Region are the combustion processes for space heating (domestic and tertiary sector, 44%), transport (13%), and waste incineration (41%). The changes in N_2O emissions over the last decade have the following characteristics :

- A reduction in emissions between 1990 and 1993 as a result of diminished production by the *Marly* cokes plant and its closure and 1993 ;
- An increase in emissions starting in 1994 following the introduction of catalytic converters (the use of catalytic converters on all petrol-engine cars was made compulsory in Belgium in 1993); N_2O emissions from transport have more than tripled in 10 years.

On the whole, however, the N_2O emissions in the Brussels Capital Region have dropped 22% between 1990 and 1999 (Table 3-2).

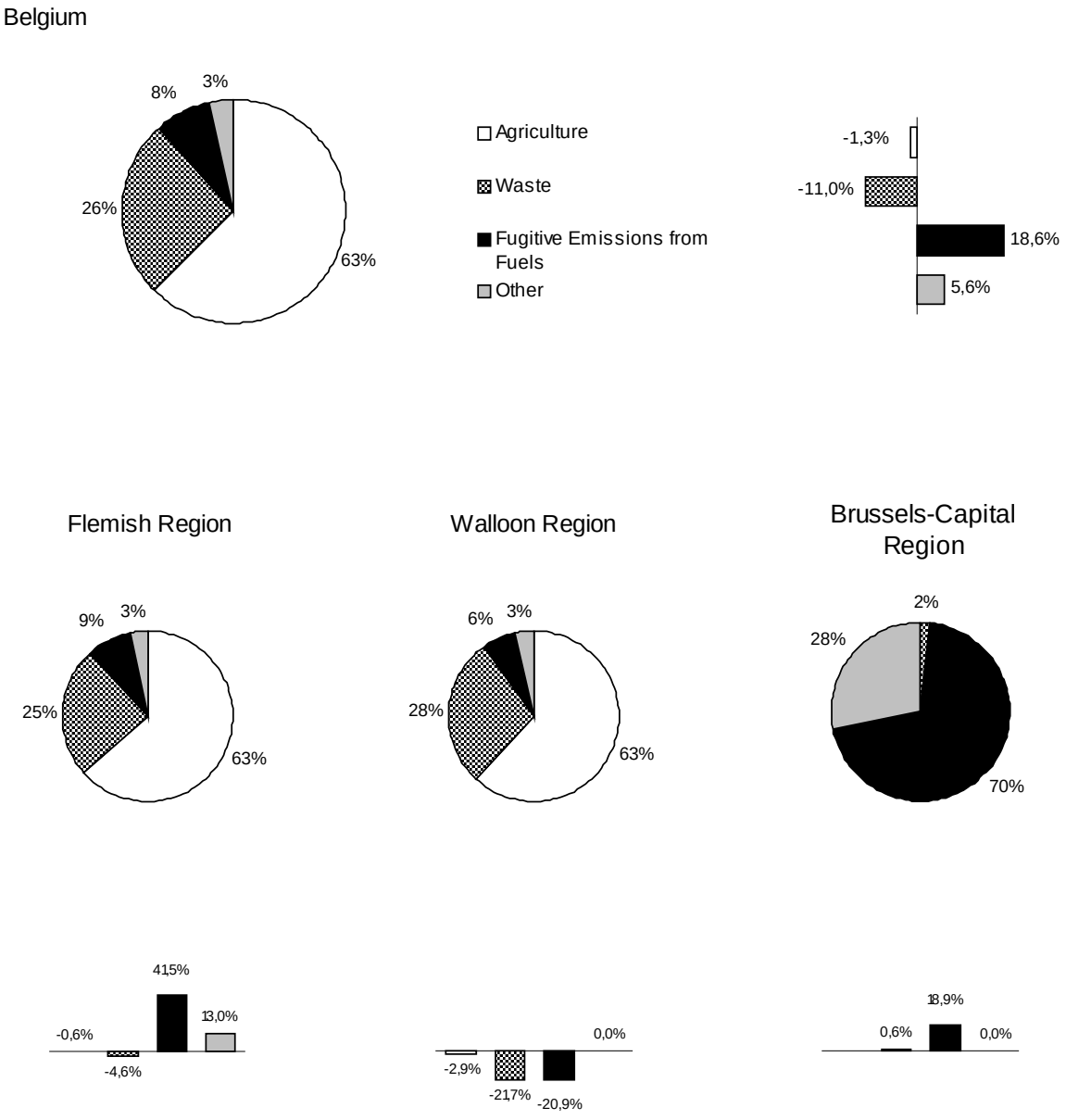


Figure 3-4. CH_4 emissions by source categories, in % of total CH4 emissions (1999) ; trend in CH_4 emissions, per sector, in the period 1990-1999
Source : National inventory of GHG emissions, 2002

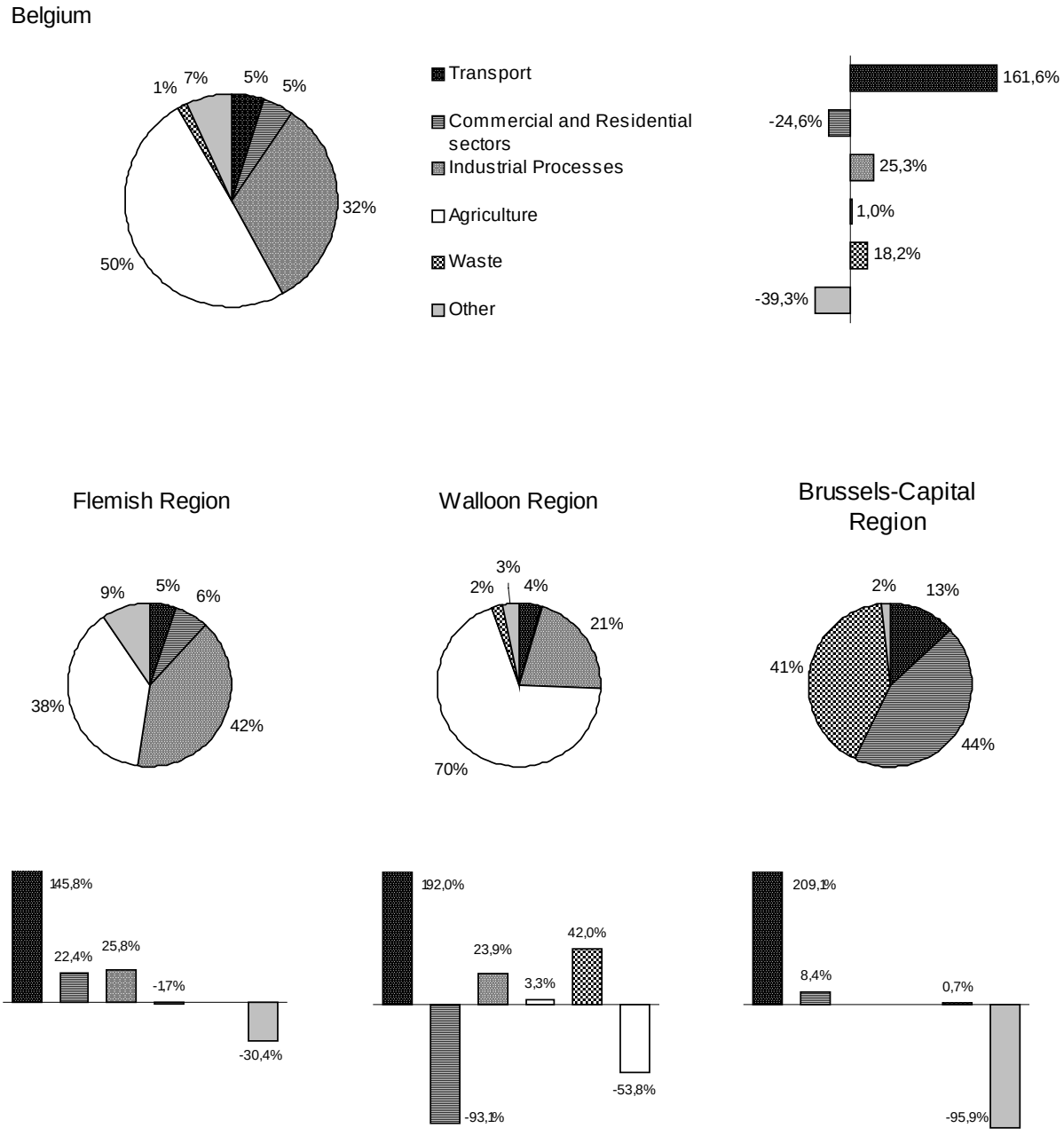


Figure 3-5. N_2O emissions by source categories, in % of total N_2O emissions (1999) ; trend in N_2O emissions, per sector, in the period 1990-1999

Source : National inventory of GHG emissions, 2002

3.3.4. AGGREGATE EMISSIONS OF THE THREE MAIN GHGS (CO_2, CH_4, N_2O)

The aggregate emissions of the three major greenhouse gases (CO_2, CH_4, N_2O), expressed in CO_2 equivalent terms (CH_4 and N_2O having a global warming potential that is respectively 21 times and 310 times as high as CO_2), have increased by 6.1% during 1990-2000 (Figure 3-2). The four most important emission sources are (Figure 3-6):

- Industry and construction (22%) ;
- Residential and commercial sector (19%) ;
- Energy industries (18%) ;
- Transport (16%).

Next come industrial processes and agriculture (10% and 9% respectively). Waste treatment generates 3 % of total emissions.

The sector that has shown the highest growth in GHG emissions in absolute terms over the last decade is the industrial (process) sector (+5,013 Gg CO_2 eq.), followed by transport (+4,889 Gg CO_2 eq.), and the residential and commercial sector (+2,155 Gg CO_2 eq.). Emissions from agriculture have nearly remained unchanged. By contrast, greenhouse gas emissions coming from energy transformation and from energy consumption by industry and construction have declined by roughly 6% during the same period (see para 3.1).

Total GHG emissions in the Flemish Region have risen by 9.4% between 1990 and 1999. This growth is due in the first place to changes in CO_2 emissions (+10,4%) and to a lesser extent to a rise in N_2O emissions (+8.6%) (see Table 3-2). CH_4 emissions have also slightly grown (+1.3%). Energy industries contribute 24% to the total GHG emissions, space heating (domestic and tertiary sector) 19%, transport 7% and industry 16%. GHG emissions from transport have increased 25% in 10 years, thus contributing for a large part to the general growth. Industrial processes (essentially the production of ammonia and nitric acid) have risen steeply in the course of the decade (+85%), bringing their share to 8% of total emissions in 1999.

In the Walloon Region, the combustion of fuels by the industrial sector is the primary source of GHG emissions (32% in 1999), followed by transport and space heating (16% each), industrial processes (14%) and agriculture (11%). The overall development of GHG emissions in Wallonia is obviously largely determined by CO_2 emissions (84% of greenhouse gas emissions), which have risen slightly between 1990 and 1999 (+0.6%). The share of CH_4 and N_2O in total GHG emissions is 6.1% and 9.8% respectively. N_2O emissions have remained stable during 1990-1999 (Table 3-2), while CH_4 emissions have dropped by 10.2 %, driving to a 0.2% decrease of the aggregate emissions of CO_2, CH_4 and N_2O.

The main greenhouse gas emitting sources in the Brussels Capital Region are combustion related to space heating (domestic and tertiary sector) (65%) and to transport (18%), and waste incineration (13%). Consequently, developments in greenhouse gas emissions in the Brussels Capital Region is closely linked to changes in CO_2 emissions, which made up 95% of total GHG emissions in 1999. However, the growth of CO_2 emissions between 1990 and 1999 (8.9%) is somewhat compensated for by a steep drop in CH_4 (-10%) and N_2O (-22,1%) emissions during the same period (Table 3-2). On the whole, the CO_2, CH_4 and N_2O emissions in the Brussels Capital Region have risen by 7% between 1990 and 1999.

3.3.5. FLUORINATED GASES

No systematic inventories of the F-gases provided for in Annex A to the Kyoto Protocol (hydrofluorocarbons HFCs, perfluorocarbons PFCs, sulphur hexafluoride SF_6) have been made prior to 1995. These gases make only a negligible contribution (less than 0.6%) to the total greenhouse gas emissions in Belgium (Annex A, Table 10s5). Even so, HFC emissions have been gradually increasing (+142% between 1995 and 1999), reflecting the current regulations relating to CFCs substitution. HFCs are mainly used in the refrigeration sector, and for the production of synthetic foams.

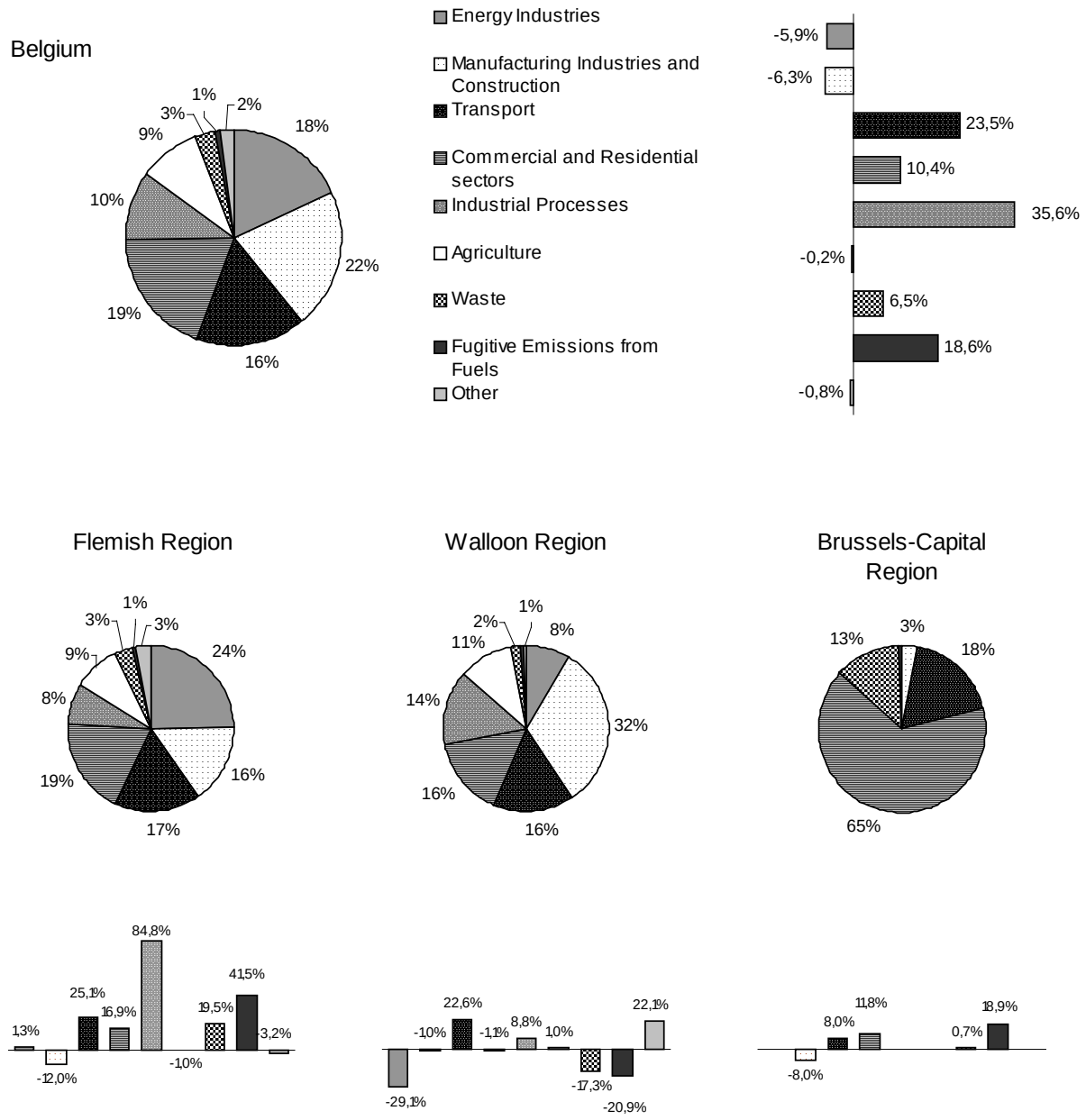


Figure 3-6. GHG emissions by source categories, in % of the total emissions expressed in CO_2 equivalent (1999) ; trend in GHG emissions, per sector, in the period 1990-1999

Source : National inventory of GHG emissions, 2002

3.3.6. INDIRECT GREENHOUSE GAS (CO, NO_X, NMVOCS) AND SO_2 EMISSIONS

Emission figures relating to the ozone precursors (CO, NO_X, NMVOCs[21]) and to SO_2 are shown in Annex A. The distribution of these emissions over the various sources (sectors) and their global changes during 1990-1999 are summarised in Figure 3-7, for each of these gas. These data are discussed below.

i. Nitrogen oxides (NO_X)

The primary NOx emitting source in Belgium is transport (54% in 1999), followed by manufacturing industries (24%) and energy industries (14%). NOx emissions have only slightly increased (+1,3%) in comparison with road traffic, thanks to the use since 1993-94 of catalytic converters on petrol-engine cars. In general, NOx emissions have dropped by 4.1% between 1990 and 1999, mainly as a result of improved performances in the production of electricity.

Traffic in the Flemish Region is the main source of NOx (NO_2) emissions (53 % in 1999). In addition, aggregate emissions from electricity production, refineries and industry (individually and collectively) contribute substantially to NOx (NO_2) emissions (42 % in 1999). In 1999, total NOx (NO_2) emissions fell by 6 % in comparison with 1990.

In the Walloon Region, road transport accounted for nearly half of NOx emissions ; energy industries come second. Emissions have dropped by 9 % between 1990 and 1999, thanks basically to road transport and, to a lesser extent, to the industrial sector. Emissions from the residential sector, on the other hand, have increased as a result of the more widespread use of natural gas for heating.

In the Brussels Capital Region, combustion linked to space heating (domestic and tertiary sector) and to waste incineration is a significant source of NOx emissions, in addition to transport. However, the introduction of catalytic converters and by production cuts in the Marly cokes plant between 1990 and 1992 and its subsequent closure have curtailed these emissions in 1993. NOx emissions consequently have dropped by 18 % between 1990 and 1999.

ii. Carbon monoxide (CO)

The majority of CO emissions in Belgium come from transport (58% in 1999) and industry (35%). Fuel combustion for space heating also contributes slightly (6%). These percentages change from one Region to another: in the Flemish and Brussels Capital Regions, transport-related emissions dominate, while in the Walloon Region industry is the main source of CO emissions, followed by road transport and, to a lesser extent, space heating.

Between 1990 and 1999, national CO emissions fell by 10.2%, chiefly as a result of the introduction in 1993 of catalytic converters and to some extent following efforts made by industry, particularly the steel industry and refineries, and the diminished use of coal for heating purposes.

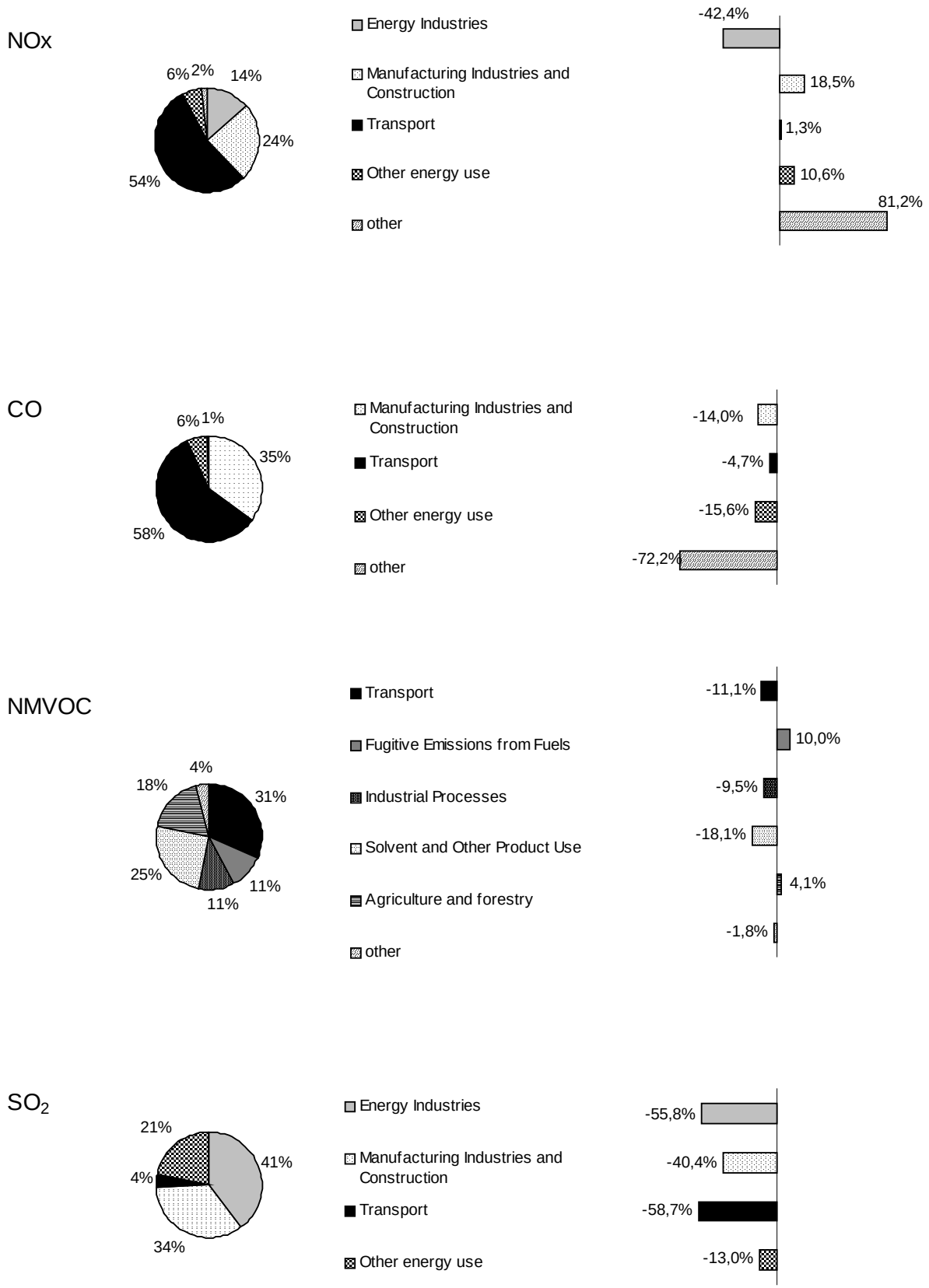
iii. NMVOCs[22]

NMVOC emissions are caused mainly by the combustion of petrol for transport (31%) and by the use of solvents (25%). Some industrial processes also contribute (11.5%), as well as forestry (13%) and fugitive emissions from fuels (11.0%). On the whole, these emissions decreased by 8.3% between 1990 and 1999, partly as a result of altered vehicle emission standards, and partly as a result of the prevention of solvent use.

In the autumn of 1998, the Flemish Region initiated a study (*Programma Beleidsgericht Onderzoek actie 16 MBP 1997-2001*) aimed at optimising the NMVOC inventory. The study was prolonged in 2000 (action 16 MBP 1997-2001) since an information-gathering concept had to be developed in addition to a general methodology for assessing emissions. The aim is to give a detailed survey of both the various sectors involved and of the types of pollutants. The information supplied by companies, partially based on the annual emission report, will be fully integrated into inventories.

[21] NMVOCs : Non-Methane Volatile Organic Compounds
[22] NMVOCs : Non-methane Volatile Organic Compounds

Figure 3-7. Emissions of precursor gases (CO, NO_x, NMVOC, SO_2): disribution per source categories (% of



the total emissions, 1999) and trends (% change over the period 1990-1999)

Source : National inventory of GHG emissions, 2002

Finally, it should be noted that NMVOC emissions from forests in Wallonia, estimated using the IPCC methodology, represent nearly one third of total emissions (the uncertainty about emission factors is very high here).

iv. Sulphur dioxide (SO_2)

SO_2 emissions produced by the energy, industry and residential (space heating) sectors declined sharply in Belgium between 1990 and 1999, leading to a general drop of these emissions by 45.5%. These reductions basically coincide with fuel substitution and with cuts in the sulphur content of the oil products used. The energy sector still account for 41% of SO_2 emissions, followed by industry (34%) and heating (21%).

In the transport sector, sulphur dioxide emissions have dropped (-58,7%), mainly due to the constant reduction in the sulphur content of fuels since 1996. Moreover, SO_2 emissions in the Brussels Capital Region have dropped as a result of a diminished production by the *Marly* cokes plant between 1990 and 1992 and its closure in 1993, and by the reduced emissions from the regional incinerator after fitting (in the middle of 1999) a wet scrubbing system.

3.4. COMPARISON WITH PREVIOUS INVENTORIES

Greenhouse gas emission data presented in this communication, covering the period 1990-2000, are extracted from the latest available GHG inventory. They substantialy deviate from emission data reported previously[23]. Availability of new background data actualy made possible to refine the estimates. Furthermore some methodological changes took place, among which the fine-tuning of some emission factors. Differences between estimates from the most recent inventory and those from past communications are shown in Table 3-3, for the year 1990.

Table 3-3. Comparison of recalculated data with previous invetories (year 1990)

	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference	Previous submission	Latest submission	Difference	Previous submission	Latest submission	Difference
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals	**111 940**	**116 366**	**4,0**	**12 853**	**11 557**	**-10,1**	**9 613**	**13 216**	**37,5**
1. Energy	**104 190**	**109 210**	**4,8**	**935**	**990**	**5,9**	**2 397**	**2 444**	**2,0**
2. Industrial Processes	**9 140**	**7 673**	**-16,1**	**73**	**48**	**-34,5**	**3 562**	**3 559**	**-0,1**
3. Solvent and Other Product Use	**0**	**0**	**0,0**	0			**0**	**0**	**0,0**
4. Agriculture	**0**	**0**	**0,0**	**8 002**	**7 151**	**-10,6**	**3 377**	**6 810**	**101,7**
5. Land-Use Change and Forestry (net)	**-2 057**	**-1 600**	**-22,2**	**196**	**106**	**-45,6**	**253**	**237**	**-6,2**
6. Waste	**667**	**1 084**	**62,4**	**3 647**	**3 261**	**-10,6**	**24**	**166**	**583,5**

Overall, recalculation engenders a 5% increase (+6735 Gg CO_2 eq.) of the total emissions of the three major GHG (CO_2, CH_4, N_2O), what is substantial. Important corrections mainly affect some sectors :

ENERGY SECTOR

CO_2 emissions from energy use are estimated on the basis of the regional energy balances since 1999. Previously, these estimates were based on national energy balances. For the year 1990, this methodological change generates an increase of 5020 Gg of the CO_2 emissions estimate (+4.8%).

INDUSTRIAL PROCESSES

In previous inventories, GHG emissions from industrial processes were reported only for the iron and steel sectors, in the Flemish Region. Currently, chemical industry processes are reported as well. This generates a 1% increase of the regional GHG emissions in Flanders.

AGRICULTURE

Differences between previous and latest estimates of CH_4 and N_2O emissions from agriculture can be explained, in the Walloon Region, by the use of a specific model, recently developed. This model allows

[23] Inventory of GHG emissions in Belgium, 1990-1996/1997, report to the COP of the UNFCCC (1999);
National Communications of the inventory of GHG emissions in Belgium (submission 2000 – data 1997-1998 ; submission 2001 – data 1998, 1999)

to increase the accuracy of these estimates. The use of that methodology resulted in a 51% increase of the estimate of these emissions for the year 1990 (+1968 Gg CO_2 eq.)

CARBON SINKS

The methodology for the estimate of carbon sinks was deeply modified, and was also applied to the 1990 GHG inventory. As a consequence, the estimate of carbon sequestration by the sinks changes from -2057 Gg CO_2 to -1600 Gg CO_2.

Emissions recalculation also led to increases or decreases, more or less substantial, for the following sectors: glass, foundry, waste management.

3.5. UNCERTAINTIES

There has so far been no uncertainty analysis of the national greenhouse gas emission inventory, although some attempts have been made at determining the uncertainty of CO_2 emissions from fossil fuel combustion in the Flemish Region on the basis of the IPCC guidelines (tier 1). Uncertainties on activity data were estimated on the basis of the information relative to the establishment of the energy balance. Uncertainty on emission factors utilized was assessed following a similar estimate for UK. Based on these data, the bias of the CO_2 emissions from combustion of fossile fuels was estimated at +-5% for 1999. Uncertainty on the evolution of CO_2 emissions from fuel combustion, from 1990 to 1999, was estimated at +-7%. Furthermore key sectors which have a large influence on the 1999 emissions on the one hand (level assessment) and on emission trends on the other hand (trend assessment) were identified. Improving the emission inventory for these particular sectors is a priority. Further work has to be done in order to refine approximations for these sectors, and where possible for other categories and greenhouse gas. A better knowledge of the uncertainty on activity data and emission factors is therefore essential.

4. POLICIES AND MEASURES

Foreword

The policies and measures brought in by the Federal State and the Regions in the context of climate change policy are presented in this section. The frame of the policy making process related to these actions is presented in § 4.1. Policies and measures are then presented per activity sector in § 4.2 to 4.6. For each activity sector, the policies and measures are classified by categories, based on the intended objective or the type of instrument employed, and the level of power concerned (Federal State / Region). When appropriate, the connections between the policies and measures implemented by the different authorities are mentioned, plus their link with the different regional plans. Additional information, relating to administrative and consultative bodies, thematic working parties and the instruments set up in the context of implementing these policies and measures, are given in the boxes. Each sub-section (§ 4.2 to 4.6) is closed by a summary table of the policies and measures in each sector. In these tables, a serial number, preceded by a letter indicating the sector concerned (E: energy; T: transport; I: industry; A: agriculture (and forestry); W: waste), identifies each action and makes clear the relationship between the actions listed in the tables and their description in the text. The information presented in these tables covers, in order: the acronym of the measure, the objective or the activity envisaged, the greenhouse gas(es) concerned, the type of instrument implemented, the stage of implementation and the institution responsible. A quantitative estimate of the reduction potential is not available for most policies and measures considered individually; a quantitative estimate of the emission reduction for the policies and measures as a whole is presented in Section 5 (projections). The codes used in these tables to indicate the type of instrument implemented and the stage of implementation are explained in Table 4-1.

Table 4-1. Implementation of PAMs : Nomenclature for the type of instrument and the stage of implementation

Type of instrument		
FIN	Financial / economic	All instruments aiming to encourage the target groups to action by means of a positive or negative financial incentive (with the exception of R&D programmes)
REG	Regulations	All instruments of a restrictive nature, that is to say aiming to encourage the target groups to modify their behaviour by a legal, regulatory or administrative constraint
R&D	Research and development	All instruments aiming to promote research and development in the sectors concerned
INF	Infrastructure	All modifications of infrastructure
PLA	Planning	Policy planning procedures
ORG	Organisation	(Re)organisation of the structures of public authorities or their mode of action
EDU	Information, education, training	All measures aiming to increase the awareness of the target groups by information, training, public awareness
VOL	Voluntary / negotiated agreements	All initiatives of the political authorities aiming to obtain the voluntary engagement of target groups with the objectives of the policy being pursued
MIX	Mixed	Integrated implementation of a whole series of instruments belonging to different categories
Stage of implementation		
IMP	Measure is implemented	Measure for which one of the conditions below is applicable: a) national legislation is in force; b) one or several voluntary agreements have been struck; c) financial resources have been allocated; d) human resources have been mobilised
ADO	Measure adopted	Measure for which a government has taken an official decision and is expressly engaged in proceeding with the implementation
PLA	Measure planned	Arrangements are currently being examined for which a favourable policy consensus exists for its future implementation

4.1. POLICY MAKING PROCESS

In the federal context of Belgium, the policies and measures aiming to alleviate greenhouse gas emissions are mapped out at different power levels, depending on the authority residing in the federal and regional authorities (see § 2.1.2). Each of these levels of power establishes its own priorities for environmental and climate policy. Instruments of co-ordination have been established, in order to harmonise and create synergy between the policies conducted by the Federal Government and the three Regions. The general context for the preparation of policies and measures regarding climate change is consequently built up by a series of guiding plans, established by the federal and regional authorities, determining the policy objectives and the strategies for attaining these objectives. These plans, plus the structures with which they are associated, are presented below, for the Federal State and the three Regions.

i. FEDERAL STATE

FEDERAL PLAN FOR SUSTAINABLE DEVELOPMENT 2000-2004 (FPSD):

The *Federal Plan for Sustainable Development 2000-2004*, drawn up to put into practice the law of 5 May 1997 regarding the co-ordination of the federal sustainable development policy, and adopted by the Federal Government on 20 July 2000, indicates the broad thrust of the policy to be followed at federal level to attain the objectives of sustainable development. This plan is characterised by both prescriptive and indicative planning. Although it has been fixed by royal decree, it is not imperative in character and does not lead to direct consequences for the man in the street. In other words, the FPSD does not have regulatory authority. The measures that it contains have to be worked out and implemented according to the habitual decision-making procedures and are, if need be, submitted to the approval of Parliament. The Federal Government is required to report each year on the progress made on the objectives of the plan. A new *Federal Plan for Sustainable Development* has to be produced every 4 years.

The FPSD especially fixes the context of the action policy relative to climate change. It provides for the implementation of strategies for the sustainable development of energy (rational use of energy, promotion of sources of renewable energy, management of supply and demand, technological development, policy of products, energy taxation). The FPSD also provides the promotion of mobility that is compatible with sustainable development, based on controlling the growth of the need for mobility, increasing the security of travel, technological innovation and modal transfer. Finally, the broad lines of the policy of protecting the atmosphere (including the issues of ozone, climate change and acidification) are also fixed in the FPSD.

Box 4-1. Interdepartmental Commission on Sustainable Development (CIDD/ICDO), Federal Council of Sustainable Development (CFDD/FRDO), Task Force on Sustainable Development

Parallel to the establishment of the *Federal Plan for Sustainable Development*, the law of the 5 May 1997 also prescribes permanent consultation between the different ministries and public bodies through the *Interdepartmental Commission on Sustainable Development* (CIDD/ICDO). This commission is responsible for preparing the four-yearly sustainable development plan and of consulting widely around this plan (with the general public) before submitting the draft to the Government. The law of 5 May 1997 also established the *Federal Council for Sustainable Development* (CFDD/FRDO), made up of representatives of a variety of social groups. These include organisations active in environmental matters, organisations of co-operation in development, consumers' organisations, workers' and employers' organisations, energy producers and scientists. This Council has to be consulted on the draft of the *Federal Plan for Sustainable Development*. It also formulates recommendations on the subject of the federal sustainable development policy, on adhering to Belgium's international undertakings (*Action 21*, *United Nations Framework Convention on Climate Change*, *Convention on Biological Diversity*), at the request of the Federal Government, the Federal Parliament and on its own account. Furthermore the CFDD/FRDO functions as a forum, stimulating the debate on sustainable development. The Task Force on Sustainable Development evaluates the level of implementation of a sustainable development policy by the Federal Government, and publishes evaluation reports twice a year. Several thematics are covered, among which energy, transport, tropospheric ozone and climate changes.

Box 4-2. The fiscal context

The total burden of standard and special taxes in Belgium is among the highest of the industrialised countries (46.3 % of the GDP in 1998[24]). This burden essentially involves income from work. The governmental agreement provides for a reduction in this fiscal pressure, with the aim of progressive alignment with neighbouring countries. The law of 10 August 2001, concerning the reform of personal taxation (MB [*Belgian Statute Book*] 20 September 2001), constitutes the first part of this recasting of the fiscal system. The government promises, if it is re-elected, to undertake a reform of company taxation, in order to encourage investment and to strengthen the competitive position of Belgian companies. These modifications of the fiscal structure should also contribute to a smooth transition from a tax system that penalises work towards a tax system whose main aim is to create objectives for sustainable development. Several measures aiming to reduce emissions of greenhouse gases for the energy and transport industries are being introduced in the context of this fiscal reform. Likewise, the production and the consumption of products that respect the environment are encouraged via changes within the indirect tax system. The adoption of "eco-reductions" (decision of the Council of Ministers of 30 March 2001) has thus reinforced the system of "eco-taxes", instituted by the law of 16 July 1993, and whose implementation continues to be the subject of negotiation.

THE FEDERAL PLAN TO COMBAT ACIDIFICATION AND OZONE IN THE TROPOSPHERE

On 31 May 2000, the *Federal Plan to combat Acidification and Ozone in the Troposphere* was approved in the Council of Ministers. The objective of this plan is to fix federal measures to be taken during the period 2000-2003 to combat acidification and ozone in the troposphere. It meets Belgium's international obligations to ratify protocols signed under the *United Nations Convention on Transborder Atmospheric Pollution* (LRTAP Convention, 13/11/1979). The *Federal Plan to combat Acidification and Ozone in the Troposphere* contains, in addition to a brief description of the environmental issues involved, a plan of actions classified by sector, plus modalities of implementation and evaluation. While this plan is not directly targeted at a reduction in greenhouse gas emissions, a certain number of measures that it contains (especially structural measures in the transport and energy sectors) are intended to reduce these emissions. A complete statement of the implementation of the measures was presented to the Council of Ministers in the spring of the year 2001.

ii. FLEMISH REGION

THE MINA PLAN:

In the Flemish Region, the broad thrust of the environmental policy is determined by a five year plan, following the "Decree on the general arrangements regarding environmental policy", approved by the Flemish Parliament on 5 April 1995. The *1997-2001 Environmental Policy Plan* (MiNa plan 2) puts the accent on medium to long term strategies and contains concrete proposals for initiatives to be implemented over the five year period. Under the theme "climate change due to the greenhouse effect", MiNa plan 2 provides for several concrete actions:

- the implementation and putting into practice of the Flemish Region's Plan *'CO_2 – rational use of energy'*;
- the preparation and implementation of a plan for reducing CH_4 emissions;
- the preparation and implementation of a plan for controlling emissions of N_2O, HFCs and PFCs;
- the investigation (via scientific research) of possibilities of fixing carbon in materials and sinks.

The next five-year plan, for the period 2002-2006 (*MiNa plan 3*), is currently being prepared.

Box 4-3. MINA, MIRA, annual environmental programmes

The environmental policy in the Flemish Region, as defined in the decree of 5 April 1995, is founded on three axes: the *Environmental Policy Plan* (MINA plan), the "Reports on the environment" (*MIRA*) and the *Annual Environmental Programmes* [25]. The "Reports on the environment" present a factual evaluation of the environmental situation and environmental policies, plus prospective scenarios. They serve to support the preparation of policies. The *Environmental Policy Plan* is drawn up for a period of five years. It is a policy document that contains both medium term strategic objectives and a plan of concrete, short-term actions. The *Annual Environmental Programmes* are drawn up annually to put into practice the actions presented in the *Environmental Policy Plan.* They announce the actions and initiatives that will be undertaken during the year, and also present a statement of the situation and any changes to the *Environmental Policy Plan.*

[24] Source : OECD, Income statistics 1965-1998
[25] « Milieu Jaarprogramma »

Box 4-4. The Flemish Region Taskforce for Climate Policy

In its decision of 20 April 2001, the Flemish Government set up a "Taskforce" for the climate policy in the Flemish Region. This taskforce is responsible for making the following things happen:
- develop a pro-active climate policy in the Flemish Region
- evaluate the results of the *'CO_2-RUE' Plan*
- prepare a *Flemish Climate Plan*, and estimate the human and financial resources necessary to ensure its implementation
- implement the *National Climate Plan*, respecting the priorities of the Flemish Region
- pursue the process of ratifying the Kyoto Protocol
- report the progress made to the Flemish Government
- prepare the position of the Flemish Region regarding the national and international climate policy.

This taskforce is made up of representatives of the ministerial cabinets responsible for the environment, energy, co-operation in development, scientific policy, the economy, agriculture, housing, public buildings, mobility, town and country planning, plus the public administrations and services concerned.

« CO_2 / RATIONAL USE OF ENERGY » PLAN

In 1994, the Flemish Region adopted the CO_2 / *RUE Action Plan*[26] in the context of the surveillance system set up by the European Union (directive 93/389/EEC). This plan, annexed to the 1994 *National Programme for the Reduction of CO_2 Emissions*, was first activated in 1996, with the identification of priority actions, and again in 1999, in the context of the MINA plan 1997-2001. The Flemish Region decided to revise its *CO_2 / RUE Action Plan* again in the context of the *Flemish Climate Plan* (see hereafter) in order to counter continued growth in CO_2 emissions. The main changes to the plan will be the inclusion of quantitative objectives, new actions accompanied by budgetary estimates, including those for human resources. The plan also explores the cost-efficiency analysis of different measures and suggests a number of policy options.

THE FLEMISH CLIMATE PLAN

The Flemish Government, in its decision of 20 April 2001, provides for the preparation of a *Climate Policy Plan for the Flemish Region*[27]. The implementation of this plan is entrusted to the *Flemish Region Taskforce for Climate Policy* (see Box 4-4). Its adoption by the Flemish Government and the Parliament is scheduled in the course of the first half year of 2002. The *Flemish Climate Plan* will constitute the contribution of the Flemish Region to the *National Climate Plan* (see hereafter.). It will integrate the actions provided for by the *Environmental Policy Plan* (MINA plan), the *CO_2 / RUE Plan*, and new policies and measures. The main point of this plan is to enable the Flemish Region to progress towards an economy with a low consumption of fossil fuels, in the context of a liberalised energy market, as ruled on in the decision of 8 December 2000. The *Flemish Climate Plan* should also enable the intermediate objective of reducing emissions of greenhouse gases to be reached in 2005, down to the 1990 level (decision of 20 April 2001). The Flemish Government has however made this objective conditional on the federal authority taking helpful measures in the fiscal area, concerning energy, transport and product policy.

iii. WALLOON REGION

THE WALLOON REGION ACTION PLAN FOR CLIMATE CHANGE

On 19 July 2001 the Walloon Government adopted the *Walloon Region Action Plan for Climate Change*[28]. This plan will constitute a major part of the *Air Plan*[29], a programme to combat atmospheric pollution that is currently being prepared and whose adoption is scheduled for the course of the year 2002. The preparation of this plan is the result of a process initiated by a decree of the Walloon Government of 21 April 1994, relating to environmental plans for sustainable development. It provides, in article 17, for the establishment of an air quality action programme.

[26] Vlaamse CO2 / REG-beleidsplan
[27] « Klimaatbeleidsplan Vlaanderen »
[28] Plan d'action de la Région wallonne en matière de changements climatiques
[29] « Plan de l'Air »

Box 4-5. Co-ordinating the climate policy in the Walloon Region

A permanent consultative body on climate change has been set up, including representatives of the ministerial cabinets and the administrations involved (decision of the Walloon Government of 18/11/1999). The main task of this body is to come up with a programme for reducing the emissions of greenhouse gases, the co-ordination of the representation of the Walloon Region to the federal authority, ensuring international matters are followed through the study of the regional impact of the measures envisaged. Its work has enabled an outline programme for reducing greenhouse gas emissions to be drawn up in the Walloon Region, approved by the Walloon Government on 18 July 2000, and followed by the *Walloon Region Action Plan for Climate Change*. From May 2001, the mission of this body has been extended to cover air issues by another decision of the Walloon Government. The new pilot group thus constituted, called the "Permanent Consultative Body on Air Quality", has been given the task of drawing up the *Air Plan*. To do this, it benefits from the support of 17 working parties that perform the technical work, and a co-ordinating group composed solely of members of the administration.

This provision was put through by the Walloon Government in its session of 26 August 1999, charging the Walloon Minister of town and country planning, urban development and the environment with starting preparatory work on the *Air Quality Action Plan*[30] in the shortest possible time. The *Walloon Region Action Plan for Climate Change* is made up of a set of measures of various kinds aiming to reconcile economic and environmental efficiency and social development. The short, medium and long-term actions envisaged in this plan are likely to meet the recommendations of the Walloon Parliament (resolution of 9 May 2001 regarding the adoption of the Kyoto protocol objectives).

iv. BRUSSELS-CAPITAL REGION

A specific action programme for the climate policy is currently being prepared in Brussels-Capital Region, in line with the *National Climate Plan*. In addition to this specific plan, various aspects of the climate policy are tackled in the following plans:

REGIONAL DEVELOPMENT PLAN

The last *Regional Development Plan*, which is the most important of the plans made by Brussels and which was approved by the Brussels Government in July 2001, is particularly targeted at rational resource management and an active policy of pollution reduction, including CO_2 emissions.

TRANSPORT PLAN

The objective of the *Transport Plan* (IRIS Plan), approved by the Brussels Government on 1 October 1998, is to stabilise car journeys in the peak morning rush hour for 2005 at the levels of 1991, which will also reduce CO_2 emissions.

AIR PLAN

The *Programme for Structural Improvement in Air Quality* (the Air Plan), whose legal basis is the ordinance regarding the evaluation and improvement of ambient air quality (25 March 1999), has the objective of avoiding, reducing or preventing the harmful effects of pollutants on human health. While the ordinance does not explicitly indicate that its object is to combat the greenhouse effect, several provisions or actions of the plan are intended to reduce emissions of GHG, especially a series of measures related to the demand for energy, in particular in buildings. This plan, currently being prepared, will be implemented by the *Brussels Institute for Environmental Management* (IBGE/BIM) in collaboration with the other regional administrations such as the *Administration for Infrastructure and Travel* (AED).

Box 4-6. Climate policy in Brussels-Capital Region

Because of its specific nature (city/region) and the limits of its authority compared with the problem of total emissions of greenhouse gases in Belgium, the Region of Brussels-Capital is heavily dependent on the climate policy of the other authorities in Belgium. The Brussels Government considers however that "the issue of global warming is an important concern of Brussels-Capital Region" and that "Brussels-Capital Region subscribes to the logic of the Kyoto protocol" (decision of 15 March 2001). A draft ordinance granting assent to the Kyoto Protocol, has moreover been approved by the Brussels Government in the ordinary session of 6 July 2001 of the Brussels-Capital Region Council.

[30] Plan d'action pour la qualité de l'air

v. NATIONAL CLIMATE PLAN

The *National Climate Plan* was adopted by the *Inter-Ministerial Conference on the Environment* (ICE) on 6 March 2002. This plan constitutes the framework of the climate policy in Belgium for the period 2002-2012. It encompasses actions taken at the level of the Federal State and the three Regions. The *National Climate Plan* is aimed at controling greenhouse gas emissions as committed under the *Kyoto Protocol* and the EU burden-sharing agreement (decision of the EU Council of 16 June 1998). A cooperation agreement was achieved between the Federal State and the Regions, in view of the implementation and follow-up of this plan. Among other things, this agreement sets up a *Climate Commission*, which will notably deal with the evaluation of the implementation of policies and measures undertaken in the frame of the *National Climate Plan*. This agreement, as well as the *National Climate Plan,* should be approved by the four Governments in the course of the first half year of 2002.

4.2. ENERGY

4.2.1. CONTEXT OF THE ACTION POLICY IN THE ENERGY SECTOR

i. Main policy objectives

The current priorities of the Federal Government for the energy policy are the rational use of energy (RUE), the progressive disengagement from nuclear energy, and the liberalisation of the energy market. The regional energy policies put a greater accent on energy efficiency and the development of renewable energy sources (RES).

The Flemish Government Agreement provides increased budgetary resources for energy efficiency, combined heat and power (CHP), the rational use of energy in buildings and renewable energy resources. The Flemish Region has fixed an objective of 3% for the minimum contribution of renewable energy sources to the total supply of electricity by the end of 2004, and 5% in 2010. Over the coming years, two thirds of the new capacity for electricity generation from renewable sources will be provided by wind power, the remainder consisting of the use of biomass. In the longer term, the use of biomass will increase in importance. These priorities, reflected in the draft *Flemish Climate Plan*, indicate the desire of the Flemish authorities to contribute to the development of energy technologies that will soon become competitive on a large scale.

The Walloon Government Declaration provides for increased efforts in the area of energy efficiency, CHP and renewable energy resources. The *Plan for the Sustainable Management of Energy*[31] is based around 5 approaches: changing individual behaviour patterns (objective: reduction of overall consumption in 2010 compared to 2000), intensifying the policy of *rational use of energy* (RUE), developing renewable energy sources, supporting research, regulating the energy markets (this plan does not include transport or mobility, which constitutes a specific policy area, treated separately). By the 2010 horizon, the objectives of the Walloon Region for green energy are to:

- produce 8% of electricity from RES (1.8% in 2000);
- produce 12% of the overall low temperature thermal consumption (heating, sanitary hot water, low temperature industrial applications) from RES (5% in 2000);
- produce 20% of the electricity from quality CHP (3.5% in 2000).

Finally, the Brussels Government Agreement mentions the need for a coherent energy policy to improve the air quality in Brussels, the promotion of the use of solar energy in the public sector and the pursuit of policies favouring the rational use of energy[32]. The preparation of an Energy Plan in Brussels-Capital Region is under way; this plan will mainly insist on the rational use of energy by proposing measures in the area of performance in terms of energy efficiency in buildings, transport, etc.

[31] Plan pour la maîtrise durable de l'énergie
[32] In view of the limited opportunities in terms of production of electricity in Brussels-Capital region, no numeric objective has been set for the proportion of renewable energy in the production of electricity (with the exception of the use of solar heating applications)

ii. Legal context of the liberalisation of the electricity market

The Federal Law regarding the operation of the electricity market of 29 April 1999 establishes the basis for the transposition of a European Directive[33] at the federal level. It concerns the production and distribution of electricity, the tariff structure, long-term planning and competition. In order to support the regional policies in favour of *rational use of energy* (RUE) and *renewable energy sources* (RES), the federal law contains several articles on public service obligations, on the market for "green certificates" for electricity produced from renewable energy (article 7), and on the construction of off-shore wind sites, along the Belgian coast (article 6). The conditions and procedures for granting permits for these offshore sites are laid down by the Royal Decree of 20 July 2000. The *Indicative Plan of Infrastructure for Electricity Production*[34] seeks to define the broad lines of the choice of sources of primary energy. Particular attention will be paid to sources of renewable energy when applying this plan.

The federal framework law and the decisions regarding its execution taken at the federal level have to be complemented by regional decrees, regarding the aspects of the European Directive that are the remit of the regional authority.

These regional responsibilities are:

- the low voltage distribution of electricity (i.e. < 70 kV);
- the obligations of public service to do with RUE;
- the obligations of public service to promote renewable energy resources;
- the social aspects.

iii. Introduction of a taxation on energy

In view of the implementation of paragraphs 404, 621, and 622 of the *Federal Plan for Sustainable Development 2000-2004* (introduction of a "green" fiscal system), the Council of Ministers decided on 20 September 2001 to study the consequences of the introduction of a taxation on energy in Belgium. The Council of Ministers notably stated in its decision that the impact of an energy tax on the households should be compensated by other measures (e.g. exonerations), and that the introduction of such a taxation would not affect the employment nor the competitive position of Belgian companies. In this context, a set of measures should also be elaborated in order to cut the energy consumption by products and services, to promote the use of CHP, to ensure a better internalisation of external costs, and to normalize the installations of production of renewable energy.

iv. Administrations and bodies in charge of energy

At the federal level, the Energy Administration of the Ministry of Economic Affairs is in charge of energy matters. Under the current legislature, the responsibility for energy falls on the State Secretary for Energy and Sustainable Development, who is also in charge of federal co-ordination of climate change policy. Certain specific instruments also have an important role to play in the management of energy at the national level. Among these are the *Control Committee for Electricity and Gas* (CCEG), given the task of regulating non-liberalised segments of the gas and electricity markets, and the *Commission for the Regulation of Electricity and Gas* (CREG), the instrument of the Council for the liberalised segment of the gas and electricity markets.

In the Walloon Region, the *General Directorate of technology, research and energy* (DGTRE) is in charge the energy policy, including research in this area.

In Brussels-Capital Region, the *Brussels Institute for Environmental Management* (IBGE/BIM) is in charge of matters related to energy.

Box 4-7. CONCERE/ENOVER

CONCERE/ENOVER (*State-Regional Energy Consultation*) is a structure for co-operation between the Regions and the Federal State over the energy policy. This structure, set up by the co-operation agreement of 18 November 1991, contributes to

[33] Directive 96/92/CE of the European Parliament and the Council of 19 December 1996 concerning common rules for the internal market in electricity
[34] Article 3 of the law of 29 April 1999

ensuring the coherence of the energy policy in federal Belgium. It is a permanent working party of the Interministerial Conference on the Economy and Energy. CONCERE/ENOVER does not have the power to regulate, but gives advice and makes recommendations. Its principal aims are to:
centralise information and promote the exchange of information between the regions, the Federal State, and at the international level (with the obligation of reporting to international institutions)
support the policy measures and issues that concern the regions or the Federal State, in a quest for internal cohesion
assemble and appoint Belgian regional delegations to international meetings

In the Flemish Region, energy matters are regulated by the Division of Natural Resources and Energy (ANRE), within the Administration of the Economy. This administration is answerable to the Department of the Economy, Employment, Internal Affairs and Agriculture of the Ministry of the Flemish Community. On the other hand, the *Flemish Institute for Technological Research* (VITO) and the *Institute for the Advancement of Scientific and Technological Research in Flanders* (IWT) play an important role in the research and development of energy technology. Finally, the *Flemish Institute for the Rational Use of Energy* (VIREG[35]), created in September 1997, is given the task of actively involving the different players in the RUE policies, of co-ordinating the Flemish initiatives in this area and of ensuring that the available funds are used in the best way.

4.2.2. MEASURES ADOPTED IN THE CONTEXT OF LEGISLATION REGARDING THE LIBERALISATION OF THE ELECTRICITY MARKET

E1 - Purchase at a guaranteed price of electricity produced from RES

The federal law of 29 April 1999 (operation of the electricity market) stipulates that the Federal Government will take measures to ensure the flow onto the market, at a minimum price, of a minimum volume of electricity produced from renewable energy sources. A mechanism will have to be established for partially or totally financing the budgetary burden related to these measures. This financial mechanism may be implemented by a levy on all, or objectively defined categories, of energy consumers or of operators on the market.

E2 – Green certificates

The Federal Government has formally recorded the necessity of establishing a system of renewable energy certificates ("green certificates"), by which the electricity suppliers undertake to derive part of their electricity from RES. The Federal Government has approved, on 7 December 2001, the project of Royal Decree concerning the green certificates; this decree sets the minimum proportion of electricity derived from renewable energy at 6% by 2010. Suppliers that cannot meet this condition will be required to pay fines.

The Flemish Government has also taken the option of imposing a minimum standard (3% by the end of 2004, 5% in 2010) for the proportion of renewable energy on the electricity suppliers, by means of a system of green certificates. The supplier fulfils its obligations by depositing a certain volume of green certificates annually. These have to be deposited with the regulatory body of the Flemish Region. If it happens that one of these suppliers cannot satisfy its obligations, a fine is imposed. These fines will supply a fund that will be used for the promotion of renewable energy resources. Finally, the transport of renewable electricity via the distribution network is exempted of taxes. A similar system of certificates will be introduced for CHP.

In the Walloon Region, "green" electricity will be also be promoted by the system of green certificates, plus via a system of support to production. The priority is the use of biomass, including various types of biodegradable waste. Then small-scale hydro-electricity (<10 MW), active and passive solar heating applications, and wind energy are coming in. The suppliers will be required, under pain of paying a fine, to supply a growing proportion of electricity from RES (some 4% in 2004 and 12% in 2010) and, with certain weighting, from "quality" CHP.

[35] "Vlaamse Instelling voor het Rationeel Energieverbruik"

In Brussels-Capital Region, as in the two other regions, a system of green certificates will be set up. Two sorts of obligations will be imposed on electricity suppliers: firstly the annual submission of green certificates (whose number is yet to be determined by the regional government), and secondly the purchase of the surplus green electricity (or electricity derived from CHP) produced by independent producers.

E3 – Eligibility of the producers and consumers of green electricity:

The Federal Government decided, on 5 April 2000, that every producer of electricity from RES will be progressively free to choose their electricity supplier for any additional needs they might have (foreseen or for emergencies). Furthermore, clients who purchase a significant proportion of electricity derived from RES are eligible to freely choose their supplier of electricity. The federal legislation, while interpreting the European directives on the liberalisation of the energy markets, also promotes combined heat and power: producers of "quality" CHP electricity will become eligible clients more rapidly. This policy was reaffirmed by the Council of Ministers in its decision of April 2000. The Flemish and Walloon Regions will also provide the immediate eligibility of producers and consumers of renewable electricity or electricity derived from CHP for access to the liberalised segment of the electricity market. Likewise, in Brussels-Capital Region, independent producers of green electricity (or electricity derived from CHP) will be immediately eligible for their additional needs.

E4 - Priority access to the network for green electricity

In the Flemish and Walloon Regions, procedures granting priority access to the network are scheduled for renewable electricity or electricity from CHP. In addition, the Flemish Region will authorize the supply of renewable electricity or electricity derived from CHP via a direct line between the producer and the consumer.

E5 - Public service obligations in the area of energy efficiency

Some public service obligations in the area of energy efficiency will be imposed on the electricity suppliers within the liberalised electricity market. The suppliers will have to undertake certain actions: in the Flemish Region, the electricity consumed over the three previous years will have to be stated clearly on the invoice, plus the origin of the electricity supplied. In Walloon Region too, the electricity suppliers will be encouraged to promote the RUE with their clientele.

4.2.3. FISCAL AND FINANCIAL INCENTIVES ORIENTED TO ENERGY EFFICIENCY, RENEWABLE ENERGY SOURCES, COMBINED HEAT AND POWER, RATIONAL USE OF ENERGY

i. Support for investment

THE FEDERAL STATE:

E6 - Fiscal deduction on investments (industrial sector)

Since 1992, 13.5% of the cost of investments aiming to increase energy efficiency in the industrial sector (including the use of renewable energy resources) may be deducted from the taxable income.

E7 - Fiscal deduction on investments (residential sector)

Taxpayers who have had one or more well-specified things done to save energy in their home, will benefit from a tax reduction[36]. Two types of expenditure are envisaged by the measure. They are, firstly, the replacement of old boilers, the installation of a sanitary water heating system using solar energy, and the installation of photovoltaic panels; 15 % of the amount spent on this may be deducted from the taxable income. The other expenditure envisaged concerns the installation of double glazing, roof

[36] Article 33 of the law of 10 August 2001, concerning the reform of personal taxation

insulation, the installation of a central heating regulator that works on a thermostatic valve or a room thermostat with a timer, plus energy audits. For this second category of expenses, 40 % of the cost can be set against tax. The tax reduced may not exceed EUR 500 per habitation. This amount may be increased to EUR 1,000 if it becomes apparent after the measure has been in place for one year that the annual amount set aside for the purpose in the budget of EUR 37.5 million has not been fully taken up. This measure, adopted within the framework of the law of 10 August 2001 concerning the reform of personal taxation, will apply from the financial year 2004 (2003 income)[37].

E8 - Financing of CHP installations

The Distrigas company[38] agrees to give financial support for the financing of CHP installations (budget: EUR 9.9157 million over a period of 5 years).

FLEMISH REGION:

E9 – Subsidies to companies for investments in energy saving

Subsidies to companies for investments in energy efficiency and renewable energy go from 20% for the small companies to 10% for the medium-sized and large companies.

E10 – Subsidies for the installation of photovoltaic panels

The Flemish authorities will provide a subsidy of 75% for the installation of photovoltaic panels, 25% of which provided by the electricity producers Electrabel and SPE (the budget set aside by the Flemish authorities for these subsidies in 2002 was EUR 1 million).

E11 – Subsidies for CHP installations

Subsidies are available for CHP installations (including research and development activities); the objective of the Flemish Region is to add an additional capacity of 1,800 MWe in CHP by 2005.

WALLOON REGION:

E12 – Subsidies to households for improving energy efficiency

A subsidy of up to EUR 1363 is granted to low-income households for improving their energy efficiency.

E13 – Subsidies to municipalities, schools and hospitals for investments in energy economy:

- the Walloon Region allocates subsidies to the municipalities for the replacement of public lighting (up to 70% of the cost of the investment)

- financial incentives have been agreed for municipalities, schools and hospitals for improving heating installations, the insulation of buildings, etc. (including the use of CHP and renewable energy resources)

E14 – Subsidies to federations of companies for investments in energy efficiency

A grant is allocated to federations of companies for improving energy efficiency in their sector as a whole (up to 100% of the operational costs).

[37] A Royal Decree will be set in 2002, fixing the criteria required for the investments in energy saving in the household sector which will allow to benefit from the tax reduction
[38] Belgian gas company

E15 – Promotion of the *Soltherm* solar water heater

An allowance has been agreed for the installation of solar water heaters: EUR 620 for 4 m² of solar panels, and EUR 99 per m² beyond this size; the objective is to have 200 000 m² of solar panels installed.

BRUSSELS-CAPITAL REGION:

E16 - Subsidies for investments in energy efficiency

A subsidy of 20% is granted for investments in energy efficiency made by municipalities, local public institutions, schools and hospitals.

E17 - Subsidies for investments in solar water heaters

A subsidy is granted for investments in solar water heater for domestic hot water (35% of the cost; max. EUR 991.574); the objective is to have 50 000 m² of solar panels installed by 2010.

ii. Energy audits

FLEMISH REGION:

E18 – Free energy pre-audits

The Flemish Government employs four energy consultants who make free-of-charge pre-audits for users. In addition, small companies will be given 50% towards purchasing consulting services for energy efficiency.

WALLOON REGION:

E19 - Grants for energy audits

- a grant (up to 75 %) for external and internal energy audit costs for companies that sign a declaration of intention in preparation of a voluntary agreement;
- a grant (up to 50 %) for external energy audit costs prior to an investment for saving energy or turning to renewable energy sources (available to all companies);
- a grant (up to 50 %) for the expense of implementing a system of energy cost accounting (promoting the CAFE programme "*The Cost Accounting of Fluids and Energy*", an energy management tool used in industrial processes).

E20 - Free consultation service for SMEs

A free consultation service for small and medium-sized companies has been set up, in order to promote the RUE. This service analyses the company's energy balance, detects the main problems, suggests solutions and supplies advice on financing, including the use of subsidies and other incentives available in the Region. This service is free for the user.

BRUSSELS-CAPITAL REGION:

E21- Subsidies for energy audits

Feasibility studies of investments in energy efficiency, plus energy audits of buildings, are subsidised up to a limit of 50% of their cost, for a maximum sum of EUR 1239.467.

iii. Other financial incentives

E22 – Rates reductions for the clients of CHP installations:

- EUR 0.4957 per GJ of natural gas for small or medium sized clients using high quality CHP installations.
- EUR 0.2131 per GJ of natural gas for large clients (consumption >33 500 GJ/year) using high quality CHP installations.

E23 – RUE/electricity fund:

On the recommendation of the *Electricity and Gas Control Committee*, two funds have been created in the electricity sector in 1996 to finance regional programmes:

- The electricity suppliers are contributing to the 'RUE / Electricity Distribution' Fund up to a limit of BEF 0.01 /kWh sold (EUR 0.00024 /kWh). The fund is designed to promote energy audits, investments in solar heating, the installation of heat pumps and solar water heaters, the use of high-efficiency lighting, the installation of condensation heaters and CHP units, etc. The funds amassed in the three regions totalled a sum of EUR 10,956,893 in 1999. In the Flemish Region, the activities financed by the fund are managed in the context of the *Flemish Institute for the rational use of Energy* (VIREG). In the Walloon and Brussels-Capital Regions, the use of the fund is decided following consultation between the energy administration and the electricity distribution companies.
- The 'RUE / Electricity Production' Fund has mainly been created to promote energy efficiency in the phase of electricity production, but also to finance *Demand Side Management (DSM)*. The total budget available for the year 1999 amounted to EUR 8.676 million. The activities carried out in 1999 included the second phase of a study of the potential for reducing GHG emissions in the electricity industry, plus projects in the area of renewable energy sources and CHP. On the demand side, EUR 495,787 have been spent on energy audits and EUR 562,718 for technological assistance. The fund is managed jointly by the electricity producers and the federal energy administration.

The Federal Government decided on 5 April 2000 to increase the RUE fund to BEF 1 billion (EUR 24.789 million), and that the fund should be managed in a more transparent and effective way. In the context of CONCERE/ENOVER (see Box 4-7), a co-operation agreement including the transfer of this fund to the regional authorities has been worked out[39].

E24 – Measures aimed at energy efficiency (in the gas sector)

The recommendations of the *Electricity and Gas Control Committee* put forward several actions for the gas industry. The measures in the area of the energy efficiency are financed by a donation of EUR 644523 annually by the Distrigas company. Among these measures figure especially the promotion of decentralisation through new direct heating installations for large premises. In May 2000, a new action started regarding process applications. The project promotes direct heating, better boiler adjustment, and better heat recovery from process applications.

E25 - Financial support for the production of electricity from RES

In January 1995, the *Electricity and Gas Control Committee* approved financial support (EUR 0.025/kWh) for the production of renewable electricity (including electricity produced from biogas and organic waste, but excluding small photovoltaic production units) for supply to the network. On 1 July 1998, an additional "green franc" (EUR 0.025/kWh) was awarded to wind and hydroelectric installations with a capacity on a single site of at least 10MW. This support will be provided for a period of 10 years. This action will be evaluated in 2003. For small photovoltaic units (<3 kW), compensation between purchases and sales from the client to the network is exceptionally authorised throughout the lifetime of the

[39] This co-operation agreement, approved on 19 September 2001, also fixes the rules for regulating the green electricity market, measures promoting co-generation, the co-ordination of technical regulations, and collaboration between the different regulators put in place by the contracting parties.

installation. With an adapted electricity meter (able to record both the consumption from- and supply to the network), this results in a selling price to the network of ~ EUR 0.15/kWh.

4.2.4. ESTABLISHING ENERGY EFFICIENCY STANDARDS

i. Building insulation standards

E26 - Energy certification of buildings

The Federal Government and the Regions have recently decided to get together and co-finance several projects in the area of construction. In the area of energy certification of buildings, a national study on the implementation of a system of energy certification of household dwellings has been conducted. This system has been applied to 15 - 20 buildings (individual houses and apartments) in the pilot phase of this study. A seminar on the results was held on 4 May 1999. In the follow-up, CONCERE/ENOVER co-financed a European project in this area. Some steps remain to be taken before the introduction of the system in practice, such as the development of software for doing the energy calculations and training the auditors. An operational system of energy certification of buildings is expected in the course of the year 2002.

E27 - Introduction of energy performance standards

Co-operation between the regions for inspecting the insulation and ventilation of buildings is being conducted under the auspices of the *Belgian Building Research Institute* (BBRI). A number of actions are being undertaken with the aim of defining, harmonising and improving the application of energy performance standards:

- an information Web site is being created about the legislation for ventilation and insulation in the three regions
- a manual is being produced for a uniform inspection procedure throughout the country
- more appropriate legislation is being prepared
- different standards are being harmonised
- application of the regulations is being strengthened (increased number of inspections)

The Flemish Region has decided to introduce legally binding regulations on the energy performance of buildings in the near future.

ii. Product standards

E28 - Energy efficiency standards for boilers and water heaters

In accordance with EU Directive 92/42/EEC on efficiency requirements for new hot-water boilers, Belgium has changed its national legislation: the Royal Decree of 18 March 1997 sets the efficiency requirements applicable to new hot water boilers that run off liquid or gaseous fuels.

E29 - Energy efficiency labels

In order to conform to Directive EU 92/75/EEC on the energy labelling of household appliances, the Belgian Government has adopted a number of Royal Decrees regarding:

- refrigerators, deep freezers and combined devices;
- washing machines, dryers and combined devices;
- dishwashers;
- electric light bulbs

4.2.5. VOLUNTARY AGREEMENTS

E30 - Benchmarking agreements (Flemish Region)

The Flemish Region is going to introduce a system of voluntary agreements for the energy intensive industry. The agreements will be based on benchmarking in the very energy-consuming large industries such as the chemical industry, iron and steel and the paper-making industry. In these benchmarking agreements, the companies themselves undertake to attain optimum energy efficiency (by comparison with the world level) by 2012. The less energy-intensive industries will be invited to make any energy-saving investments with a pay-back term of less than five years. Periodic audits will define appropriate investment programmes.

E31 - Voluntary agreements with industry (Walloon Region)

The Walloon Region has already taken the first steps to introduce voluntary agreements with a variety of industrial sectors. The first sectors to have signed a letter of intent were the chemical and paper industries, in July 2000. In 2001, three industrial sectors (cement, lime, and non-ferrous) signed a letter of intent. In the twelve months dating from the signature of these letters of intent, the industries involved will sign the full voluntary agreement, requiring them to reduce their energy consumption for 2010.

E32 - The "Eco-Dynamic Company" label (Brussels-Capital Region)

The Region of Brussels-Capital has inaugurated a company label programme, on a voluntary basis, called the "eco-dynamic company". In order to be given the label, the company signs a charter undertaking to respect a certain number of environmental management principles. Among these principles are the progressive reduction of energy consumption related to temperature regulation, the lighting of premises, electric and electronic equipment, as well as preferential access to renewable energy resources.

4.2.6. OTHER ACTIONS IN THE ENERGY SECTOR

E33 - AMPERE Commission

The *Commission for the analysis of the means of producing electricity and the evaluation of energy vectors* (AMPERE) was instituted by the Royal Decrees of 19 April, 18 October and 25 November 1999. It has been responsible for compiling a report examining the economic context of energy as a whole, the demand for electricity in Belgium, and the technologies of producing electricity. The Commission brought particular attention to bear on the following principles, formulated in the governmental declaration:

- to progressively withdraw from nuclear energy (deactivation of nuclear power stations once they reach the age of 40 years);
- to control the demand for electricity;
- the necessity of developing renewable energy resources.

The Commission also draws attention to the development of efficient cycles for producing electricity (such as combined gas-steam cycles, CHP), the careful management of decentralised production, R&D in the different areas involved in the production of energy. The members of the Commission have looked forward into the next 20 years, looking at technologies that may be brought into service and used in industry by the year 2020. The Commission, in its report published on October 2000, considered controlling the demand for electricity to be Belgium's main goal if it is to attain the objective fixed by the Kyoto protocol. It specifically mentions the information made available to the consumer, labelling and the imposition of standards, the promotion of energy audits, "third-party financing" by "energy service companies", the introduction of a more transparent tariff system, better reflecting the social and environmental costs of different energy sources. Regarding electricity supply, the report favours the

STAG principle (combined gas/steam cycle), the use of renewable energy sources and CHP, and discourages the use of the coal in the present state of the technology.

At the start of 2001, the report of the AMPERE Commission was evaluated by a committee composed of five international energy experts (conclusions available on the internet at: http://www.deleuze.fgov.be/site/fr/index_fr.html)

E34 - Projected new infrastructure (wind, photovoltaic) (Flemish Region)

- measures have been taken to integrate plans for producing renewable energy (e.g. wind sites) in regional (and municipal) town and country planning, making use of the Geographical Information Systems (GIS approach);
- a new inventory of potential sites, available to the Government, will lead to specific wind installation, hydroelectric and photovoltaic projects.

E35 - demonstration projects (Flemish Region)

Demonstration projects are supported financially by the Ministry of the Flemish Community. Each project may be given a subsidy covering up to 35% of the total cost. The total budget varies between 0.743 and 1.487 million EUR per year. To be eligible, the demonstration projects must have an innovative nature and present economic opportunities to the region. The main themes concerned are CHP, propulsion engines and alternative fuels for vehicles (e.g. hybrid fuels, natural gas, biodiesel, hydrogen) and sources of renewable energy. A large-scale draft pilot scheme on electrical vehicles, conducted on the car fleets of certain municipalities between 1995 and 1998, has resulted in the increased use of electrical vehicles.

E36 - Code of good behaviour for the gas distribution sector (Flemish region)

The Flemish Region reconsiders a code of good behaviour with the gas distribution sector in Flanders to prevent leaks of CH_4 resulting from old pipes, infrastructure works or damages. A deepening analysis will be hold in consultation with the sector.

Remark: research and development activities of new energy technologies are presented in Section 8 “Systematic research and observation”.

Table 4-2. Summary of the policies and measures: 1. Energy

Heading	objective or activity affected	GHG affected	Type of instrument	Stage of implementation	Implementing entity(ies)
E1 - Purchase at a guaranteed price of electricity produced from RES	Promotion of RES	CO_2	FIN	ADO	Federal State Ministry of Economic Affairs (Energy Administration)
E2 – Green certificates	Promotion of electricity derived from RES or from CHP	CO_2	REG	ADO	Federal State Ministry of Economic Affairs (Energy Administration)
				IMP	Ministry of the Flemish Community (Energy Administration)
				ADO	Walloon Region General Directorate of Technology, Research and Energy
				ADO	Brussels-Capital Region IBGE/BIM

E3 – Eligibility of producers and consumers of green electricity	Promotion of electricity derived from RES or from CHP	CO_2	REG	ADO	Federal State Ministry of Economic Affairs (Energy Administration)
				ADO	Ministry of the Flemish Community (Energy Administration)
				ADO	Walloon Region General Directorate of Technology, Research and Energy
				ADO	Brussels-Capital Region IBGE/BIM
E4 - Priority access to the network for green electricity	Promotion of electricity derived from RES or from CHP	CO_2	REG	ADO	Ministry of the Flemish Community (Energy Administration)
				ADO	Walloon Region General Directorate of Technology, Research and Energy
E5 - Obligations of public service in the area of energy efficiency	Energy efficiency	CO_2	REG	ADO	Ministry of the Flemish Community (Energy Administration)
				ADO	Walloon Region General Directorate of Technology, Research and Energy
E6 - Tax reductions on investments (industrial sector)	Improvements in energy efficiency (industry)	CO_2	FIN	IMP	Federal State Ministry of Finance
E7 - Tax reductions on investments (residential sector)	Improvement in energy efficiency (residential)	CO_2	FIN	IMP	Federal State Ministry of Finance
E8 - Financing CHP installations	Promotion of CHP	CO_2	FIN	ADO	Federal State Ministry of Economic Affairs (Energy Administration)
E9 – Subsidies to companies for investments in energy economy	Improved energy efficiency and promotion of RES	CO_2	FIN	IMP	Ministry of the Flemish Community (Energy Administration)
E10 – Subsidies for the installation of photovoltaic panels	Promotion of solar energy (photovoltaic)	CO_2	FIN	IMP	Ministry of the Flemish Community (Energy Administration)
E11 – Subsidies for CHP installations	Promotion of CHP systems	CO_2	FIN	IMP	Ministry of the Flemish Community (Energy Administration)
E12 – Subsidies to households for improving their energy efficiency	Improvement of energy efficiency	CO_2	FIN	IMP	Walloon Region General Directorate of Technology, Research and Energy
E13 – Subsidies to municipalities, schools and hospitals for investments leading to energy economy	Improvement of energy efficiency and promotion of RES	CO_2	FIN	IMP	Walloon Region General Directorate of Technology, Research and Energy
E14 – Subsidies to federations of companies for investments leading to energy efficiency	Improvement of energy efficiency	CO_2	FIN	IMP	Walloon Region General Directorate of Technology, Research and Energy
E15 –Promotion of the Soltherm solar water heater	Promotion of solar water heaters	CO_2	EDU/FIN	IMP	Walloon Region General Directorate of Technology, Research and Energy
E16 - Subsidies for investments leading to energy efficiency	Improvement of energy efficiency	CO_2	FIN	IMP	Brussels-Capital Region IBGE/BIM
E17 - Subsidies for investments in solar water heaters	Promotion of solar water heaters	CO_2	EDU/FIN	IMP	Brussels-Capital Region IBGE/BIM
E18 - Free energy pre-audits	Energy efficiency	CO_2	FIN/EDU	IMP	Ministry of the Flemish Community (Energy Administration)
E19 - Grant towards the cost of an audit energy	Energy efficiency, promotion of RES	CO_2	FIN/EDU	IMP	Walloon Region General Directorate of Technology, Research and Energy

E20 Free consultation service for SMEs	Energy efficiency, promotion of RUE	CO_2	FIN/EDU	IMP	Walloon Region General Directorate of Technology, Research and Energy
E21- Subsidies for energy audits	Energy efficiency	CO_2	FIN/EDU	IMP	Brussels-Capital Region IBGE/BIM
E22 - Reductions in tariff for the clients of CHP installations	Promotion of CHP	CO_2	FIN	IMP	Federal State Ministry of Economic Affairs – Energy Administration
E23 – RUE/electricity Fund	Improvement of energy efficiency, promotion of the RES and the RUE	CO_2	FIN	IMP	Federal State Ministry of Economic Affairs – Energy Administration
E24 – Measures to encourage energy efficiency (gas industry)	Energy efficiency	CO_2	FIN	IMP	Federal State Ministry of Economic Affairs – Energy Administration
E25 - Financial Support for the production of electricity from RES	Promotion of RES	CO_2	FIN	IMP	Federal State Ministry of Economic Affairs – Energy Administration
E26 - Energy certification of buildings	Energy efficiency of buildings	CO_2	REG	ADO	Energy Administrations (federal + regional)
E27 - Introduction energy performance standards	Energy efficiency of buildings	CO_2	REG	Flemish Region: IMP other regions:PLA	Energy Administrations (regions)
E28 - Standards of energy efficiency for boilers and water heaters	Improvement of the energy efficiency of boilers and water heaters	CO_2	REG	IMP	Federal State Ministry of Social Affairs, Public health and environmental health
E29 - Energy efficiency labels	Improvement of the energy efficiency of domestic appliances	CO_2	REG	IMP	Federal State Ministry of Social Affairs, Public health and environmental health
E30 - Benchmarking Agreements (Flemish Region)	Energy efficiency in the industrial sector	CO_2	VOL	IMP	Ministry of the Flemish Community (Energy Administration)
E31 - Voluntary agreements with industry (Walloon Region)	Energy efficiency in the industrial sector	CO_2	VOL	IMP	Walloon Region General Directorate of Technology, Research and Energy
E32 - “Eco-dynamic Company” Label (Brussels-Cap. Region)	Improving energy efficiency in companies	CO_2	VOL	IMP	Brussels-Capital Region IBGE/BIM
E33 - AMPERE Commission	Analysis aimed at planning energy policy	CO_2	PLA	IMP	Federal State Ministry of Economic Affairs – Energy Administration
E34 - New infrastructure projects	new infrastructure (wind, photovoltaic)	CO_2	PLA	ADO	Ministry of the Flemish Community (Energy Administration)
E35 - Demonstration projects (Flemish Region)	Information and public awareness (energy efficiency and RES)	CO_2	EDU	IMP	Energy Administrations (regions)
E36 – Code of good behaviour for the gas distribution sector	Analysis and prevention of CH_4 leaks	CH_4	VOL	PLA	Ministry of the Flemish Community (Administration of Environment)

4.3. TRANSPORT

4.3.1. MAIN OBJECTIVES OF THE TRANSPORT POLICIES

The action of the Federal Government regarding transport is essentially aimed at readjusting the modal split in favour of rail and navigable waterways. As an extension to the Government's general policy declaration of 17 October 2000, the Council of Ministers on 30 March 2001 undertook to increase the proportion of traffic carried by rail by 15% by 2010. This means that the railways will have to be able to transport 50% more travellers and goods. Furthermore, a *Regional Express Network* (REN[40]) project around Brussels, involving the Federal Authority and the 3 Regions, the first fruits of which should be unveiled by 2005, is currently in a consultation phase.

In the Flemish Region, a draft *Mobility Plan* was worked out in mid-2001. The objective of this plan is to control the growth of car traffic and to reduce the pollution associated with it, while maintaining accessibility to cities and villages. One of the goals of the *Mobility Plan* is to stabilise CO_2 emissions due to the transport sector in 2010 at the 1990 level. The preferred way to attain these objectives is to invest in public transport. In parallel, the environmental aspects of mobility are dealt with in the environmental policy, whose broad thrust was established in the *Environmental Policy Plan* (MINA plan). The 2nd MINA plan (1997-2001) contains a range of actions intended to reduce emissions due to transport, especially via technological measures that favour clean vehicles and fuels. The *Mobility Plan* is directly connected with the actions of the 3rd "Environmental Policy Plan" (MINA 3). In addition to actions that have already been implemented or adopted, the Flemish Region will in future put in place various measures that will encourage both passengers and goods to consider different modes of transport (improvement of infrastructure, adoption of a clear price system, technological development, etc.). In order to strengthen the efficiency of these investments, the Flemish Region will also seek to modify users' behaviour through economic incentives.

In the Walloon Region, transport issues are handled in the *Walloon Region Action Plan for Climate Change* (approved by the Walloon Government on 16 July 2001). The measures contained in the transport section are essentially of the structural type. Also found in it, but in a less active way, are organisatory and management measures, likewise measures related to education, public awareness and training. In addition to the measures contained in this National Communication, the Walloon Region will in the future seek an equitable distribution of the public space between users. Thus, it will encourage the use of "soft" ways of getting about (bicycle, on foot) by eliminating "blackspots" and the physical barriers present on some roads. Regarding the transport of goods, the Walloon Region also wants to promote a shift away from road transport. However, today, all the conditions and connections needed for the co-ordinated development of networks and freight terminals are not yet in place. The setting up of instruments for managing and planning the flow of goods is currently being studied.

Box 4-8. Regional Express Network project

The *Regional Express Network* (REN) project is targeted at providing a credible and effective alternative in order to encourage the use of public transport and to reduce that of the car. The project hinges around journeys by train and bus being complementary.
The rail part of the project comprises 6 existing SNCB/NMBS [*Belgian National Railway Company*] lines where the traffic will be increased to 4 trains an hour in each direction at rush hours. This greater frequency will offer commuters more flexibility. Nine major REN lines will be included in the scheme based on SNCB/NMBS travelling statistics, passing through Brussels.
While the railway represents the backbone of this draft, several urbanised areas cannot be served directly by trains. For this reason several bus connections are also being planned. Thus, 5 bus services will link up with the rail network (Brussels/Ninove/Londerzeel/Haacht/Leuven/Wavre). Some bus services will also run more frequently. Likewise, public transport in the heart of the capital will also improved by additional metro services, extensions to lines and new metro lines. Furthermore, new infrastructure should also come on stream (new stations, dropping-off parking areas, bicycle shelters, etc.).
A draft co-operation agreement has been worked out and was approved on 20 April 2001 by the Federal Council of Ministers. This draft co-operation agreement is currently at the consultation stage with the regional governments.

[40] Réseau Expres Régional (RER)

In Brussels-Capital Region, the mobility policy is laid out in the *Transport Plan* or *Iris Plan*. The objective of this plan is to stabilise car journeys in the morning rush hour at the 1991 level by 2005. It uses a number of actions on urban structures, public transport, car traffic, pedestrians, bicycles and motorcycles and the transport of goods. The *Iris Plan* was approved by the government of the Brussels-Capital Region on 1st October 1998. An *Iris Plan II* is being prepared. It is part of the *Regional Development Plan* (PRD), whose main target is to reduce the pollution due to transport. It gives priority to reducing automobile traffic (the aim is a 20 % reduction in the number of kilometres driven in 2010 compared to 1999). This policy is based on an integrated multi-modal approach. Finally, the measures contained in the *Air Plan* (which is targeted at preventing harmful effects on human health) are also designed to contribute towards reducing the volume of road traffic and the emissions due to it. As is the case for the two other regions, the Brussels-Capital Region provides, in addition to measures already in place or that will be brought in in the near future, for other actions to promote more sustainable mobility. Thus the Brussels-Capital Region will for example, in the area of car parking, create an infrastructure for transferring between motor cars and public transport. Brussels Region will also improve complementarity between ways in which goods are delivered by developing road-rail connections and improving access to the airport and setting up distribution centres. To conclude, the Brussels Region is also investigating the possibility of introducing tax and tariff measures with the aim of changing the cost of some forms of transport and internalising external costs.

The policies and measures presented below hinge around three main approaches:

- measures that aim at moving people and goods to other forms of transport (including measures encouraging a reduction in the demand for transport);
- measures aiming to reduce polluting emissions from vehicles
- other actions, including making people aware of the issues.

4.3.2. MEASURES TO ENCOURAGE THE USE OF DIFFERENT FORMS OF TRANSPORT

4.3.2.1. Passenger transport

i. Improvement of the number of trains and the quality of public transport

The three Regions, plus the Federal State, have undertaken a series of measures aiming to improve the amount and quality of public transport:

T1 – Improvement of public transport in the Flemish Region[41]

- development of the links and points of connection between networks
- increased amount of urban and regional transport
- measures intended to increase traffic flow; priority regulations for public transport
- improvement of user safety on public transport
- development of new services such as systems of giving travellers information about all modes of transport from one centralised source

T2 – Improvement of public transport in the Walloon Region[42]

- Increasing supply to meet demand: services and vehicles appropriate for the population and building density, at the right time (buses in the evening or at night, taxi-bus combinations, etc.), and for the people they want to serve (e.g.: low floors, facilities for people with reduced mobility, etc.)
- Co-ordination of the timetables between railways and other public transport

[41] Decree concerning the provision of passenger transport on public highways and establishing the Flanders Mobility Council (20/04/01)
[42] Walloon Region management contract – TEC and SRWT; Approval decision by the Walloon Government regarding the SRWT investment programme; Federal State management contract - SNCB/NMBS

- Regulation of intersections controlled by traffic lights, giving priority to public transport on the main access roads to city centres
- Setting up systems to help with operation (systems for managing the bus fleet and for giving real time information to travellers)
- Progressive renewal of the stock of public transport vehicles (less polluting vehicles)

T3 - Improvement of public transport in Brussels-Capital Region [43]

- Development of bus and tram lines (changes to the metro, new lines to the suburbs)
- Integration of the fare structure to encourage the use of different forms of transport
- Priority routes for trams and buses
- Increased frequency of trams, buses and metro trains
- Increased operating speed of trams and buses

T4 - The Federal Government's Railway investment plan

An ambitious investment plan in the railways (EUR 17 billion), was approved by the Federal Government on 13 July 2001. This plan, spread over several years (2001-2012), will allow the SNCB/NMBS to optimise the services it offers to transport people and goods by improvements in capacity, safety and speed. So investments will be made to improve the service to the clientele and to increase the regularity plus the speed of the traffic. The investments will be targeted at improved maintenance and capacity, on improving the rolling stock, on high speed train (TGV) infrastructure and on improving mobility in Brussels. This plan will also the subject of a co-operation agreement with the Regions.

ii. Promoting the use of alternative means of transport for daily journeys

FEDERAL STATE (FISCAL MEASURES):

T5 - Exemption from tax of contributions made by employers to the price of public transport season tickets and to car-pooling[44]

Contributions by employers to the cost of a season ticket from a public transport company for making journeys between home and the place of work can from now on be wholly set against tax (up to a limit of EUR 125 per year). Previously the tax exemption had been limited to the quota corresponding to the contribution the employer was obliged to make. This measure applies to both the private and sector public and comes into force in the 2001 tax year, that is to say for the income of the year 2000. The employer's contribution for car-pooling is also free of tax. The amount exempted is in this case limited to the price of a first class train season ticket for a distance equal to the distance the worker has to travel by public transport.

The two measures below have been adopted under the law of 10 August 2001 reforming personal taxation (M.B. of 20 September 2001):

T6 - Fiscal Deduction of travel costs

In order to encourage taxpayers to journey between home and the place of work otherwise than in a motor car, the deductible professional expenses relating to such journeys are fixed at a set level of EUR 0.15 /km, even if the real cost is lower (Art. 9 of the above-mentioned law). At present this deduction only concerns journeys by motor car, hybrid vehicle or minibus; so it is being extended to all modes of journey, whether this be walking, by bicycle, public transport or even car-pooling. For the 2002 tax year (income from 2001), the maximum distance allowed for is fixed at 50 km for the round trip. It may be increased later if the available budget of BEF 2.5 billion is not exhausted;

[43] Brussels Region management contract- STIB (2001-2005)
[44] Law of 10 July 2001 modifying article 38 of the Code concerning tax on 1992 income regarding the employer's contribution to travel expenses from the home to the workplace (M.B. of 22 August 2001).

T7 - Fiscal deduction of expenses agreed to by the employer for the use of collective transport available to members of staff

Employers may deduct 100 % of expenses agreed to for the operation of collective transport of members of staff (Art. 62 of the law of 10 August 2001). Currently, this deductibility is limited, in certain cases, to 75 %. The investments and expenses to be taken into consideration are: investments in minibuses, buses and coaches that are used for the collective transport of workers from home to the place of work; the expenses directly incurred by these vehicles, such as maintenance and repairs, the road tax, the insurance, the fuel, etc.; the expenditure paid to companies that, in place of the employer or the group of employers, undertake the collective transportation of workers from home to the place of work. This measure will be applied starting with the 2002 tax year (2001 income). From the 2003 tax year onwards (income earned in 2002), the amount that can be deducted will rise to 120 % (Art. 63).

FLEMISH REGION:

T8 - Implementation of local transport plans (schools and companies)

An intensive programme of company mobility, with a point of contact in each province, has just finished. An evaluation of the programmes has been performed. Moreover, the Mobility Cell will continue to support companies that wish to set up a transport plan by making explanatory notes available to them.

T9 - Pricing policy in support of public transport

The public transport company 'De Lijn' (bus & tramway) has agreed to grant free access to children (-12 years old) and senior citizens (+60 years old)

WALLOON REGION:

T10 - Promotion of plans for transporting company staff

- an agreement between Walloon Region and the Walloon Business Federation[45] for a campaign to make people aware of issues in managing the mobility of Walloon companies;
- the production, in collaboration with the "UWE Mobility Cell" and based on existing experiences, of a methodological guide intended to help companies draw up a *Company Transport Plan* (PTE);
- running training courses for company mobility advisors;
- agreements between the Walloon Region and companies (public or private) to conduct pilot transport plan experiments.

T11 - Promotion of the use of the bicycles for the daily home-school journeys:

- information and awareness campaigns drawing the attention of municipalities and schools to the need to encourage children to come to school by bicycle, in groups under the supervision of adults;
- programme for promoting school bicycles: the Region Wallonia is supporting a "Wallonia school of school bicycle instructors" whose aim is to train instructors responsible for this service. These monitors are made available to municipalities, schools and associations.

BRUSSELS-CAPITAL REGION:

T12 - Plans for transporting company staff

Organisation of home-work journeys by members of staff (car pooling, transfer from using cars to walking, bicycles and public transport, etc.) plus professional journeys (service vehicles, etc.).

[45] Union wallonne des entreprises (UWE)

iii. Improvement of the infrastructure for cyclists and pedestrians

FLEMISH REGION:

T13 - Improvement of the infrastructure for cyclists and pedestrians

- extension of a functional network for pedestrians and cyclists
- improvement of cycle paths and facilities for bicycles

BRUSSELS-CAPITAL REGION:

T14 - Improvement of infrastructure for cyclists[46]

- The general opening of one-way streets in two directions for cyclists
- Installation of appropriate facilities (bicycle stands, bicycle hire and minor maintenance) at the main stops and stations of Brussels public transport

4.3.2.2. Transport of goods

FEDERAL STATE:

T15 – Improvement of transport infrastructure around the Port of Antwerp

- A new platform connecting different types of transport (the Main Hub) was inaugurated on 29 August 2001 at the port of Antwerp. This container terminal, representing an investment of approximately BEF two billion (nearly EUR 50 millions), is intended to respond to the present and future strong growth of maritime container traffic. By 2005 it will cater for 6 to 700 000 movements per year, and is called to play a major role in the development of integrated continental transport.
- Access to the port of Antwerp will be improved, by creating a second rail access, and reopening the “Iron Rhine” (rail link between Antwerp and the Ruhr via Roermond).

FLEMISH REGION:

T16 - Improvement of the quality of transport by navigable waterway

- resolution of the structural bottlenecks on the navigable waterways
- guaranteed minimum provision of services for the navigable waterways of the Transeuropean Network (TEN)
- encouragement of ‘short sea shipping’
- maintenance of the network of main navigable waterways

T17 - Improvement of multimodal systems to promote the use of alternative modes of transport

- implementation of integrated systems for information about all forms of transport, reservation and payment
- identification and resolution of bottlenecks in the different transport systems following a hierarchy, taking into account the present situation
- development of new products and services to ensure a link between different modes of transport and to improve the quality and efficiency of moving between modes (efficient logistics systems, on-line data processing services, etc.). These measures must enable loading problems leading to loss of time and surcharges to be resolved; the standardisation of loading units is also an element that has to be improved.

[46] Brussels Region-SNCB/NMBS Agreement, Iris Plan

WALLOON REGION:

T18 - Improvement of the quality of navigable waterways

- Achievement of the upgrading to the European size (1350 tonnes) of the Walloon canals: Improvement of the Scheldt-Meuse link, modernisation of the low Meuse, Improvement of the middle Meuse (restoration of the Ivoz-Ramet dam)
- Management of sediment that has to be removed by dredging

T19 - Creation of multimodal platforms

Development project for the independent port of Clabecq and creation on this site of a third hub for three modes of transport that will allow the development of integrated transport from the Charleroi-Brussels canal.

BRUSSELS-CAPITAL REGION:

T20 - Rationalisation of the driving and parking rules for heavy loads in the city:

- Development of parking for deliveries and control of its good use
- Modification of the regulations about the loading and unloading of goods, to avoid this occurring at peak hours

T21 - Creation of multimodal platforms[47]:

- The creation of a hub with a container terminal connected to the integrated water-rail-road transport systems
- Liaison between the outer harbour and the new infrastructure for forming goods trains at Schaerbeek

4.3.3. REDUCTION OF POLLUTING EMISSIONS FROM VEHICLES (FISCAL MEASURES AND FINANCIAL INCENTIVES)

FEDERAL STATE:

The following measures are contained in the *Federal Plan to combat Acidification and ozone in the troposphere (2000-2003)*:

T22 - Modulation of the value of the European road tax

A law[48] introduces a differentiation of the amount payable in European road tax in accordance with "EURO" standards, in such a way as to encourage vehicles to meet the most recent standards for polluting emissions.

T23 - LPG Allowances[49]

Since 1st January 2001, allowances of BEF 20,500 are granted if LPG equipment is fitted on a petrol-powered car already in circulation. This allowance scheme will remain in effect for 2 years.

[47] Iris Plan
[48] Law of 13 March 2001 concerning approval of the Protocol modifying the Agreement of 9 February 1994 relative to the perception of a right of use for the use of certain routes by heavy utility vehicles, in the light of the coming into force of Directive 1999/62/EC of the European Parliament and Council of the European Union of 17 June 1999 relating to the charging of heavy goods vehicles for the use of certain infrastructures, signed in Brussels on 22 March 2000, between the Governments of the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands and the Kingdom of Sweden, and modifying the law of 27 December 1994 concerning approval of the aforementioned Agreement and introducing a European road tax disk, in accordance with Directive 93/89/EEC of the Council of the European Communities of 25 October 1993 (M. B. of 30 March 2001).
[49] Royal Decree of 14/02/01, published 12/04/01 in the 'Moniteur Belge' (M.B.)

REGIONS[50]:

T24 - Reduction of the car registration tax for LPG vehicles

The car registration tax (a tax only paid when purchasing a vehicle) for cars fitted from the outset with LPG will be reduced by BEF 12,000. This will promote the purchase of new LPG motor cars (in practice, this reduction will make the car registration tax free for the smallest vehicles).

T25 - Reduction of the car registration tax for "Euro 4" motor cars

The car registration tax for new motor cars that meet the European "Euro4" standards of lower air pollution will be reduced, in 2002, by BEF 25,000 for diesel-powered vehicles and by BEF 13,000 for petrol-driven vehicles. In 2003, the reductions will be respectively BEF 20,000 and 10,000 and in 2004, they will be BEF 10,000 and 5,000. Up to a capacity of 10 CV, the tax will be zero. From 2005, the "Euro 4" standard will be obligatory so there will no longer be a reduction.

T26 - Revision of the car registration tax for second-hand vehicles

The car registration tax for second-hand vehicles will only be reduced by 5% per year dating from the 5th year after they were initially put onto the road, instead of 10%.

T27 - Modulation of the road tax depending on polluting emissions

The road tax will be modified depending on polluting emissions: the tax is reduced for vehicles that satisfy the "Euro 2" standard; it is raised for vehicles that do not meet the "Euro 1" standard.

4.3.4. OTHER MEASURES

FLEMISH REGION:

T28 - Promotion of "clean" vehicles

Modification of behaviour patterns of consumption in favour of vehicles that emit low amounts of pollutants; Internet database stating the fuel consumption of every new motor car distributed in Belgium.

T29 – Traffic Regulation

Use of technological means to regulate traffic flow (e.g. ISA: Intelligent Speed Adaptation).

WALLOON REGION:

T30 - Training of Mobility Advisers

This basic training pursues two fundamental objectives: to develop the awareness of Mobility Advisers and create a "common language" thus reinforcing the connections between the various mobility players; in parallel to these activities, a centre of documentation and for spreading information about mobility has been created.

T31 - Mobility observatory[51]

- A mobility observatory has been set up; it has the following missions, covering the transport of people and goods:
- to gather, analyse, and disseminate data about mobility;

[50] Fiscal measures relative to the car registration tax and the road tax are part of the regional competences from 1/1/2002 ; the different measures presented here are implemented within the framework of a cooperation agreement concluded between the three regions on 25 January 2002
[51] Approved by the Walloon Government on 12/07/01

- to establish and keep up to date a set of indicators intended to characterise mobility systems and evaluate their performance and their interactions;
- to establish a diagnosis of mobility in the Walloon Region;
- to contribute to a better understanding of behaviour patterns in mobility and how they evolve;
- to improve the ability to predict mobility.

BRUSSELS REGION

T32 - Setting up of a mobility observatory[52]

Missions: see action T31 “Mobility observatory” in the Walloon Region

T33 - Campaigns to promote the use of bicycles in town

- Promoting the image of bicycles as a travel mode (sole or combined with other modes
- Planning a network of cyclable itineraries throughout the region with users’ associations

[52] Iris Plan

Table 4-3. Summary of the policies and measures: 2. Transport

Heading	objective or activity affected	GHG affected	Type of instrument	Stage of implementation	Implementing entity(ies)
T1 - Improvements to public transport (Flemish Region)	Increase the provision and improve the quality of public transport	CO_2, N_2O, ozone	MIX	ADO	Flemish Region Mobility Cell
T2 - Improvements to public transport (Walloon Region)	ditto	CO_2, N_2O, ozone	MIX	IMP	Walloon Region (MET (DG3), SRWT, TEC) + SNCB/NMBS
T3 - Improvements to public transport (Brussels-Cap. Region)	ditto	CO_2, N_2O, ozone	MIX	IMP	Brussels-Capital Region AED+STIB/MVIB[*Brussels Public transport Company*]+Federal State
T4 - Federal Government's rail investment plan	ditto	CO_2, N_2O, ozone	PLA	ADO	Federal State (Min. Communications and Infrastructure) + agreement for State / Region co-operation
T5 - Tax exemption for employer's contribution to the price of public transport season tickets and car pooling	The use of public transport and car pooling for home / work journeys	CO_2, N_2O, ozone	FIN	ADO	Federal State Min. of Finance
T6 - Journey expenses become tax deductible	Use of alternative means of transport for home / work journeys	CO_2, N_2O, ozone	FIN	ADO	Federal State Min. of Finance
T7 - Agreed employer's expenses for operating collective transport for members of staff becomes tax deductible	Collective transport of company personnel	CO_2, N_2O, ozone	FIN	ADO	Federal State Min. of Finance
T8 - Implementation of local transport plans (schools and companies)	Collective transport (school children and company personnel)	CO_2, N_2O, ozone	VOL	IMP	Flemish Region Mobility Cell
T9 - Pricing policy in favour of public transport	Promotion of the use of public transport	CO_2, N_2O, ozone	FIN	IMP	Flemish Region Mobility Cell, De Lijn company
T10 - Promotion of company staff transport plans	Collective transport of company personnel	CO_2, N_2O, ozone	VOL	PLA	Walloon Region
T11 - Promotion of the use of the bicycles for daily home-school journeys	Use of bicycles for home-school journeys	CO_2, N_2O, ozone	EDU	ADO	Walloon Region municipalities
T12 - Plans for transporting company personnel	Use of alternative means of transport for home / work journeys	CO_2, N_2O, ozone	VOL	IMP	Brussels Region MCI+ IBGE/BIM+ AED
T13 - Improvement of the infrastructure for cyclists and pedestrians	Use of bicycles and walking for short journeys	CO_2, N_2O, ozone	INF	ADO	Flemish Region Mobility Cell
T14 - Improvement of infrastructure for cyclists	Promotion of the use of bicycles in towns & cities	CO_2, N_2O, ozone	MIX	IMP/ADO	Brussels Region AED+ municipalities
T15 – Improvement of transport infrastructure around the Port of Antwerp	Use of different modes of transport	CO_2, N_2O, ozone	INF	IMP	Federal State + SNCB/NMBS + Port of Antwerp
T16 - Improvement of the quality of transport by navigable waterway (Flemish Region)	Increase of the proportion of goods transported by navigable waterway	CO_2, N_2O, ozone	INF	ADO	Flemish Region: Mobility Cell

T17 - Improvement of systems to promote the use of alternative modes of transport	Changing between modes of transport	CO_2, N_2O, ozone	INF	PLA	Flemish Region: Mobility Cell
T18 - Improvement of the quality of navigable waterways	Increased proportion of goods transported by navigable waterway	CO_2, N_2O, ozone	INF	ADO	Walloon Region
T19 - Creation of multimodal platforms (hubs) (Walloon Region)	Changing between modes of transport	CO_2, N_2O, ozone	INF	ADO	Walloon Region
T20 - Rationalisation of the traffic flow and parking for heavy loads in cities	Freeing up city traffic	CO_2, N_2O, ozone	REG	PLA	Brussels Region Police+AED
T21 - Creation of multimodal platforms (hubs) (Region Brussels)	Changing between modes of transport	CO_2, N_2O, ozone	INF	ADO	Brussels Region Port of Brussels +SNCB/NMBS+SDRB
T22 - Modulation of the size of the European road tax	Promotion of less polluting vehicles	CO_2, N_2O, ozone	FIN	IMP	Federal State Min. of Finance
T23 - LPG Allowance	Promotion of less polluting vehicles	CO_2, N_2O, ozone	FIN	IMP	Federal State Min. of the Environment
T24 - Reduction of the tax for bringing LPG vehicles onto the road	Promotion of less polluting vehicles	CO_2, N_2O, ozone	FIN	ADO	Regions (Cooperation agreement)
T25 - Reduction of the tax for bringing “Euro 4” cars onto the road	Promotion of less polluting vehicles	CO_2, N_2O, ozone	FIN	ADO	Regions (Cooperation agreement)
T26 - Revision of the tax for bringing second-hand vehicles onto the road	Promotion of less polluting vehicles	CO_2, N_2O, ozone	FIN	ADO	Regions (Cooperation agreement)
T27 - Modulation of the tax for getting the vehicle on the road depending on polluting emissions	Promotion of less polluting vehicles	CO_2, N_2O, ozone	FIN	ADO	Regions (Cooperation agreement)
T28 - Promotion of “clean” vehicles	Changing the behaviour patterns of consumption	CO_2, N_2O, ozone	EDU	IMP	Flemish Region: Aminabel- air section
T29 – Traffic regulation	Reduce polluting emissions due to car traffic	CO_2, N_2O, ozone	PLA	IMP	Flemish Region Mobility Cell
T30 - Training of mobility advisers	To strengthen the authority of mobility organisations	CO_2, N_2O, ozone	EDU	IMP	Walloon Region MET (DG1, DG2, DG3) +DGRNE + DGATLP
T31, T32 - Mobility observatory	Monitoring and evaluation of policies	CO_2, N_2O, ozone	PLA	ADO	Walloon Region
				ADO	Brussels Region AED
T33 - Campaigns promoting the use of bicycles in the city	Promotion of the use of bicycles in the city	CO_2, N_2O, ozone	EDU	IMP	Brussels Region AED+ municipalities

4.4. INDUSTRY

preliminary remark:

Policies and measures that aims at improving energy efficiency in the industrial sector are presented in § 4.2 ("Energy"). Actions that relate to training or making people aware of the issues are set forth in Section 9 "Education, training and public awareness ". So actions in the industrial sector with a main objective other than the improvement of energy efficiency, and making use of other instruments than training, are only referred to here. The measures listed are essentialy measures of process improvement.

4.4.1. POLICY CONTEXT OF ACTIONS IN THE INDUSTRIAL SECTOR

In the Flemish Region, the context for introducing measures for reducing non-energy sources of greenhouse gases emissions in the industrial sector is the regulations relating to environmental permits[53] and benchmarking agreements. Regarding benchmarking, negotiations have been initiated between the public authorities and the iron and steel, chemical, and paper industries.

The prefered strategy of the Walloon Region to encourage industry to reduce emissions of greenhouse gases per unit produced is based on negotiated voluntary agreements. These agreements that cover an entire sector constitute a "contract" between the public authorities and associations of companies in the industry, by which the two parties agree a quantitative improvement in the emission of pollutants. In addition to improving energy efficiency (see § 4.2.5), these agreements aim especially at the management of industrial waste, the implementation of "best available technologies" (structural process modifications), product policies. They will be given teeth with penalties if they are not respected. These voluntary agreements are subscribed to under the general legislation regarding environmental conventions, established by the decree of the Walloon Government of 20 December 2001.

In Brussels-Capital Region, there is currently no integrated policy as such for reducing greenhouse gases emissions in the industrial sector (except relative to energy efficiency, see § 4.2.5). However, particular measures have been taken notably through environmental permits.

4.4.2. POLICIES AND MEASURES IN THE INDUSTRIAL SECTOR

FLEMISH REGION:

I1 - Adaptation of the VLAREM regulations (N_2O catalysts)

The Flemish Region is changing the present regulations regarding environmental permits (VLAREM II) in order to encourage the introduction of new and efficient technologies (catalysts) substantially reducing the emissions of N_2O related to the production of nitric acid; these catalysts have the potential to reduce N_2O emission by 50%.

I2 - Regulations aiming to limit the use of fluorinated greenhouse gases

The "reduction of the ozone layer" chapter of the *Environmental Policy Plan* (MiNa plans 2 and 3) includes a section relating to the use of fluorinated greenhouse gases, since these gases are often used as substitutes for ozone depleting substances. Additional regulations regarding the use of refrigeration installations and the approval of cold techniques must provide every guarantee that emissions of refrigerating fluids from leaks will be limited. Practical measures must lead to abandon the use of ozone depleting substances and fluorinated greenhouse gases in favour of environment-friendly alternatives.

[53] Cf. decrees on the Flemish Regulations regarding environmental permits VLAREM I (February 1991), VLAREM II (July 1995) and subsequent adaptations.

I3 - Best Available Technologies

Every industrial establishment in the Flemish Region will be obliged to meet performances equivalent in terms of results to the use of BAT (best available technologies) in order to obtain their environmental permits (implementation of the EU Directive "Integrated Pollution Prevention and Control").

WALLOON REGION:

I4 - Sector agreements

- declarations of intent were signed with the chemical (WalChim) and paper (Cobelpa) industrial federations in July 2000, followed by the federation of mining industries (FedIEx) and the cement producers' federation (Febelcem) in February 2001 and July 2001 respectively;
- advance contacts have also been made with the iron and steel sector, with the non ferrous metals industry and the smelting works' sector
- a convention is being investigated regarding the limitation of N_2O emissions in the chemical industry (manufacture of nitric acid), through the development of catalysts

I5 - Best Available Technologies

Same as **I3** above (implementation of the IPPC EU directive "Integrated Pollution and Prevention Control")

Table 4-4. Summary of the policies and measures: 3. Industry

Heading	objective or activity affected	GHG affected	Type of instrument	Stage of implementation	Implementing entity(ies)
I1 - Adaptation of the VLAREM regulations (N_2O catalysts)	Limitation of N_2O emissions released by the production of nitric acid	N_2O	REG	PLA	Flemish Region
I2 - Regulations aiming to limit the use of fluorinated greenhouse gases	Reduced emissions of fluorinated greenhouse gases	HFCs, PFCs, SF_6	REG	IMP/ADO	Flemish Region
I3 - "Best Available Technologies" (Flemish Region)	Implementation of the IPPC directive	all	REG	ADO	Flemish Region
I4 - Sector agreements (Walloon Region)	Reduction of GHG emissions (Chemistry, paper, mining industries, cement)	all	VOL	ADO/PLA	Walloon Region
I5 - "Best Available Technologies" (Walloon Region)	Implementation of the IPPC directive	all	REG	ADO	Walloon Region

4.5. AGRICULTURE AND FORESTRY

4.5.1. CONTEXT OF THE ACTION POLICY IN THE AGRICULTURE AND FORESTRY INDUSTRIES

The authority of the Federal State over agriculture is limited to determining the Belgian position towards agricultural policies on the level of the European Union and international organisations, together with preparing for the implementation of the European Directives and regulations regarding these policies.

In the Flemish Region, important modifications have been made since the first and second National Communications towards the integration of environmental policy into agricultural policy. Generally speaking, these modifications concern the reduction of inputs into the agricultural system, with in the majority of cases a positive effect on the emission of greenhouse gases.

In the Walloon Region, the *Walloon Rural Development Plan* (RDP – 2000-2006) constitutes the context of the policy action in the agricultural sector. This plan, which is founded on the CAP (Common Agricultural Policy of the EU), was drawn up to put into practice Council Regulation 1257/99/EC. The RDP hinges on three main priorities, which are: sustainable agriculture, helping young farmers get started, and quality and control. In addition, two legislative instruments coming into force soon will define a favourable environmental context in which agriculture can participate and develop an integrated approach to preventing and reducing pollution:

- the decrees putting into practice the decree concerning environmental permits (11/03/1999);
- the decree relating to the sustainable management of nitrogen in agriculture.

They will form the main legal backdrop for sustainable agriculture in Wallonia.

In the Brussels-Capital Region, as the area of land devoted to agriculture is now extremely reduced, there is no agricultural policy as such. It is merged with the policy regarding town and country planning and the environment, and is primarily targeted at the preservation and harmonious development of green spaces.

4.5.2. POLICIES AND MEASURES IN THE AGRICULTURE INDUSTRY

FLEMISH REGION:

A1 - Manure Action Plan[54]

- in the context of the new policy on manure, which has been in force since 1/1/2000, new standards for spreading nitrogen have been established; they will be introduced gradually up to 2003;
- a limit on the increase of livestock has been imposed: until 2005, no environmental permits for additional beasts may be granted;
- techniques of manure transformation will be developed, in order to convert animal waste into exportable products, without additional emission of greenhouse gases;
- different systems of assessing the nutrient balance are provided as management instruments to assist farmers; these systems must enable quantities of nutrients entering and leaving a given system (farm, plot of land, animal) to be calculated.

A2 - Reduction in pig breeding

The progressive move away from pig farming will be sustained financially by the authorities. By 15 May 2001, 437 requests had already been submitted for a total of 11,134 sows and 61,197 porkers, in other words 2.5 % of the total livestock. An initial evaluation shows that the surplus consumption of

[54] 'Mest Actie Plan 2'

nitrogenous fertiliser by farms could be reduced by approximately 1,400,000 kg (1.8% of the total fertiliser surplus)

A3 - Plan for Reducing Ammonia

The *Plan for reducing ammonia* (action 21 of MiNa plan II), which came into force at the end of 2000, is targeted at reducing uncontrolled emissions of ammonia-generating gases produced by cowsheds and by fertilising agricultural ground. The principal measures target changes of practice in storing, handling and spreading liquid manure. The plan relies on a phased approach in which the most effective measures (from the cost point of view) will be applied first.

A4 - The "Organic Farming" Action Plan

The *"Organic Farming" action plan* is targeted at transforming all agricultural production in the Flemish Region into a more sustainable form. The objective of this plan is to cultivate 10 % of farmland organically by 2010. The action plan includes measures based on support for investment, permanent training, the supervision of reorientation, the promotion and sale of farm produce, and education.

A5 - The Flanders Rural Development Programme[55] (POP)

The objective of this programme is to establish a context for sustainable development of rural areas. The major objective is the development of more sustainable mixed farming, in the context of an integrated rural policy. This basic strategy is reflected in ten strategic objectives of integrated rural policy, which include:

- the promotion of methods of production that favour quality, and take into account social and environmental aspects and animal welfare;
- the accelerated development of activities that will extend organic farming and the marketing of organic produce;
- the involvement of farmers and horticulturists in the management of the natural environment, within the farm structure, plus in predefined zones;
- conversion towards sustainable water management.

If all these measures are successful, emissions of CH_4 and N_2O will be reduced by 0.6 Mton CO_2 eq. / year in 2005 compared with the 1990 level.

WALLOON REGION:

A6 - Rural Development Plan (RDP)

The *2000-2006 Rural Development Plan* is made up of a coherent set of measures, of which several are designed to reduce emissions of greenhouse gases; the list below is not exhaustive, but gives a flavour of them:

- measures to stimulate investment in energy saving and the reduction of emissions of pollutants of agricultural origin;
- financial support for training in agricultural and environmental techniques;
- encouragement for good management practices (in farming and the environment), in the form of grants to operators who follow a management plan (5% of the businesses are involved);
- a variety of actions for awareness raising;
- measures designed to combat destruction of soil structure, to introduce the scientific application of organic matter, waste recovery, etc.

A7 - Agri-environmental measures

Among the agri-environmental measures passed by the Walloon Government on 11 March 1999[56], the following measures will have a significant impact on the emission of greenhouse gases from the agricultural sector:

[55] that implements directive EC/1257/99
[56] Moniteur Belge/Staatsblad of 31 March 1999

- the introduction of extensive strips of meadow or grassed strips at the side of cropfields along waterways to avoid losses of nitrogen and pesticides onto the surface water;
- the introduction of seeded crops in between other cultivated crops in order to reduce the loss of nitrates by leaching or run-off by 50%;

These measures are supported financially to the tune of 50% by the Walloon Region and 50% by the EU.

A8 - Storage, handling and spreading of farmyard manure

A set of measures concerning the storage, handling and spreading of farmyard manure is being brought in gradually by 2010. These measures are especially aimed at optimising the techniques and practices of storage, spreading, composting and production of bio methane, via environmental agreements and with the financial support of the public authorities.

A9 - Reduction in the application of mineral nitrogen

The Walloon Region will be introducing between now and 2010 a set of measures aiming to reduce the quantity of mineral nitrogen used in agriculture. These measures will concern the entire management of organic matter, the storage infrastructure for farmyard manure, the physico-chemical characterisation of this manure, when is the best time to apply it, the assessment of its fertilising value in the context of manuring plans and a scientific approach to complementing organic fertilisers with mineral fertilisers.

4.5.3. POLICIES AND MEASURES IN THE FORESTRY INDUSTRY

FEDERAL STATE:

A10 - Measures for supervising reforestation

The Federal Government has implemented a measure for overseeing actions undertaken at the regional level to encourage reforestation; financial assistance was available compensating farmers for the loss of revenue associated with reconversion (reforestation of agricultural or other plots of land); this governmental aid, rarely requested, was phased out in 2000.

FLEMISH REGION:

A11 - Reconversion of lands (reforestation)

The authorities of the Flemish Region have set up, under the town and country planning act (“Flanders Structural Town and Country Plan”), measures aiming to extend the amount of woodland. The Flemish Region policy of reforestation is based on two strategies: firstly the authorities are pursuing a purchasing policy aiming to create new areas of woodland; secondly they are pursuing a policy of financial support aiming to initiate reforestation initiatives by local authorities or individuals.

A12 - Prohibition on deforestation

New regulations regarding deforestation came into force in February 2001. The objective of these regulations is to preserve wooded areas in the Flemish Region; the deforestation of ground outside residential and industrial areas is no longer allowed unless special exemption is obtained from the general prohibition of deforestation. Furthermore, if any trees are felled from a plot of land compensation is required; this may be made in kind (by planting trees elsewhere), or by a payment. The compensation factor depends on the ecological value of the wood concerned and varies from a factor of 1 to 2; the basic figure for the compensation is BEF 80/m², multiplied by the compensation factor.

WALLOON REGION:

A13 - preservation of the ecological stability of forests

The *Rural Development Plan 2000-2006* provides compensation for the lack of income for proprietors who practice forest conservation, by a policy of awarding allowances to private proprietors for setting up, managing and conservation of private forest reserves.

A14 - The Wood Energy Plan

A *Wood Energy Plan* was set up in March 2001. It is targeted at initiating and conducting a dozen projects for automatic wood heating, gas generation or other technologies using wood designed to recover energy from wood in Wallonia. This plan essentially concerns municipalities and communities, whether or not connected to district heating. By this plan, actions will be taken to give out information and make people aware of the issues, feasibility pre-studies will be performed (evaluation of the available resources, evaluation of energy needs, evaluation of the potential RUE) and assistance will be furnished with setting up projects.

A15 – Study of carbon sequestration

Since 1987, the Walloon Region has participated in co-financing research conducted by the Gembloux Agricultural University (FUSAGx[57]) on the Vielsalm site. Since 1998, this work has been directed towards the Kyoto Protocol; thus Vielsalm is part of an international network of pilot sites that in due course will enable us to better understand and quantify the impact of forests and how they affect the land.

Table 4-5. Summary of the policies and measures: 4. Agriculture and Forestry

Heading	objective or activity affected	GHG affected	Type of instrument	Stage of implementation	Implementing entity(ies)
agriculture					
A1 - Manure Action Plan 2")	Reduction of agricultural inputs	N_2O, CH_4	REG	ADO	Flemish Region VLM - manure bank
A2 - Reduction in pork rearing	Reduction of agricultural inputs	N_2O, CH_4	FIN	IMP	Flemish Region ALT (Agricultural and horticultural administration)
A3 - Ammonia reduction plan	Reduction in NH3 emissions	N_2O	REG	ADO	Flemish Region
vA4 - "Organic Agriculture" action plan	10% of farmed land to be "organic" by 2010	N_2O, CH_4	FIN/EDU	PLA	Flemish Region ALT (Agricultural and horticultural administration)
A5 - Flanders Rural Development Programme	Improvement of agricultural practices	N_2O, CH_4	FIN/EDU	ADO/PLA	Flemish Region
A6 - Rural Development Plan (RDP)	Improvement of agricultural practices	CO_2, N_2O, CH_4	FIN/EDU	ADO/PLA	Walloon Region
A7 - Agri-environmental measures	Improvement of agricultural practices	N_2O	REG	ADO/PLA	Walloon Region
A8 - Storage, treatment, spreading of farmyard manure	Optimisation of fertilisation	N_2O, CH_4	FIN/VOL	PLA	Walloon Region
A9 - Reduced input of mineral nitrogen	Reduction of added nitrogen	N_2O	REG	PLA	Walloon Region

[57] "Faculté universitaire des sciences agronomiques de Gembloux"

forestry					
A10 - Measure to support reforestation	reforestation	CO_2	FIN	IMP (end: 2000)	Federal State Min. of Agriculture
A11 - Reconversion of ground (Flemish Region)	reforestation	CO_2	FIN	IMP	Flemish Region Department of Woods and Countryside
A12 - Prohibition of deforestation	Preservation of wooded land	CO_2	REG	IMP	Flemish Region Department of Woods and Countryside
A13 - Preservation of the ecological stability of forests	Forest Conservation	CO_2	FIN	ADO	Walloon Region
A14 - Wood Energy Plan	Recovery of energy from wood	CO_2	EDU	ADO	Walloon Region
A15 – Investigation of carbon sequestration	Improved knowledge of carbon sinks	CO_2	R&D	IMP	Walloon Region

4.6. WASTE

4.6.1. THE ACTION POLICY IN THE WASTE INDUSTRY

At the federal level, a policy of waste limitation by the eco-tax system is currently being developed. The principle of this policy is to discourage the use of disposable packaging by introducing a difference of price between re-usable packaging and disposable packaging by the tax system.

In the Flemish Region, methane emissions from landfill sites (old or in use) are being regulated under the VLAREM II regulations (regarding environmental permits). Managers of landfill sites are required to install a system for collecting methane emissions and eliminating them (by combustion) in a controlled manner. The recovery of energy from waste gases is obligatory where it is economically advantageous. The waste prevention fund and the prohibition from dumping biologically degradable waste are managed by the *Flemish Public Waste Management Agency* (OVAM).

The action policy for waste in the Walloon Region is based partly on prevention (an audit is currently under way to define a regional waste prevention strategy, with the collaboration of the municipalities, the inter-municipal authorities and the private sector), and partly on waste recovery, and the optimisation of types of treatment.

In Brussels-Capital Region, the waste management strategy is defined by the *Waste Prevention and Management Plan (1998-2002).* This plan emphasises the prevention of waste at source, and on recovery methods.

4.6.2. POLICIES AND MEASURES IN THE WASTE INDUSTRY

FLEMISH REGION:

W1 - Moratorium on dumping organic waste

The regulations regarding the closure of biologically active landfill sites and the banning of dumping organic waste of biological origin have been in place since 1st July 2000.

W2 - Maintenance of obligations of elimination and reinforcement of the regulations regarding the putting to good use of gas from landfill sites

The strengthening of the VLAREM legislation (regulations regarding environmental permits) will require the installation of structures for the elimination of and the energy recovery from gas, and will not allow this last obligation to be waived by proving it is not a money-making activity (i.e. the opposite of the prevailing system), on an objective basis. The granting of environmental permits will be linked to these obligations being honoured. These new arrangements regarding dumps should, in combination with the moratorium on the dumping of organic waste, lead to a reduction of 0.8 Mton CO_2 eq in 2005 compared to 1999. This represents 60% of the potential for reducing total emissions (all sources together) of methane in 2005.

THE WALLOON REGION:

W3 - Setting up of specific channels of waste management

With the industrial sectors the Walloon Region is putting in place channels of waste management that relate to specific types of waste, so as to ensure optimal treatment, to develop recycling and recovery, and minimise the amount sent to landfill sites.

W4 - Ban on dumping organic biodegradable waste

A pilot decree heralding a ban on dumping organic waste in Walloon Region from 1st January 2005 onwards was adopted by the Walloon Government on 7 March 2001; this banning of discharge into landfill sites will have important repercussions on Walloon methane emissions. A series of measures aiming to ensure the appropriate treatment of organic waste (selective collection, development of new technology for drying it, composting, bio methane production, etc.) will accompany this plan.

W5 - Remedial treatment of old landfill sites

The programme to treat former dump sites will be pursued and intensified; this programme is intended to make sure that any emissions are recovered and treated correctly.

BRUSSELS-CAPITAL REGION:

W6 - Modifications to waste incineration installations

Under the *Waste Prevention and Management Plan of the Brussels-Capital Region (1998-2002)*, the number of installations for incinerating waste in the Brussels-Capital Region has been reduced (three incineration installations have been taken out of use between 1997 and 2000). Moreover stricter standards regarding atmospheric emissions have been imposed on incineration installations that continue to operate.

W7 - Waste reduction at source

The *Waste Prevention and Management Plan (1998-2002)* is targeted at reducing the amount of waste produced at source in 2002 by 10% (in weight) compared to the 1995 figures. In practical terms this will be achieved by information campaigns and public awareness, especially of preventing waste at source, of individual composting and of sorting and recycling waste.

W8 - Waste recovery

The *Waste Prevention and Management Plan* contains actions to encourage the recovery of household waste. These include improved selectivity of collection, development of a network of container parks, the investigation of new treatment procedures and recovery of organic waste, textiles, etc. In addition specific actions to recover non-household waste will be conducted, in schools, offices, the construction industry and the hotel and restaurant trade.

Table 4-6. Summary of the policies and measures: 5. Waste

Heading	**objective or activity affected**	**GHG affected**	**Type of instrument**	**Stage of implemen-tation**	**Implementing entity(ies)**
W1 - Moratorium on dumping organic waste	Closure of biologically active landfill sites	CH_4	REG	IMP	Flemish Region OVAM
W2 - Modifications to the VLAREM legislation	Elimination and recovery of discharged gases	CH_4	REG	PLA	Flemish Region AMINAL
W3 - Introduction of specific channels of waste management	Optimised management and recovery of industrial waste	CO_2/CH_4	VOL	PLA	Walloon Region
W4 - Ban on dumping biodegradable organic waste	To stop waste going to landfill sites	CH_4	REG	PLA	Walloon Region
W5 - Remedial treatment of old landfill sites	Recovery of discharged gas	CH_4	REG	IMP	Walloon Region
W6 - Modifications of waste incineration installations	To improve the environmental performance of incinerators	CO_2/CH_4	REG	IMP	Brussels-Capital Region
W7 - Reduction of waste at source	To reduce the quantity and harmfulness of waste at source	CO_2/CH_4	EDU	IMP	Brussels-Capital Region
W8 - Recovery of waste	Waste recovery, prevention	CO_2/CH_4	MIX	IMP	Brussels-Capital Region

5. PROJECTIONS OF EMISSIONS AND TOTAL EFFECT OF POLICIES

5.1. INTRODUCTION

The main objective of this section is to give an indication of the future trends in greenhouse gas emissions and sequestration, given the current national circumstances and the policies and measures implemented and accepted within the framework of the *National Climate Plan*. Wherever possible, projections are given for all greenhouse gases and all sectors, and estimated in five year intervals. Projections are given both for the medium term (2010) and the long term (2020), starting from the last available inventory data (1999). An estimation is also given of the effects of two classes of measures, namely fiscal and non-fiscal measures.

The IPCC revised guidelines propose that at least three different scenario's are calculated:

1. a scenario without measures, starting between 1990 and 1995
2. a scenario with implemented measures and accepted future measures
3. a scenario with additional measures.

Of the three scenario's, only the second is compulsory. In this report, we chose not to present a scenario without measures for several reasons. First of all, the econometric model used for estimating the medium term effects of measures (HERMES) does not allow for an easy differentiation between scenario's (1) and (2). Secondly, the carbon/energy tax and many measures of the 1994 *National Programme for the reduction of CO_2 emissions*[58] were not implemented and the baseline emissions rose as a result of higher than expected economic growth and lower than expected energy prices. Due to this, in the medium term, emissions are likely to be close to their baseline trajectory[59]. The scenario with 'implemented and accepted measures' will therefore serve as a reference scenario for comparison with a scenario with 'additional measures'.

An ad hoc working group was convened several times in order to determine which models and methods should be used to make an overall evaluation of the policies and measures included in the *National Climate Plan*, and which projected greenhouse gas emissions should be reported here. The group was made up of representatives from the federal and regional Governments. The ad hoc working group on models, decided that the projections to be reported in this section, for the medium term (2010) and for the long term (2020), would be mainly based on the following sets of models:

- Medium term projections: the combination of HERMES and EPM are used to estimate emissions for the medium term (up to 2010). For the scenario with measures, this results in the estimation of emissions from all sectors for the three main greenhouse gases, namely CO_2, CH_4 and N_2O. For the scenario with additional measures, only measure reducing energy related emissions are modelled.
- Long term projections: the combination of GEM-E3 and MARKAL are used to estimate emissions for the long term (up to 2020). The greenhouse gases covered are CO_2, CH_4 and N_2O emitted on the Belgian territory, with the exception of emissions from marine and aviation bunkers (used for international transport). For these gases, only energy related emissions are studied using a combination of the GEM-E3 and MARKAL models. Process emissions and emissions from the agricultural sector of CH_4 and N_2O are not considered in this study. Energy related emissions for CH_4 and N_2O account respectively for 8% and 22% of the total emission levels of these gases. Together, the emissions considered represent 87% (in 1990) of the total emissions covered by the Kyoto protocol. All results from MARKAL are derived for an average outside temperature.

[58] Programme national belge de réduction des émissions de CO2, juin 1994
[59] First in depht review of Belgium, FCCC/IDR.1/BEL, p.22.

For matters of comparison, medium term estimates produced by projections with the GEM-E3 and MARKAL models are also reported on an aggregate level. For a description of these models and further reading, we refer to annex B.

Simulations of the effects of detailed non-fiscal measures were made possible by joining the macro-economic characteristics of the HERMES model with the bottom-up technico-economic approach taken in the EPM energy model. The results of these simulations was used as a basis for drafting the *National Climate Plan*. The results from the GEM-E3/MARKAL long term optimisation were taken from a publication dating November 2000. These were originally produced for helping in the drafting of a preliminary version of the *National Climate Plan*.

The different scenario's are presented in detail in paragraph 5.2, together with the macroeconomic background and main assumptions behind the projections. The following paragraph 5.3 presents the results of the projected emissions and discusses the effects of aggregated policies and measures in both scenario's (with measures and with additional measures) on the medium and long term emission paths. Because different sets of models are used, methodological and statistical differences occur between the medium and the long term projections. This results in different emission projections for the same time frame. However, we see the comparison of results as a useful sensitivity analysis. It emphasises how a combination of statistical and methodological choices can substantially influence the projected future emissions. Paragraph 5.4 discusses the effects of aggregated measures, before presenting the synthesis of all emission projections in paragraph 5.5. and the conclusions that can be drawn from this exercise.

5.2. SCENARIOS AND KEY ASSUMPTIONS

5.2.1. THE SCENARIO WITH MEASURES

The scenario with measures indicates where Belgium is heading if no additional measures are taken besides those already implemented between 1990 and 2000. In 1994, the Belgian federal and regional Governments approved the first national plan for reducing greenhouse gas emissions. This plan proposed a total of 14 sets of non-fiscal measures related to the energy, household and transport sectors. The document also contained plans for the introduction of a European-wide carbon/energy tax. However, not all of the planned non-fiscal measures where realised. At the European level, the proposal for a carbon/energy tax didn't make it through the Council of Ministers. Therefore, the emissions trajectory that is projected in the scenario with measures is the result of a partial implementation of the measures in the first national plan, some new measures that have been taken since and some structural changes in the Belgian economy. Section 4 of this national communication discusses at length the complete list of measures that have been taken into account in this scenario. The voluntary agreement between the European Commission and the Association of Automobile Constructors (ACEA) to reduce emissions from new vehicles is explicitly excluded. Table 5-1 summarises the main policy instruments and measures implemented for reducing energy related emissions.

5.2.2. THE SCENARIO WITH ADDITIONAL MEASURES

In this scenario, a different set of measures is selected for the medium term (2012) simulation exercise than for the long term (2020) optimisation exercise. The different set of measures applied to different models results in diverging outcomes. The magnitude of these differences gives an indication of the influence the choice of models and statistical assumptions can have on the outcome of projections. It therefore forms a sensitivity analysis of the results of the projection.

- The medium term scenario with additional measures makes use of a combination of the macro-sectoral HERMES model and the technico-economic bottom-up EPM model to estimate the effects of measures. This combination allows for the assessment of the effect of detailed non-fiscal and

fiscal measures[60][61]. From the year 2002 onwards, a carbon tax is introduced at EUR(90) 1,3 / ton CO_2 and slowly increased to the level of EUR(90) 11,5 / ton CO_2 in 2010. This fiscal measure is combined with a number of non-fiscal measures, presented in Annex C. Note again that the list of measures and their effects are limited to the reduction of energy-related emissions.

- The long term scenario with additional measures makes use of the combination of the general equilibrium GEM-E3 model and the MARKAL partial equilibrium model for the energy market to estimate the effects of the introduction of a carbon tax. The policy measures and instruments assumed to be taken in this scenario only include measures aimed at reducing energy related emissions of greenhouse gases, namely those of Table 5-1 above, along with a carbon tax. The level of the tax is chosen by the model so that the Kyoto target of -7,5% below 1990 levels is reached at minimal costs. For after 2010, we have assumed that emissions must continue to decrease: in 2030, they must be 15% below their 1990 levels. In accordance with the political decision, a nuclear phase-out after 2015 is also assumed. The level of the tax, optimized for reaching the Kyoto target, is set at EUR(90) 20,4 / ton CO_2.

Table 5-1. Measures and policy instruments for reducing energy related emissions since 1990

MEASURES	**POLICY INSTRUMENTS OTHER THAN TAXES**		
Residential and service sector			
1. Improvement of the insulation level in new buildings	1.1. K55 insulation level for new buildings in the residential sector		
	1.2. Insulation standard for the service sector		
2. Penetration of highly efficient electric appliances and saving-bulbs	2.1. Subsidies for highly-efficient bulbs through agreement with the electricity producing and distributing companies		
Industrial sector			
1. Penetration of renewables	1.1. Subsidy of 0.05 Euro/kWh for electricity based on renewables		
2. Investment plan in the electricity sector	2.1. New STAG power plants are built in 1995 and 2000		
	2.2. No new nuclear power stations and maximum lifetime for existing nuclear power stations of 40 years		
Fiscal policy instruments (in 1990BEF/GJ)			
	1990	1995	1997
Industrial sector			
Heavy fuel (high sulphur)		16,0	15,5
Heavy fuel (low sulphur)		5,3	5,2
Gasoil		13,2	12,8
Residential and service sector			
Gasoil		16,0	15,6
Natural gas		15,9	15,5
Electricity		16,0	15,6
Transport sector			
Gasoline	467,1	531,5	626,9
Gasoil	283,3	336,7	327,8

[60] An explanation on how this integration has been realised is included in annex**.
[61] Note that the measures included in this scenario do not entirely correspond to the policies which are currently adopted or planned within the framework of the *National Climate Plan*. However, this scenario is used as a preliminary overall evaluation of the *National Climate Plan*; a more refined evaluation of the set of policies and measures of the *National Climate Plan* will be carried out in the short-term.

5.2.3. MACRO-ECONOMIC FRAMEWORK FOR THE MEDIUM TERM PROJECTIONS (2012)

In estimating the emission projections for the medium term, a number of assumptions were made about the future evolution of economic activity and energy prices. These are presented in Table 5-2. The numbers are based on predictions from the European Commission and the OECD for the period up till 2006. For the period 2007-2012, no external information was available, so the hypothesis are based on the growth trends over the last 20 years. In the medium term, world inflation in BEF would stabilise at around 1,8%. This development is the result of a slight appreciation of the Euro compared to the dollar, an inflation in the Euro zone of 2% and a stable evolution of natural resource prices. Energy prices follow the tempo of world inflation. It should be noted, however, that these figures do not take into account the current change in the world economic climate.

Table 5-2. Major hypothesis for the international environment (average annual growth rates, unless specified differently) for the period 1996-2012

	1996-2000	2001-2006	2007-2012	2001-2012
Potential export market for Belgium	7,4	6,4	5,7	6,1
World prices excluding energy in $US	-5,3	2,4	2,4	2,4
World prices excluding energy in BF	2,4	1,7	1,8	1,8
Oil prices (Brent, average price in $US per barrel	19,7	26,6	30,6	28,6

Source: Federal Planning Bureau

The assumptions about the Belgian macro-economic and sectoral background are presented in Table 5-3. The growth figures in the period 2001-2006 are better than those in the period 2007-2012. A first reason is the dynamic internal demand. Private consumption receives a push through fiscal reform, allowing for a gradual increase in household purchasing power. In the period 2007-2012 this effect runs out and the private consumption returns to its normal growth path. The second reason is the international context. The export would increase yearly with 5,9% between 2001-2006 and only with 5,1% in the period between 2007-2012. The import requirements are also higher in the first period of the simulation (on average 5,9%) due to a dynamic domestic demand.

The average contribution of domestic demand and net export to the economic growth are smaller in 2007-2012 than in 2001-2006. Therefore, the economic growth only amounts to 2,4%, after having been 2,7% in the first half of the projection period. The Belgian inflation would accelerate to about 2% in the period 2007-2012.

The structure of the electricity park for the simulation period is presented in Table 5-4. The generation of electricity from wind and water energy increases sharply in the second period of the simulation. The largest increase in capacity is foreseen to occur after 2006. The total capacity for wind and water is estimated at 3,1 TWh in 2012. These estimations are coherent with those from other sources[62], but do not correspond to the targets set out by the European Commission or the Belgian Governments. The production of nuclear electricity remains constant over the whole period. The production of the other units will continue to increase. This growth would entirely come from the production of electricity based on natural gas with so called steam and gas (STAG) installations and installations with combined heat and power (CHP). The portion of imported electricity in the gross internal consumption also increases slightly.

[62] See for example:
- Rapport de la Commission pour l'analyse des modes de production de l'électricité et le redéploiement des énergies (AMPERE) au Secrétaire d'Etat à l'énergie et au développement durable - Conclusions et recommandations (résumé exécutif) - Octobre 2000
- "Energy projections 2000-2020", Planning Paper n°88 of the Federal Planning Bureau.

Table 5-3. Major macro-economic and sectoral results for the period between 1995 –2012 (average annual growth rates, unless specified differently)

	1995-2000	2001-2006	2007-2012	2001-2012
DEMAND AND PRODUCTION				
Gross Domestic Product	2,7	2,7	2,4	2,6
Private consumption	2,0	2,6	2,1	2,3
Public consumption	1,8	1,6	1,9	1,8
Gross investments	4,3	3,5	3,2	3,4
Total domestic demand	2,4	2,6	2,4	2,5
Export	5,6	5,9	5,1	5,5
Total final demand	3,9	4,3	3,9	4,1
Import	5,4	5,9	5,3	5,6
PRICES AND INTEREST RATES				
Particular consumption	1,7	1,8	2,0	1,9
Health consumer price index	1,4	1,9	2,1	2,0
Gross Domestic Product deflator	1,3	2,0	2,1	2,1
Long term interest rate (10 years)				
Nominal	5,8	5,5	5,8	5,7
Real	4,1	3,8	3,8	3,8
TAX POLICY	Fiscal reform			
ADDED VALUE PER SECTOR				
Agriculture	4,0	1,6	1,3	1,5
Industry	3,0	2,7	2,1	2,4
Intermediate goods	4,0	2,8	2,1	2,5
Investment goods	3,8	2,8	1,6	2,2
Consumer goods	2,5	2,5	1,7	2,1
Service sector	2,7	3,4	2,9	3,2
Total of the market sector	2,9	3,1	2,6	2,8

Source: Federal Planning Bureau (2001)

Table 5-4. Production of electricity (in TWh)

	2000	2002	2006	2012
Water and wind energy	0,4	0,6	1,0	3,1
Nuclear energy	47,3	48,2	48,2	48,2
Thermal energy	35,4	36,6	42,7	51,8
Petroleum products	*0,6*	*0,8*	*0,9*	*0,9*
Steel oven and cokes gases	*2,6*	*2,7*	*2,5*	*2,1*
Natural gas	*17,3*	*22,5*	*31,3*	*43,2*
Bio mass and waste	*1,5*	*1,5*	*1,5*	*1,5*
Other combustibles	*0,5*	*0,5*	*0,5*	*0,5*
Coal	*12,9*	*8,6*	*5,8*	*3,5*
Total	83,1	85,4	91,9	103,1

Source: Federal Planning Bureau (2001)

5.2.4. MACROECONOMIC FRAMEWORK FOR THE LONG TERM PROJECTIONS (2020)

The economic growth assumptions are based on those used in the European Commission (DG Research) long-term reference scenario with the POLES model (P. Criqui & N. Kouvaritakis, 1999): 2,5% as an average GDP growth rate until 2005 and 2,1% for 2005-2020, followed by a slowdown to 1,6% for after 2020 in the OECD countries (Table 5-5). For the short and medium term, the economic growth assumptions correspond to those used in the economic forecast of the Federal Planning Bureau of April 1999 for 1999-2004. The oil price assumption is based on the same European Commission (DG Research) reference scenario computed with the POLES World energy model. In this scenario, given the assumption of a rapid economic recovery from the 1997-1998 crisis and relatively moderate oil and gas resources, the oil price in real terms continues to increase rather sharply until 2010 with a slowdown thereafter. Oil and gas prices evolve in parallel.

Table 5-5. Major hypothesis for the international environment for the period 2000-2030 (in average annual growth rates)

	2000/2005	**2005/2010**	**2010/2020**	**2020/2030**
OECD GDP	2,5	2,4	2,0	1,6
Oil ($90/bl)	4,5	4,5	2,5	1,8
Gas ($90/boe)	4,2	4,2	3,6	1,8
Coal	0	0,3	0,2	0,2

The European macroeconomic and sectoral evolution under the scenario with measures is computed with the GEM-E3 model, a linked general equilibrium for 14 EU countries. The general assumptions of Table 5-5 were complemented with country specific policy assumptions regarding the evolution of tax policies, public consumption, investment, general assumptions and exogenous technical progress (Table 5-6).

Table 5-6. Macroeconomic background and sectoral evolutions for Belgium for the period between 1999 and 2030 (in average annual growth rates)

	1999/2005	**2005/2010**	**2010/2030**
Macroeconomic background			
GDP growth	2,2	2,1	1,8
Public investments	1,4	2,0	2,0
Public consumption	1,3	1,0	1,0
Private consumption	2,3	2,2	2,2
Housing stock	0,6	0,5	0,3
Tax policy	Stable over the entire horizon		
Technical progress			
Labour	0,8	0,8	0,8
Materials	1,0	1,0	1,0
Sectoral production			
Agriculture	1,8	1,9	1,7
Iron & Steel	0,5	0,7	0,4
Chemical sector	0,9	1,0	0,7
Building materials	0,7	0,7	0,4
Non energy intensive sectors	1,6	1,7	1,4
Service sector	1,5	1,9	1,8

Source: CES (2000)

The sectoral allocation of the growth reflects the trend towards a service economy coupled with a decrease in the share of the energy intensive sectors such as the iron and steel industry and the building materials industry. The shift is however slowed down after 2010 (Table 5-6). The sectoral activity levels and the growth in housing stock and private income (reflected in private consumption evolution) are the main determinants for the evolution in the demand for energy services in the scenario with measures.

5.2.5. COMPARISON BETWEEN CO_2 EMISSION INVENTORIES USED

Differences persist between the CO_2 emission inventories used in the HERMES and the MARKAL model and the inventories as presented in Section 3. The Federal Planning Bureau (HERMES) uses a "top-down" method based upon the energy balances of Eurostat. These on turn are mainly based on the energy balences of the Federal Ministery for Economic Affairs. The Center for Economic Research (MARKAL) uses a "top-down" methodology based upon statistics of the energy use that come from the Federal Ministry for Economic Affairs. These inventories are also normalised for temperatures by MARKAL.

5.3. PROJECTIONS AND AGREGATE EFFECTS OF POLICIES AND MEASURES

5.3.1. MEDIUM TERM PROJECTIONS (2010)

The HERMES model was used to estimate the effect of the scenario with measures. A combination of EPM and HERMES was used to estimate the effect of a scenario with additional measures. For this matter, the HERMES model was prepared to integrate the information generated by the EPM model. This was a delicate phase, because microeconomic information had to be translated into macro-sectoral terms. For a methodological description of both models and their combination, we refer to Annex B. In what follows, we discuss the results of the simulations for every major greenhouse gas.

CO_2 EMISSIONS

Table 5-7 presents the evolution in CO_2 emissions for the scenario with measures and the scenario with additional measures. As just mentioned above, historical energy related CO_2 emissions are derived from the Eurostat energy balances and thus differ slightly from the inventories as reported in Section 3. The other historical emissions are derived from sectoral activity data as calculated by HERMES and specific emission factors. Projections are made from the year 2000 onwards.

In the scenario with measures, total energy related CO_2 emissions are to increase by 15,4 mln tons or 14% above 1990 levels by the year 2010. The emissions from the transport sector are expected to increase by 21,6 mln tons or 47%. Emissions from households and services would increase by 8,3 mln tons or 33%. The energy sector would more or less stabilise its emissions over this period. The emissions from this sector are very much determined by the structure of the electricity park (see above). The scenario with measures foresees a large increase in the use of natural gas instead of coal and liquid fuels, and an increase in efficiency. The industrial emissions of energy related CO_2 would reduce by 2,2 mln tons or 7%. This would be mainly caused by structural adjustments in the energy consumption of coal and liquid fuels to gas and electricity, a reduction in the importance of the energy intensive sectors in favour of less energy intensive services and a more efficient energy use through the use of energy friendly technologies.

Besides emissions from the combustion of fossil fuels, CO_2 emissions also come from certain industrial and other processes. This is the case for instance for the cement and steel industries and for incineration of waste. These non-energy related CO_2 emissions would increase by 6,1 mln tons in a scenario with measures. This would amount to a total increase in 2010 of 59% above 1990 levels.

Table 5-7. Historical and projected emissions of CO_2 for a scenario with measures and with additional measures (in mln ton CO_2)

	Historical		With measures			With additional measures		
	1990	1995	2000	2005	2010	2000	2005	2010
Energy	**107,7**	**114,2**	**118,4**	**121,0**	**123,1**	**118,4**	**113,9**	**109,4**
Energy transformation sector	30,2	31,3	30,3	29,3	29,9	30,3	25,6	24,2
Manufacturing and construction	32,0	29,8	33,7	32,9	29,8	33,7	30,6	24,7
Transport sector	20,2	22,5	24	26,7	29,7	24,0	26,5	29,0
Residential and services	25,4	30,6	30,4	32,1	33,7	30,3	31,1	31,5
Industrial processes	**10,2**	**10,5**	**12,3**	**14,5**	**16,3**	**12,3**	**14,5**	**16,2**
Intermediate goods	3,2	3,5	4,2	5,0	5,6	4,2	5,0	5,6
Investment goods	2,5	2,3	2,9	3,6	4,3	2,9	3,6	4,3
Consumer goods	3,6	3,7	4,1	4,7	5,1	4,1	4,7	5,1
Energy sector	1,0	1,0	1,1	1,2	1,4	1,1	1,2	1,3
Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Waste	**0,4**	**0,4**	**0,4**	**0,5**	**0,5**	**0,4**	**0,5**	**0,5**
Grand total	**118,3**	**125,1**	**131,1**	**136,0**	**140,0**	**131,1**	**128,8**	**126,2**
Trend index	**100,0**	**105,7**	**110,8**	**114,9**	**118,3**	**110,8**	**108,8**	**106,6**

Source: Federal Planning Bureau, Econotec

The effects of the additional measures reduce energy related emissions in 2010 by 13.7 mln tons or 11% compared to the scenario with measures. Energy related emissions now increase by 1,5% from 1990 levels. The additional measures have little impact on the transport sector. They are only reduced by 0,7 mln tons compared to the scenario with measures. Emissions from the energy transformation sector and the manufacturing and construction sectors are reduced by respectively 5,8 mln and 5 mln tons. Residential and service emissions, finally are reduced by 2,3 mln tons and now increase by 24% in 2010 compared to 1990 levels. Despite the additional measures, CO_2 emissions remain 6,6% above the level of 1990.

CH_4 EMISSIONS

Table 5-8 shows the projected CH_4 emissions in the scenario with measures. This scenario takes into account the effects of all reduction measures taken so far, as well as the evolution of emissions in the absence of additional measures. The scenario shows significant reductions in CH_4 emissions over the period between 1990 and 2010. Total emissions would be reduced by 25,3%, from 14,1 mln tons CO_2 eq. in 1990 to 10,5 mln tons CO_2 eq. in 2010. These reductions could be mainly attributed to evolutions in the agricultural sector (-6,7% or 0,5 mln tons CO_2 eq.) (e.g. reduction of the cultivated area), the waste sector (-65% or nearly 3 mln tons CO_2 eq.) (e.g. prohibition of landfilling of organic waste, recovery of landfill gas) and the gas distribution sector (-7,5%) (despite a substantial increase in the extent of the network). Emissions from combustion would increase slightly.

Table 5-8. Historical and projected emissions of CH_4 for a scenario with measures (in Mln ton CO_2 eq.)

	Historical		With measures		
	1990	**1995***	**2000***	**2005***	**2010**
Energy	1.254	1237,8	1221,5	1205,3	1.189
Combustion	*311*	*312,0*	*313,0*	*314,0*	*315*
Gas transport	*943*	*925,8*	*908,5*	*891,3*	*874*
Production processes	37	33,0	29,0	25,0	21
Waste treatment	4.551	3816,3	3081,5	2346,8	1.612
Agriculture	8.252	8114,0	7976,0	7838,0	7.700
Enterogenous fermentation	*4.855*	*4733,8*	*4612,5*	*4491,3*	*4.370*
Effluent storage	*3.397*	*3380,3*	*3363,5*	*3346,8*	*3.330*
TOTAL	14.094	13201,0	12308,0	11415,0	10.522
Trend index	100	93,7	87,3	81,0	75

* Numbers estimated by means of a linear intrapolation

Source: EPM model, Econotec

A scenario with additional measures was not available at the time of writing. Nevertheless, several additional measures could further reduce emissions substantially[63]. In the waste sector, the recovery and valorisation or incineration of landfill gas could be extended further. The losses that accrue in the distribution of gas could also be further reduced through increased retrofitting of pipelines. Finally, in the agricultural sector, changes in the nutrition given to the live stock, anaerobic digestion of liquid effluents and reductions in the storage time for liquid effluents waiting to be treated, would reduce emissions of CH_4 too.

N_2O EMISSIONS

Contrary to the emissions of methane, in the scenario with measures N_2O emissions would grow by 18% over the period 1990-2010. They would amount to 14,3 mln tons CO_2 eq. in 2010. Road transport and industrial processes account for the biggest part of this increase. Only in the agricultural sector will emissions of N_2O decrease. This will be due to reduced use of fertilisers, a reduction of proteins in the nutrition given to live stocks and a reduction in the cultivated areas. A reduction in the production of nitrates could also partly offset the increase in N_2O emissions over the time horizon.

Table 5-9. Evolution of N_2O emissions in a scenario with measures (in mln ton CO_2 eq.)

	Historical		With measures		
	1990	1995*	2000*	2005*	2010
Energy	994	1170	1345	1521	1696
Stationary combustion	*711*	*731*	*751*	*771*	*791*
Transport	*283*	*439*	*594*	*750*	*905*
Industrial processes	3057	3399	3740	4082	4423
Anestethics	222	222	222	222	222
Agriculture	7093	6958	6823	6687	6552
Emissions from the soil	*4874*	*4797*	*4720*	*4642*	*4565*
Effluent storage	*2220*	*2162*	*2104*	*2045*	*1987*
Forests	729	729	729	729	729
Water purification	0	166	331	497	662
Grand total	**12095**	**12642**	**13190**	**13737**	**14284**
Trends index	**100**	**105**	**109**	**114**	**118**

* Numbers estimated by means of a linear intrapolation

Source: EPM model, Econotec

Again, additional measures could be taken to reduce emissions of N_2O. Catalytic reductions could reduce emissions of N_2O from smoke. And in the agricultural sector, a further reduction in the use of N_2O fertilisers and of proteins in live stock nutrients could be achieved.

5.3.2. LONG TERM PROJECTIONS (2020)

Table 5-10. presents the projected long term energy related emissions of CO_2, N_2O and CH_4 for a scenario with measures and with additional measures. In the scenario with measures, emissions in 2010 are 10,2% higher than in 1990. The difference with the HERMES projections (+14,6%) can be partly explained by the assumption in MARKAL that all no regret measures have been taken. The fact that MARKAL uses emission inventories that are normalised for temperature, also may explain some of the difference, since emissions in 1990 were lower due to mild temperatures (see also § 5.3.3) Finally, the higher expected growth in electricity production of HERMES contributes to the difference.

According to MARKAL, between 1990 and 2010, emissions in the energy sector decrease by 23%, mainly because of the increasing share of gas for electricity production. The difference with HERMES can again be explained by different assumptions for the electricity sector. After 2010, MARKAL predicts emissions

[63] ECONOTEC: "Analyse des options de réduction des émissions des gaz à effet de serre et des précurseurs d'ozone troposphérique", Plan d'appui scientifique à une politique du Développement Durable, Federal Office for Scientific, Technical and Cultural Affairs, 2001

of the electricity sector to rise rapidly (by nearly 100% between 2010 and 2020) as nuclear plants are replaced by coal power plants.

Between 1990 and 2010, CO_2 emissions in the manufacturing and building sector rise by 14% and by 17% in the residential and service sector. In these two sectors, the main increase occurs in the nineties, while after 2000 (and up to 2030), emissions remain more or less stable, as energy efficiency is progressively improved and the growth in the number of households decreases. Projections by MARKAL for the manufacturing and construction sector contradict figures from HERMES, which expect a reduction in emissions by 7% to occur. However, over the period 2000-2010, both models predict a stabilisation of emissions.

In the transport sector, emissions increase steadily (+40% between 1990 and 2010, and 15,6% between 2010 and 2020), because the demand increases (2% per year) more than the impro-vement in fuel efficiency of the road vehicles (0,4% per year). These figures are consistent with projections from the HERMES model (+47% between 1990 and 2010).

Emissions from CH_4 and N_2O related to the energy sector increase by 16,7% between 1990 and 2010, which is consistent with the trends detected by the EPM model from Econotec. Between 2010 and 2020 these emissions are projected to increase by another 12%.

Table 5-10. Evolution of energy related greenhouse gas emissions for a scenario with measures and with additional measures (in mln tons CO_2 eq.) for the period 1990-2020

	Historic	Scenario with measures				Scenario with additional measures			
	1990	2000	2005	2010	2020	2000	2005	2010	2020
Energy sector	29,7	25,3	21,3	22,8	45,5	25	19,9	16,9	19,5
Manufacturing and construction	29,8	33,6	32,8	34	35,8	33,3	31,8	22,8	19
Residential and services	29,8	33,8	34,2	35	36,3	33,5	34,1	33	26,3
Transport sector	21,6	25,6	28,1	30,2	34,9	25,6	27,8	29,4	33,2
Subtotal	*110,9*	*118,3*	*116,4*	*122*	*152,5*	*117,4*	*113,6*	*102,1*	*98*
CH4 and N2O (CO2 eq.)	3,6	4,3	4	4,2	4,7	4,2	3,9	3,8	3,9
Total GHG (CO2 eq.)	**114,5**	**122,6**	**120,4**	**126,2**	**157,2**	**121,6**	**117,5**	**105,9**	**101,9**
Trends	**100,0**	**107,1**	**105,2**	**110,2**	**137,3**	**106,2**	**102,6**	**92,5**	**89,0**

Source: CES (2000)

In the long term scenario with additional measures, we have imposed that emissions in 2010 must be 7,5% lower than in 1990 (to fulfil Belgian's part in the EU burden sharing agreement), and we let the optimisation model MARKAL choose the technologies to satisfy the energy needs in the most efficient way. As a by-product, MARKAL provides the level of CO_2 tax that would lead to that result. The tax has to be imposed on all sectors (energy, manufacturing and building, residential and services, and transport). The tax that is simulated here for achieving the 2010 objective amounts to EUR(90) 20,3 / ton CO_2. We repeat that for the period after 2010, we have assumed that emissions must continue to decrease: in 2030, they must be 15% below their 1990 levels. After 2010, a higher tax level is imposed and new house insulation measures, more rational use of energy in residential and services and more efficient cars lead to more savings in the residential, service and transport sectors. Table 5-11 shows where the strongest reduction takes place relative to the scenario with measures.

Table 5-11. Greenhouse gas emissions changes in the scenario with additional measures versus the scenario with measures

	1990	**2000**	**2005**	**2010**	**2020**
Energy transformation	0%	-1%	-6%	-26%	-57%
Manufacturing and construction	0%	-1%	-3%	-33%	-47%
Residential and services	0%	-1%	0%	-6%	-27%
Transport	0%	0%	-1%	-3%	-5%
CH_4 and N_2O	0%	0%	-1%	-11%	-17%
Total GHG (CO_2 eq.)	0%	-1%	-2%	-16%	-35%

Source: CES (2000)

The tax reduces total CO_2 eq. energy related emissions by 16% in 2010 compared to the scenario with measures. The difference increases to 35% in 2020. By 2010 the strongest reductions are in the manufacturing and construction sector (-33%) and in the electricity generation sector (-26%). Emission reductions are much smaller in the residential and transport sector (6% and 3%).

In the longer term (2020), emission reductions become stronger in all sectors. New house insulation measures, more rational use of energy in residential and services and more efficient cars lead to more savings in residential, services and transport sectors.

5.3.3. SENSITIVITY ANALYSIS

We have already noted that the differences that prevail between the projected emissions of HERMES/EPM and GEM-E3/MARKAL, illustrate the importance of the choice of modelling approach and the statistical assumptions. From the analysis above, it seems that broadly speaking, both modelling frameworks lead to consistent projections. The differences that occur can be attributed to differences in some basic assumptions about the growth and production mix in the electricity sector, the differences in the approach towards no-regret measures (excluded from MARKAL) and the use of temperature normalised emission inventories (MARKAL).

In relation to these temperature normalised inventories, the following can be said. Since the temperature in 1990 was rather high compared to average figures, real emissions in 1990 were lower than the normalised emissions used in MARKAL. Therefore, it is likely that a higher reduction effort will have to be made in 2010 compared to the figures in MARKAL (which are for average figures both in 1990 and 2010). One can estimate that the correction for temperature will impose a further increase of 3,5% of total emissions. This implies a reduction of 11% (instead of 7,5%) in 2010 compared to 1990. A higher tax will be necessary to achieve this.

The simulations performed above were done using data before the economic slowdown of the second half of 2001. Regretfully, at the time of publication, no simulations were available with different assumptions for expected growth in GDP.

5.3.4. OTHER PROJECTIONS

HFC, PFC, SF_6 EMISSIONS

The projections for HFCs and SF_6 are presented in Table 5-12. Belgium has no substantial emissions of PFCs. The historical data has been provided by Econotec (2001) and projected amounts come from a study in progress performed by the Flemish Institute for Technological Research (VITO) for the Flemish Government. The scenario takes into account the effects of the implementation of the EU regulation on the phase-out of ozone depleting substances. It also accounts for the effects of several Flemish regional policy measures that have an effect on emissions of HFCs. These include an estimated reduction of 5% in emissions from air conditioners and cooling. For fire extinguishing materials, an assumption is made that 27% will still use HFC-227ea. No specific measures where taken into account for the Walloon or the Brussels Capital region. The base year for these emissions is 1995 and their trajectory is projected till 2010.

Total emissions of fluorinated gases are expected to increase with a factor 5 by 2010 from 1995 levels. By far the largest contribution is expected to come from the use of HFCs for cooling and air conditioners. These projections form a preliminary estimate of the possible future emissions trajectory in a scenario with measures. Final figures are expected to be available in March 2002.

Table 5-12. Preliminary estimation of emissions and projections of HFCs, PFCs and SF_6 in Gg CO_2 eq. in the scenario with measures in the period 1990-2010

	Historical	With measures		
	1995	2000	2005	2010
Total SF6	206	157	151	146
SF6 (elek)		*3,8*	*3,8*	*3,8*
SF6 (glas)		*154*	*147*	*142*
Total HFC's	332	1127	1531	2436
MDI's (HFC-227EA)		*0,135*	*44,4*	*65,0*
Fire extinguishers (HFC-227EA)		*1,71*	*2,49*	*2,68*
ing and airco (HFC-134A, 125 & 143A)		*898*	*1000*	*1722*
oly Urethane cans (HFC 134A & 152A)		*196*	*250*	*320*
Isolation foam (HFC-134A & 152A)		*31*	*234*	*327*
Grand total	***538***	***1284***	***1681***	***2582***
Trend index	**100**	**238,7**	**312,5**	**479,9**

Source: VITO, Econotec

BUNKER FUELS

The evolution in emissions from bunker fuels have been estimated for the scenario with measures by means of the HERMES model. The same macro-economic framework conditions prevail in this scenario as for the estimation of CO_2 emissions from other economic activities (see above). The results are presented in Table 5-13. Emissions from ship bunkers are roughly five times higher than from aviation bunkers. Both, however, are expected to increase substantially over the 1990-2010 time frame. In a scenario with measures as well as in a scenario with additional measures, total bunker fuel emissions are expected to increase by nearly 50%. One should note, however, that these projections do not take into account the effects the bankruptcy of SABENA (the Belgian national airline company) might have on future emissions.

Table 5-13. Evolution of total greenhouse gas emissions from bunker fuels per sector (in mln tons CO_2 eq.) for the period 1990 - 2010

	Historical		With measures			With additional measures		
	1990	1995	2000	2005	2010	2000	2005	2010
International ship bunkers	15,4	14,7	17,3	20,5	24,5	17,3	20,2	23,6
International aviation bunkers	2,9	2,9	3,8	3,5	3,8	3,8	3,5	3,8
Total international bunker fuels	**18,3**	**17,6**	**21,1**	**24,0**	**28,3**	**21,1**	**23,7**	**27,4**
Trend index	**100,0**	**96,0**	**115,2**	**131,2**	**154,9**	**115,2**	**129,5**	**149,6**

Source: Federal Planning Bureau (2001)

SINKS

The Walloon region made an estimation of the evolution in annual carbon sequestration potential in the Walloon forests. Aforestation, deforestation and reforestation activities were calculated according to the IPCC special report on land use, land use change and forestry. A hypothesis was maintained of a linear trend in forest areas and overall biomass increase between 1991 and 1999. A distinction was made between the deciduous and coniferous species. Based upon the difference between annual wood growth and wood harvested, annual biomass changes were derived. The results of this inventory and projection exercise are presented in Table 5-14.

Because at the time of writing no projections of sequestrated amounts were available for the Flemish region, the following approximation has been undertaken to derive figures for the whole Belgian territory. The sequestration potential for Flanders in a scenario with measures was derived for the year 1991 from the difference between total sequestration levels in 1991 as reported in the former Belgian national communications (2,057 Mt CO_2 eq) and the amount that was sequestrated for that year in the Walloon region. The ratio between total sequestrated levels and Walloon sequestrated levels in 1991 (0,78) was then assumed constant for all subsequent years. Thus estimates could be made of all future total sequestration amounts for Belgium. From this, Flemish estimates could also be derived.

Sequestrated amounts of the Brussels Capital region were not taken into account (0,03% of total forest area).

Table 5-14. Annual CO_2 sequestration potentials using the IPCC methodology

	Historical		With measures		
	1991	**1995**	**2000**	**2005**	**2010**
Walloon Region					
Annual variations of total biomass	872.630	1.042.587	982.560	922.514	862.467
Annual variations of deciduous biomass	*- 273.817*	*261.560*	*265.404*	*269.250*	*273.096*
Annual variations of coniferous biomass	*1.146.447*	*781.027*	*717.157*	*653.264*	*589.371*
Carbon variations in tons	436.315	521.293	491.280	461.257	431.233
CO2 eq. variations in tons	1.599.821	1.911.409	1.801.361	1.691.275	1.581.189
Flemish Region*					
CO2 eq. variations in tons	452.540	539.115	508.076	477.026	445.976
Total Belgian CO2 eq. variations in tons	**2.057.000**	**2.450.525**	**2.309.437**	**2.168.301**	**2.027.166**
Total Belgian CO2 eq. variations in Mtons	**2,06**	**2,45**	**2,31**	**2,17**	**2,03**
Trend index	**100,0**	**119,1**	**112,3**	**105,4**	**98,5**

* Derived from difference between Walloon figures and total figure reported for 1991 in second and third National Communication

Source: Perrin et al (2000) for the Walloon region

5.4. EFFECTS OF AGGREGATED MEASURES

The effects of individual measures, based on detailed impact studies are addressed in Section 4 (Policies and measures), in terms of reduction potential (when available). The expected total effects of additional measures have also been estimated in the current section on a more aggregated level. This was done on the basis of the difference between the emissions from the scenario with measures and the scenario with additional measures. The results were discussed in paragraph 5.3.

5.4.1. MEDIUM TERM (2010)

For the medium time frame and within the scenario with additional measures (see § 5.3.1), a distinction can be made between the effects of fiscal and non-fiscal measures. Table 5-15 identifies the possible influence of both categories of measures on the total emission reductions that are achieved for a number of sectors from the year 2000 onwards (no estimates were available for the transport sector). Nota again that only measures reducing energy related emissions were modelled.

Table 5-15. Effects of fiscal and non-fiscal measures on the emissions of CO_2 (excluding transport sector) for the years 2005 and 2010.

	non-fiscal reductions		**fiscal reductions**		**total reductions**	
	2005	2010	2005	2010	2005	2010
Residential + services	-0,47	-1,10	-0,50	-1,16	-0,97	-2,26
Manufacturing and construction	-1,10	-2,57	-1,19	-2,47	-2,29	-5,04
Energy transformation	-3,38	-3,85	-0,29	-1,91	-3,67	-5,76
Total	**-4,95**	**-7,52**	**-1,98**	**-5,54**	**-6,92**	**-13,07**

Table 5-15 shows that half of the reductions are achieved by 2005 (-6,92 mln tons CO_2) and half by the year 2010 (-13,07 mln tons CO_2). By the year 2005, non-fiscal measures are responsible for three times more reductions than the fiscal measure. This can be explained by the fact that the tax is introduced at a relatively low level and only progressively increases to its maximum level in 2010, when its full effect on emissions will be observed. The non-fiscal measures also only achieve their full effect in 2010. Both categories of instruments are then responsible for a substantial reduction in emissions.

On a sectoral level, over the whole time period both the residential and service sector and the manufacturing and construction sector react equally to the fiscal and the non-fiscal measures. The

energy transformation sector, on the contrary, reacts much quicker to the non-fiscal measures than to the fiscal measure. Total reductions are greatest in the energy transformation sector and in the manufacturing and construction sector.

5.4.2. LONG TERM (2020)

For this time frame, the difference between emissions in the scenario with measures and with additional measures were also discussed in paragraph 5.3. No distinction can be made between the effects of non-fiscal and fiscal measures, since only the latter were considered in the scenario with additional measures. The modelling approach that was used over the long term period (GEM-E3/MARKAL) assumes that all additional non-fiscal measures which result in non-regret emission reductions are already included in the scenario with measures.

5.5. SYNTHESES

Projections of GHG emissions for the medium term are shown in Table 5-16 and Figure 5-1.

Table 5-16. Total greenhouse gas emissions and sequestration for the medium term (2010) (excluding bunker fuels)

	Historical emissions		**With measures**			**With additional measures**		
	1990	1995	2000	2005	2010	2000	2005	2010
CO2	118,3	125,1	131,1	136,0	140,0	131,1	128,8	126,2
CH4	14,1	13,2	12,3	11,4	10,5	12,3	11,4	10,5
N2O	12,1	12,6	13,2	13,7	14,3	13,2	13,7	14,3
HFC, PFC, SF6		0,538	1,3	1,7	2,6	1,3	1,7	2,6
Sinks	-2,1	-2,5	-2,3	-2,2	-2,0	-2,3	-2,2	-2,0
Total (CO2 eq.)	**142,5**	**149,1**	**155,6**	**160,6**	**165,3**	**155,6**	**153,5**	**151,5**
Trend index	**100,0**	**104,6**	**109,2**	**112,7**	**116,0**	**109,2**	**107,7**	**106,4**

Sources: Federal Planning Bureau, Econotec, VITO, Perrin et al.

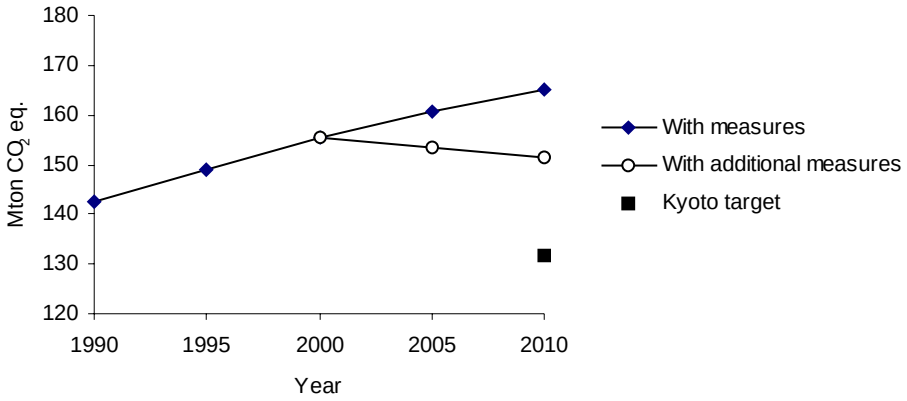


Figure 5-1. Projections of total greenhouse gas emissions for the medium term (2010)
Source: Federal Planning Bureau, Econotec

The figures in Table 5-16 indicate that despite the proposed additional non-fiscal and fiscal measures, total GHG emissions are still most likely to increase by 6,4% above their 1990 levels. Nevertheless, in comparison to the scenario with measures, emissions will have been reduced by 9,6%. To bridge the gap of 13,9% that remains between these emission levels and those put forward for Belgium in the internal

EU burden sharing agreement[64] (-7,5% emission reductions in 2010 from 1990 levels), further measures need to be taken. If additional national measures are chosen, they should be implemented in a timely matter for their effect to materialise within the first commitment period. Note, however, that figures presented here are not corrected for temperature fluctuations. They are also based upon economic growth forecasts that do not take into account the current backdrop in economic climate. If the lower economic growth is accounted for, the emissions reduction gap could turn out to be lower.

Long term simulations with the MARKAL model (Table 5-17, Figure 5-2) suggest that in a scenario without additional measures, due to the phase-out of nuclear energy from 2015 onwards, a shift will occur towards the construction of additional coal power plants, thus substantially increasing emissions from the energy transformation sector. A carbon tax of EUR(90) 20,5 would be necessary to reduce Belgian emissions sufficiently to achieve its EU burden sharing emissions reduction target. An increased tax would reduce emissions further in 2020 to 89% of 1990 levels. One should nevertheless note that these projections are subject to stringent hypothesis about transaction costs and perfect information (see Annex B).

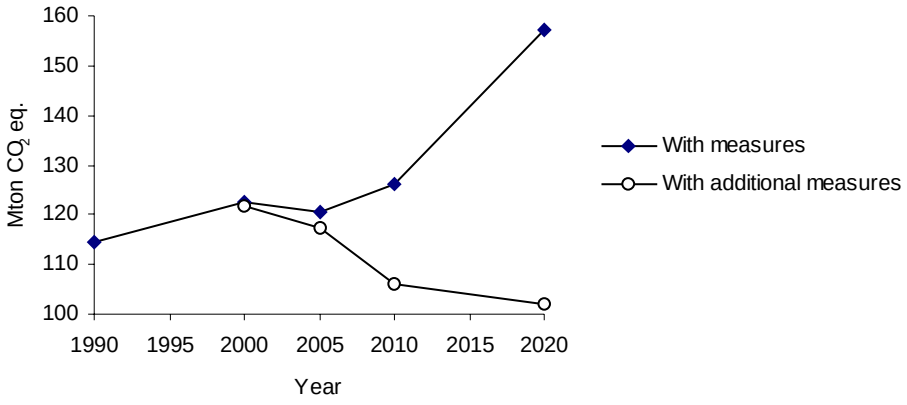


Figure 5-2. Projections of total enery related greenhouse gas emissions for the long term (2020)
Source: CES-KUL (2000)

Table 5-17. Total energy related greenhouse gas emissions for the long term (2020)

	Historic	Scenario with measures				Scenario with additional measures			
	1990	2000	2005	2010	2020	2000	2005	2010	2020
Energy sector	29,7	25,3	21,3	22,8	45,5	25	19,9	16,9	19,5
Manufacturing and construction	29,8	33,6	32,8	34	35,8	33,3	31,8	22,8	19
Residential and services	29,8	33,8	34,2	35	36,3	33,5	34,1	33	26,3
Transport sector	21,6	25,6	28,1	30,2	34,9	25,6	27,8	29,4	33,2
Subtotal	*110,9*	*118,3*	*116,4*	*122*	*152,5*	*117,4*	*113,6*	*102,1*	*98*
CH4 and N2O (CO2 eq.)	3,6	4,3	4	4,2	4,7	4,2	3,9	3,8	3,9
Total GHG (CO2 eq.)	**114,5**	**122,6**	**120,4**	**126,2**	**157,2**	**121,6**	**117,5**	**105,9**	**101,9**
Trends	**100,0**	**107,1**	**105,2**	**110,2**	**137,3**	**106,2**	**102,6**	**92,5**	**89,0**

Source: CES (2000)

64 EU agreement relative to contributions of each Mamber State to the overall Community reduction commitment (Council Conclusions of 16 June 1998)

6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1. INTRODUCTION

6.1.1. METHODOLOGY

Vulnerability depends on the sensitivity of a system and on its ability to cope with change; this is the reaction level of this system to a specific climate change (positive as well as negative effects) and the ability of the system to adapt to climate changes. Due to the fact that the available studies do not use comparable climate scenarios and methods and due to uncertainties with regard to sensitivity and the ability of natural and social systems to adapt, vulnerability assessment of the different sectors in Belgium is of a qualitative nature.

Analysis of priority themes such as soil, agriculture, horticulture and forestry, freshwater systems, coastal zones and sea level has been undertaken according to the guidelines. For the other themes such as fauna and flora, landscape, energy sector, industry, transport, financial sector, health, leisure and tourism a limited description summarising the most important data is given.

The preparation of this section included a combination of elements:

- an inventory and in-depth analysis of all experimental data of relevant research projects for effects of climate changes from:
    - o all Belgian research programmes;
    - o other research activities in Belgium within the framework of international programmes;
    - o international research programmes and programmes in countries with results relevant to Belgium (regional and empirical analogies);
- research on the models and scenarios applied and used in Belgium;
- discussion with foreign experts;
- discussion and follow-up by Belgian experts

In addition to the description of the effects and the adaptation strategies, recommendations for future research and for strategic approaches are given.

6.1.2. SCENARIO FOR BELGIUM

The scenario chosen for Belgium is based upon the scenarios developed by the IPCC (1997, 2001) and the UK Climate Change Impact Review Group (1996). These scenarios assume a status quo concerning greenhouse gas emissions. The climate scenario used here is based on the following assumptions:

- the present " CO_2 equivalent " concentration will double to reach 700 ppmv by 2100;
- a CO_2 concentration of 700 ppmv will result in an average temperature increase of 2°C by 2100;
- the period from 1990 to 2100 is considered;
- the temperature changes will be uniform for the whole of Belgium.

It should be emphasised however that a range of scenarios has been taken into consideration for the further assessment of the effects. The above scenario has been selected for Belgium in consultation with both a resource team of scientific experts and a steering committee representing the Federal and Regional Departments involved.

6.1.3. DESCRIPTION OF THE CLIMATE AND HYDROLOGY IN 2100 IN BELGIUM, BASED ON THE SCENARIO ADOPTED

(Reference year is 1990).

Temperature:

- average increase in air temperature (winter and summer) of 2°C;
- increase of extreme weather conditions (not only changes in the average temperatures but also in extremes and variability), sudden unusually cold conditions;

Precipitation:

- slight decrease (approx. 3%) in precipitation, or precipitation stable during the summer but increased during the winter (approx. 10%);
- changes to precipitation distribution will have a major impact;
- the storm frequency will increase by 30% towards 2050. The exact frequency and the changes in frequency of the of storms cannot yet be predicted;

Relative humidity:

- as decrease in the relative humidity of approx. 6%;

Potential evapotranspiration:

- an increase of 10-15%;

Drainage of rivers:

- annual drainage change may be of between 5% increase and 30% decrease;
- increase in flood frequency during winter and spring, increased low levels in summer and autumn;

Sea level:

- sea level rise for Belgium of between 40 and 70 cm;

Uncertainties:

- there will be much more natural variation in local climate than the continental-scale climate variables can show;
- when determining the future effect, strong regional variations in variables such as precipitation, clouds and the frequency of extreme weather conditions (extreme precipitation, extreme drought, storms etc.) must be taken into account.

6.2. IMPACT AND ADAPTATION

6.2.1. FRESHWATER SYSTEMS

6.2.1.1. Impact assessment

The major effects of climate change as predicted by the models that have been used on freshwater systems are summarised in Table 6-1.

Table 6-1. The effects of climate change on freshwater systems.

Effects	Remarks
The replenishment and level of groundwater and surface water reservoirs decreases during summer	Possible problems for the supply of drinking water and irrigation water; possible reduction of wetlands
Probable rise of water level of rivers during winter	Increased risk of flooding
Groundwater quality deteriorates following: - salt intrusion caused by higher seawater levels - alterations in soil properties due to changed groundwater levels	Groundwater quality is predominantly affected by factors other than climate change
Demand for water for consumption increases	
Increasing frequency of extreme conditions leads to more frequent and more extensive floods on the one hand and dry rivers on the other	The effect is difficult to predict and depends on the river basin
River morphology changes brought about by increased erosion	There is a possible impact particularly on floods and navigation
Lower levels in summer and autumn	Possible problems for river life and aquaculture

6.2.1.2. Strategies and measures for adaptation

Water management is a process of constant adaptation, anticipating demands, new technology, new information, new legislation and new expectations. To prevent water shortages and floods, and to ensure water quality, measures have to be taken to change the management and use of the resource, irrespective of the direct causes such as climate change.

Adaptation strategies should include:

- adequate management of returning land to rivers to prevent floods (as already applied in Belgium);
- introduction of technological measures for the management of water reserves; these include water-saving measures, development of criteria for land use, erosion control; construction of additional basins and pipelines to assure the availability of freshwater, in an integrated and global approach to watershed management;
- direct measures for more efficient use of water to limit the use of water and land (including promoting the use of rain water);
- incentives and penalties to encourage more efficient water use.

6.2.1.3. Conclusion

As for other sectors, there are still many uncertainties about the prediction of climate change effects on freshwater systems. Very diverse predictions are obtained when modelled at a regional scale (watershed scale). Therefore, it is of major importance that further research is done in the field of hydrology, which will result in improvements to model predictions. The predictions of the frequency of extreme conditions in particular are subject to great uncertainties. The overall trend, however, with regard to Belgian river basins is a likely increase in the frequency and extent of flooding and low water levels . Given the fact that water management activities can minimise the effects of climate change on freshwater systems, they constitute an important policy instrument.

6.2.2. COASTAL AREA AND SEA LEVELS[65]

6.2.2.1. Impact assessment

The possible effects of climate change following the adopted scenario are described in Table 6-2.

Table 6-2. Qualitative description of the possible effects of climate change on the Belgian coast

Factor	Intermediate effects		Final effects
	Primary	Secondary	
Sea level rise Storm frequency increase	Change in flora and fauna		impact on fisheries
	River tide alterations	Increase of inland floods	increased risk of victims and damage
	River tide alterations		impact on navigation / shipping
	Salt intrusion into surface waters	Changes in flora and fauna	nature reserve damage
	Sedimentation patterns change		impact on fisheries
			increased risk of victims and damage
			impact on navigation / shipping
	Coastal erosion	Biota changes	nature reserve damage
			infrastructure damage
			increased risk of victims and damage
			decline in tourism
	Increased flooding		increased risk of victims and damage
			impact on agriculture
		Soil quality damage	impact on agriculture
	Increased coastal pollution		tourism decline
			increased health risks
			impact on fisheries
			impact on navigation / shipping
			impact on fisheries
			impact on navigation / shipping

6.2.2.2. Strategies and measures for adaptation

The following adaptation strategies are considered:

- a prevention strategy focused on coastal defence;
- intensifying preventive measures against coastal erosion caused by waves and tides, particularly gentle measures such as beach profiling, sand accumulation, sand supplementation, planting of beach grass;
- provision of sufficient funds for effective coastal defence in the light of climate change.

6.2.2.3. Conclusion

The risks to coastal residents, the damage to nature reserves, a decrease in tourism and an impact on agriculture are considered to be the major effects of a sea level rise. An increase in storm frequency will adversely affect fisheries and navigation/shipping. Intensification of coastal erosion prevention measures should limit the effect of a sea level rise in Belgium to a loss of nature reserves.

[65] A study was conducted in April 2000 in the Flemish region about the possible effects of climate change on sea-level, river flow, frequency of storms and flooding. In a long-term perspective, this study was extended to the Dutch part of the Scheldt estuary, and the Dutch coastline (see http://www.waterland.net/sic/ltv/onderzoek exogene factoren.pdf)

Policy measures in this context have to be part of *Integrated Coastal Zone Management* (ICZM). The different sectors involved, however, often have different priorities, making the introduction of ICZM difficult. It is crucial in this context to improve co-operation between coastal planning (possible future effects) and coastal defence (preservation of the present situation).

6.2.3. SOIL

6.2.3.1. Impact assessment

The major effects of climate change as predicted by the models that have been used for assessing the effect on soils are summarised in Table 6-3.

Table 6-3. The effect of climate change on soils.

Effects on soil	Remarks
Slight addition of salts	Consequences for soil life and agriculture
Increased erosion caused by increased precipitation and wind action	taking into account the erosion increase through changes in land use partial prevention through afforestation and land management programmes
Modification of soil moisture evolution (more frequent moisture deficit).	Consequences for soil life
Lower organic material content following the temperature increase resulting in higher rates of application of inorganic fertilisers	Limited importance in relation to impact of agriculture Increase of CO_2 emissions
Soil shrinking: peat by up to 45 cm, clay by 10-45 cm; increased shrinking and expansion action	Affected areas include the polders, river depositions, the Rupel area, large parts of East and West Flanders, the Fens; repercussions mainly for the construction industry
Sea level rise will result in increased salinity in polders	Consequences for soil life and agriculture

6.2.3.2. Strategies and measures for adaptation

The following adaptation strategies are considered:

- current land use is a major contributor to soil erosion. At present, a number of erosion prevention measures are being developed, including slope reduction, specific agricultural interventions and land management;
- improved management of underground / soil water is necessary;
- use of exogenous humus;
- development of guidelines for stabilityof construction work.

6.2.3.3. Conclusion

There is still uncertainty about the effects of climate change on soils because most effects depend on future local precipitation patterns, which are difficult to predict. Furthermore, there is uncertainty about the effect of an increased CO_2 concentration on vegetation. This will influence organic material content, degradation speed, nutrient balance, etc. of the soils (secondary effects). Despite the available data concerning changes in humidity, erosion and organic material, it remains impossible to clearly determine the effects of climate change on soils in natural and semi-natural habitats.

For the time being, land use constitutes the main constraint on soils in Belgium. In the future, climate change may become a major driving force for the soil (e.g. flooding, erosion, etc.). It is therefore necessary to link these two elements (land use and climate change) in further research.

The data available at present suggest that climate change in Belgium will have little direct effect on soils. Indirect effects as a result of moisture deficit and erosion may however occur.

6.2.4. AGRICULTURE, HORTICULTURE AND FORESTRY

6.2.4.1. Impact assessment

The effects of climate change on agriculture, horticulture and forestry are diverse and wide-ranging. Table 6-4 presents the most important effects.

Table 6-4. The most important effects of climate change on agriculture, horticulture and forestry

Effects on agriculture, horticulture and forestry	Remarks
Elevated CO_2 levels and temperatures will result in increased rates of photosynthesis and improved water use efficiency (hence increased rates of crop development)	production and productivity increases for most crops, especially for sugar beet and carrot. production decrease for cauliflower and fruit trees
Hydric stress for grasslands and vegetable crops	In relation to increasing soil moisture deficits
Decreased protein level in crops	Unknown effect on crop quality
Increased migration and distribution of pests	New pest control techniques will be required
Change in species composition	Effect on biodiversity
Sea level rise will result in increased salinity in polders	Decrease in farmable area, possible damage to crops
Increased temperature will benefit horticulture	Less energy (heating) use, possibility to cultivate more species
Decreased forest diversity but higher overall productivity	Strongly influenced by management

6.2.4.2. Adaptation strategies and measures

The following adaptation strategies are considered:

- further analysis of pests migration and distribution, in view of the predicted climate change, and research on pest control strategies
- agricultural management improvement to overcome biophysical limitations such as water availability, soil characteristics, genetic diversity for crop cultivation and topography;
- intensification of afforestation programmes (CO_2 sinks and erosion prevention);
- further global analysis of consequences for vegetable crops and husbandry.

6.2.4.3. Conclusion

The vulnerability to the effects of climate change depends not only on physical and biological but also on socio-economic characteristics. The favourable socio-economic situation encountered in Belgium, as well as the capacity for adaptation, makes vulnerability of agriculture, horticulture and forestry quite low.

An increase in CO_2 concentration and temperature might result in an increased production of most crops in Belgium; however, this increase is crop-specific and will compensate for a possible water shortage (notably grassland and vegetable crops), or possible pest damage. In horticulture, climate change in Belgium is expected to have a positive effect partly due to the opportunity to grow new species and partly due to reduced energy needs. Fruit cultivation, however, would be threatened, although only to a small extent.

Recent developments in forest management make it hard to determine the cause of observed changes: climate change or change in management. Climate change effects on forests in Belgium are considered to be closely linked to the impact of land use and of socio-economical factors.

6.2.5. THE OTHER SECTORS: OVERVIEW

6.2.5.1. Impact assessment and adaptation strategies

The most relevant information available for the other sectors is given in Table 6-5:

Table 6-5. Overview of the most important effects of climate change in Belgium, for various sectors

Fauna and flora	
IMPORTANT EFFECTS	- change in species composition - species diversity (particularly for plants) is expected to decrease - increase in insect populations - invasion of new species
POSSIBLE ADAPTATION STRATEGIES	- change static approach to nature conservation and management to a dynamic approach - creation and conservation of corridors and/or stepping stones
Landscape	
No important effects or adaptation strategies to mention, except those that may originate from coastal and river defence structures on the one hand and from watershed management on the other hand.	
Public Health	
IMPORTANT EFFECTS	▪ effects will mainly occur in summer (less in winter) as a consequence of: - heat waves resulting in increased mortality; - increased air pollution caused by heat (more asthma and allergies to pollen and spores) - thinning of the ozone layer resulting in increased harmful ultraviolet light exposure ▪ contamination of water reserves by increased floods
POSSIBLE ADAPTATION STRATEGIES	- further extension of present public health system - improved control of climate change effects
Energy	
IMPORTANT EFFECTS	- changes in energy consumption for heating and cooling of residential and commercial buildings - reduced availability of cooling water
POSSIBLE ADAPTATION STRATEGIES	- in the event of gradual climate change, there is a high possibility of autonomous adaptation through new techniques and industrial processes - research on renewable energy sources
Industry	
IMPORTANT EFFECTS	- the production sector is often directly or indirectly related to freshwater systems (extraction, transport, cooling, water quality) - the socio-economic impact of climate change might result in changes in demand, and consequently in production
POSSIBLE ADAPTATION STRATEGIES	- taking possible effects of climate change into account in the development of new technologies in the construction industry - preparation for changes in demand by means of market studies
Financial sector	
Insufficient data available to make an impact assessment.	
Tourism	
IMPORTANT EFFECTS	- Higher mean temperatures might result in an increase of outdoor activities - winter sports and river sports industry will decrease - indirect effects depend on the effects on freshwater systems, fauna and flora and sea level
POSSIBLE ADAPTATION STRATEGIES	- already constant adaptation depending on demographic, ecological and economic processes
Transport	
IMPORTANT EFFECTS	- indirect effects through changes in flows of goods (e.g., following changes in agricultural production patterns) and passengers - changes in river flows may affect inland shipping
POSSIBLE ADAPTATION STRATEGIES	- for this sector, a strong autonomous adaptation is expected in the coming 50 years

6.2.5.2. Conclusion

Little information is available on the effects in Belgium of climate change on **fauna and flora**, and most of it is merely expert opinion. Changes in species distribution, loss of biodiversity and/or invasion of new species are probably the most important effects of climate change. Policy in this sector in the light of climate change needs to give due consideration to other factors that have an impact. It is thus expected that e.g. changes in agriculture policy, possible fiscal advantages for forestry, changes in land use or changes in water extraction in the near future (next 50 years), will have a large impact on fauna and flora in Belgium.

Future changes in **landscape**, in species composition and distribution of plants and animals in the landscape are likely to be equally or even more influenced by land use policy measures than by climate change. Significant policy decisions which entail changes in the agriculture policy, fiscal stimulants for forestry or changes in water use are likely to have more impact on the landscape than climate change. Such policy decisions, however, could be (in part) motivated by climate change.

Climate change, together with its ecological and economic consequences, poses an increased risk to **public health** in the long term. Monitoring of possible effects of climate change on human populations is indicated. Overall, vulnerability in Belgium to the different effects of climate change on public health is limited due to the existence of adequate public health infrastructure and systems. The effects of heat waves and extreme weather conditions, however, can not be excluded.

The **energy** sector is the main cause of climate change, being the major source of anthropogenic CO_2 emissions. Direct impacts of climate change on the energy sector will, however, be much smaller than those caused by economic developments, technological changes or mitigation measures aimed at reducing the greenhouse gas emissions. The kind of energy use that is most susceptible to climate change effects is heating and cooling of residential and commercial buildings, where a net reduction in energy use is expected.

The **industries** that are thought to be most vulnerable to climate change are those depending on agriculture, horticulture or forestry for the supply of raw materials. The relation between industrial processes and their impact on freshwater systems and the energy sector is an important element for the evolution in these sectors. The development of new technologies for the construction sector should take into account possible effects of climate change. By means of market studies, the industry, retail trade and tertiary sector can prepare themselves for changes in demand for certain products.

At present, little information is available about the possible effects of climate change on the **financial sector**.

Given the present predictions effects on there are mostly positive effects of climate change on **tourism**. Preventative and adaptation measures are required for sectors that indirectly influence tourism. Major negative impacts are anticipated for the winter sports and river sports in the Ardennes. Coastal tourism will enjoy a mainly positive impact, provided that the possible adverse effects of sea level rise are controlled. Belgian tourism will always be linked with possible climate change in the future. The predictions, however, are all based on the assumption that the present economic, ecological and demographic conditions persist. Any change in these conditions (which is very likely) will influence the present findings.

Like the energy sector, the subject of **transport** in relation to climate change is also seen in most studies as a cause of climate change. The direct impacts of a climate change on the transport sector will therefore be much smaller than those caused by economic developments, technological changes or mitigating measures to reduce greenhouse gas emissions on the one hand and to meet the growing demand for transport on the other.

6.3. OVERALL CONCLUSION

Based on the present information, it can be put forward that the effects to be expected from climate change in Belgium are rather limited. This is the result of the stable socio-economic situation in Belgium and the specificity and resilience of the different sectors that are affected. Nevertheless caution is always needed when little information is available. In a scenario of large climate change, effects may become more significant. The sectors that will experience the most direct impacts are the freshwater systems (change in water levels and water reserves) and the coastal zone. For the coastal zone, the impact will be minimal with proper adaptation measures. Next to these, industry, and the construction industry in particular, agriculture, public health and tourism are important issues. Apart from the effects of climate change, important evolutions are expected in sectors such as industry, transport and energy that will enable an autonomous adaptation with regard to climate change.

The major effects will occur under extreme conditions, which are very hard to predict with the current understanding of the climate. Due to an increase in the frequency of storms, floods, heavy precipitation, extreme heat, soil moisture stress, etc., effects will emerge that were not taken into account. It is of major importance to take these effects into consideration and to further investigate them in order to elaborate contingency plans.

7. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

7.1. INTRODUCTION

This section presents an overview of the Belgian development aid through contributions to financial mechanisms and transfer of environmentally sound technologies, including international training programmes, in order to support developing countries in their quest for economic, social and institutional growth, bearing in mind the sustainable development for future generations.

The Belgian Federal Government is strongly committed to the principles and guidelines contained in the Declaration of Rio (UNCED 1992) and has started to implement them in its development assistance programmes ever since.

Belgium also adheres to the co-ordinated approach of donor countries, through an active participation in the international forums, such as the European Union and the OECD. Considering the global character of climate change, only a well co-ordinated, international strategy may stand a chance of success.

As a whole, the Belgian *Official Development Assistance* (ODA) disbursements for the year 2000 amounted to BEF 35.528 billion, representing 0,36 % of the *Gross National Product* (GNP). This percentage, which is already 20 % higher than the previous year is expected to increase further in 2001. The *Directorate General for International Co-operation* (DGIC) of the Ministry of Foreign Affairs is in charge of over 68 % of these resources, the rest being shared by other federal ministries, ministries of the regional governments, provinces and municipalities.

7.2. MULTILATERAL AID

7.2.1. THE GLOBAL ENVIRONMENT FACILITY (GEF)

i. Pilot Phase

During the GEF Pilot phase, Belgium contributed BEF 198,532,682 (4,420,900 SDR[66]) to the Core Fund and additionally co-financed a solar water heating project in Tunisia and a West African community-based natural resources and wildlife management project in Burkina Faso and Ivory Coast up to BEF 247,270,324, overhead costs included (5,000,000 SDR).

ii. GEF-1

During the first replenishment period of GEF covering FY1995 to FY1998 Belgium contributed 1.58 % to the GEF Trust Fund budget, through the *Directorate General for International Co-operation* (DGIC), summing up BEF 1.1 billion, paid in cash.

iii. GEF-2

For the current replenishment period, covering FY1999 tot FY2002, Belgium's contribution represented 1.66% of the GEF trust Fund, reaching the total of BEF 1,248,000,000, paid in cash through DGIC.

[66] SDR : *Special Drawing Rights* : IMF's currency unit of account (basket of national currencies)

iv. GEF-3

Replenishment negotiations for GEF-3 are currently underway and are expected to arrive at an agreement at the beginning of 2002. Belgium is advocating a substantial increase of GEF resources for the next period (FY2003-FY2006).

7.2.2. MULTILATERAL FUND OF THE MONTREAL PROTOCOL

Although *Ozone Depleting Substances* (ODS) make up a fair share of the greenhouse effect, the direct results of financial contributions to the Multilateral Fund under the Montreal Protocol, on the mitigation of climatic changes are very difficult to calculate. Nevertheless, disbursements to the Montreal Protocol Multilateral Fund may be indicative of a country's commitment to international co-operation concerning sustainable development. The Belgian Federal Government's contributions to the current replenishment period of the Multilateral Fund amount to BEF 210,000,000.

7.2.3. SPECIAL PROGRAMME FOR AFRICA (PHASES I AND II)

Since mitigation is not only about reduction of emissions, but equally important about enhancing sinks, simultaneously mitigating the adverse effects of climate change, efforts made in the field of forestation, reforestation and the combat against desertification should be reported.

Over the last 10 years the Belgian Federal Government has supported the *Special Programme for Africa* (phases I and II) with roughly BEF 1.8 billion, through the *International Fund for Agricultural Development* (IFAD). Field projects comprise rural development, water management, forestation, soil degradation, in those areas of sub-Saharan Africa that are especially vulnerable to climate change.

Within the countries belonging to the *Southern African Development Community* (SADC), a similar initiative, through bilateral co-operation projects, has received close to BEF 300 million for the period 1993-1997.

7.2.4. CONVENTION TO COMBAT DESERTIFICATION

After several years of voluntary contributions, DGIC is now in charge of the Belgian contributions to the Core Budget of the *Convention to Combat Desertification* (CCD) amounting to BEF 4,100,000 yearly. In addition, several activities in Africa have been supported through desertification programmes of UNDP and UNEP.

7.3. BILATERAL AID

i. Federal Government

In the bilateral aid programmes climate change issues are mainly dealt with through initiatives of Belgian universities and scientific institutions, funded by the *Directorate General for International Co-operation* (DGIC):

- The *Katholieke Universiteit Leuven* (KUL) started in the year 2000 a project to support capacity building, research and development of renewable energy in Cameroon, with a funding amount of BEF 12,026,857.
- The *Katholieke Universiteit Leuven* (KUL), together with the University Foundation of Luxembourg (FUL), is setting up an atmospheric model for the study of climatic changes and the follow-up of agricultural campaigns in Côte d'Ivoire. The project started this year 2001 and has a budget of BEF 10,540,903.

- The Royal Museum for Central Africa participates in the international research programme "Palaeoclimatic Evolution and Human Population in West Africa", in Mali, together with the universities of Bamako, Paris X-Nanterre and Oxford. The project started in 2001 and will run until 2004. The Belgian share of the budget amounts to BEF 1,239,000.

With regard to the combat of desertification, Belgian projects have been addressing land degradation and deforestation since many years. These activities have been channelled through direct bilateral aid by means of DGIC projects, as well as through indirect bilateral aid, by means of NGOs, universities and scientific institutions, with the financial support of DGIC. The details of these actions have been reported to the UNCCD Secretariat in 1999 and 2000.

ii. Flemish Government

The Flemish Government is channelling its activities in the realm of climate change through the Flemish universities of Leuven, Brussels, Ghent and Antwerp.

In China its activities are related to the relation between volcanism and global environmental changes (with the Chinese Academy of Geological Changes, BEF 2,895,800), the climatic effect of biomass burning particles (with the National Research Centre for Environmental Analysis and Measurements, BEF 2,989,000), greenhouse gas reduction through the implementation of small-sized CHP technology (with ZheJian University, BEF 2,982,640) and the environmental impact of volcanism (with the Chinese Academy of Sciences, BEF 3,981,000).

In South Africa there is a project on soot and other atmospheric aerosols that affect human health and the global climate (with the Vista University, BEF 3,770,000).

iii. Walloon Government

The Walloon Government focuses its bilateral aid programmes in the South on capacity building and the transfer of technology, through including the environmental dimension in all of its agreements. In its *Action Plan for Climate Change* it therefore concentrates on policy support and instruments for sustainable development in energy and environment. In particular, it will tackle management instruments for the UNFCCC: vulnerability assessment, adaptation measures, financial mechanisms including the Clean Development Mechanism, in Francophone countries.

Another line of action has to do with information exchange on climate change and developing synergies with desertification and biodiversity: networking of focal points, capacity building in information technology, creation of a clearing house on climate change, preparation and distribution of information for the general public.

Under its *Research and Development Programme*, the Walloon Government is currently implementing the *CHP-Total Energy* programme for developing new or scarcely used technologies, with an emphasis on micro-generation and CHP from biomass. At the moment 5 projects, for a total value of BEF 72,000,000, are running, involving universities, research centres and private companies.

7.4. TECHNOLOGY TRANSFER AND CAPACITY BUILDING

i. Federal Government

At the federal level, the DGIC has always included the aspects of technology transfer and capacity building in its bilateral agreements. Transfer of environmentally sound technology should allow rapid growth of developing countries while safeguarding the general environment and natural resources. Capacity building serves the same purpose, as it prepares the individual countries for dealing with the wide array of international agreements, national plans, technology evolution, etc.

Most bilateral projects of the DGIC include, therefore, training segments, either in the developing country itself, in Belgium or both. DGIC also supports International Course Programmes and International Training Programmes at Belgian universities.

ii. Regional Governments

As Belgium has only recently become a Federal State, Regional Governments are just now extending their environmental expertise towards developing countries. Efforts of the Flemish, Walloon and Brussels Region can be located at the private rather than the official level, but have been taken up in their Plans of Action for Climate Change and have started to be implemented.

As for the Federal Government, the bilateral aid programmes of the Regional Governments always include aspects of technology transfer and capacity building.

8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1. GENERAL POLICY

The competence areas related to science, technology and innovation (STI) in Belgium are distributed across all federated and the federal entities of Belgium. The main responsibility for STI policy is conferred on the Regions and the Communities within their own areas of competencies. As an exception to this rule a number of competencies involving scientific research are entrusted to the Federal government.

Communities have the main responsibility for fundamental research in universities and applied research in higher education establishments. Regions have the main responsibility for economically oriented research, technological development and innovation promotion. The Federal State is responsible for scientific activities linked to its own competencies, and develops STI activities of national and international interest, in agreement with Communities and Regions. Co-operation and consultation between the federated entities is organised through the *Inter-Ministerial Conference on Science Policy* (CIMPS-IMCWB), embracing representatives of the Federal State, the Communities and the Regions.

i. FEDERAL STATE

At federal level, the Council of Ministers from the Federal government is the executive body, responsible for STI policy. The administrative structure responsible for the implementation of the federal science policy is the *Federal Office for Scientific, Technical and Cultural Affairs* (OSTC), placed under the authority of the Minister responsible for scientific research, and under the administrative control of the Prime Minister. OSTC prepares and implements actions falling under the Federal government 's responsibility described above: either programmes and activities developed by the Federal authority autonomously, or in the framework of co-operation agreements with the Regions or the Communities. An essential part of the tasks of the OSTC concerns the implementation and co-ordination of scientific and technical activities requiring a multi-annual approach. Other federal departments administering significant research budgets are the Economic Affairs department (nuclear research, collective research centres, geological services, patents, measurement and certification, standardisation), National Defence, Social Affairs, Public Health and Environment, Justice, Development and Co-operation, and Agriculture.

ii. WALLOON REGION

The Walloon Minister of Research and New Technologies is competent for STI policy. He administers the most significant component of regional STI policy, namely research with technological implications. Other Ministers are also empowered to fund research activities in their respective areas of competence. They develop these activities in full autonomy. The administrative body in charge of preparation and execution of the policy is the *Directorate General for Technologies, Research and Energy* (DGTRE). This administration develops projects, manages programmes and funds in support of R&D and technological innovation in companies, research centres and universities in the Region. Other administrative directorates of the Ministry of the Walloon Region are responsible for the management of more limited budgets and actions in support of STI activities in their own areas of competence: Natural Resources and Environment, Social Programmes and Health, Town and Country Planning, Equipment and Transport, etc.

iii. FRENCH COMMUNITY

In the French Community, the Minister of Higher Education and Scientific Research has primary responsibility for STI policy for this federated entity. Other Ministers of this government are responsible for a limited portfolio of programmes within their own areas of competence. The administrative body in charge of preparation and execution of the science policy is the *Directorate General for non-compulsory Education and Scientific Research of the Ministry of the French Community* (DGENORS). This

administration is responsible for the financing of universities and higher education establishments and for fundamental research (including FNRS[67] and the associated funds), and ensures the co-ordination of all research and scientific activities in the other departments of the French Community Ministry. It is also responsible for the follow-up of international R&D activities, especially at EU level. Other departments of the Ministry of the French Community are responsible for sector-specific research programmes related to matters falling within their competence: health, culture, sports, tourism, public services.

iv. REGION OF BRUSSELS-CAPITAL

The executive responsibility for STI policy in the Region of Brussels-Capital lies with the Minister-President of this government. At administrative level, the *Research and Innovation Office* (SRI-DOI) of the Ministry of the Region of Brussels-Capital takes responsibility for the implementation of the policy. Its main mission is to administer the funds to support basic industrial research and prototype development in regional companies. *Technopol Brussel-Bruxelles* is a non-profit organisation of actors from the Region, financed by the regional government, to support technology transfer and innovation development with the cooperation of all science, technology, and economic and public actors in the Region. As such, it plays a central role in the STI policy setting in the Region of Brussels-Capital.

v. FLEMISH REGION

The responsibility for Flemish policy on STI is shared between the Minister for Economics, Town and Country Planning and Media and the Minister for Education and Training. The latter is responsible for the training of scientists and the structural funding of scientific research at universities and higher education establishments. The administrative body responsible for preparation, execution, follow-up, evaluation and promotion of the Flemish science and technology policy is the *Science and Innovation Administration* (AWI) of the Ministry of the Flemish Community. This administration manages horizontal coordination of actions between the various ministerial departments involved in STI actions. Other departments of the Ministry of the Flemish Community are responsible for the preparation and execution of sector-specific policies, namely in Education, Economy, Employment, Internal Affairs, Environment and Infrastructure, Welfare, Public Health and Culture.

In addition to these administrative units of the Ministry of the Flemish Community, the Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT-Flanders) is a public body playing a major role in the execution of Flemish Technology and Innovation policy. Especially, IWT manages financial support for industrial research and technology transfer in the Flemish industry. Furthermore, IWT has the mission to coordinate all technology transfers and innovation intermediaries in Flanders.

8.2. RESEARCH ACTIVITIES

In comparison to other countries, research activities in Belgium (both research on climate system and policy supporting research), are basically carried out in universities and, to a lesser extent, in several institutes, among which: the *Royal Meteorological Institute* (KMI-IRM), the *Belgian Institute for Space Aeronomy* (BIRA-IASB), the *Royal Institute for Middle Africa* (KMMA-MRAC), the *Management Unit of the Mathematical Model of the North Sea* (MUMM), the *Federal Planning Bureau* (FPB-BFP), the *Flemish Institute for Technological Research* (VITO), the Walloon *Institute*, the *Institute for Forestry and Environmental protection* (IBW - AMINAL). Consultant Offices such as ECONOTEC and ECOLAS and non-profit organisations such as the *Institute for Sustainable Development* (IDD) also contribute to research activities in the field of climate change. Research activities led by these universities and institutes in the field of climate change take place either in federal or regional research programmes, or in international participations. These research activities are presented hereafter.

[67] FNRS: National Fund for Scientific Research

8.2.1. INTERNATIONAL CO-OPERATION

The trans-boundary character and the complexity of the climate system including the dynamics, physics and chemistry in the troposphere and the atmosphere and their interaction, the role of the cryosphere and the hydrosphere (including oceans) and the dynamics of ecosystems and bio-geochemical cycles, induce the need for an international co-operation with respect to research and observation, scientific assessment and integration. Belgium takes a large part in this effort.

i. Belgian participation in international research programmes

Belgian scientists participate actively in the following international research programmes (non-exhaustive list):

- Energy, Environment and Sustainability Programme (EC, R&D Framework Programme 5)
- European programme on transport, transformation of trace components in the troposphere over Europe (EUROTRAC II)
- International Geosphere and Biosphere Programme (IGBP)
- World Climate research Programme (WCRP): in particular Climate Variability and Predictability (CLIVAR and EUROCLIVAR), Arctic Climate System Study (ACSYS), Climate and Cryosphere (CLIC) and Stratospheric processes and their role in climate (SPARC)
  IGBP/International Human dimensions programme (IHDP)
- European Ice Sheet Modelling Initiative (EISMINT)
- European Project for Ice Coring in Antarctica (EPICA)
- Consortium for Ocean Drilling (ECOD)
- European Network of Earth system Modelling (ENES)
- International Space Programmes (see details in § 8.2.2)
- Network for the Detection of Stratospheric Change (NDSC)
- Energy Technology Systems Analysis Programme (ETSAP - IEA and OECD)

ii. Scientific integration and assessment

Belgium contributes to international efforts towards scientific integration and assessment through the participation of Belgian experts to international expert panels, assessment and integration activities, such as the *Intergovernmental Panel on Climate Change* (IPCC), the *World Meteorological Organisation* (WMO), the *Scientific Assessment Panel on Ozone Depletion*, and the *European Ozone Research Co-ordination Unit* (EORCU).

8.2.2. FEDERAL RESEARCH PROGRAMMES AND ACTIVITIES

Implementation of actions falling under the federal science policy is mainly a responsibility of the *Federal Office for Scientific, Technical and Cultural Affairs* (OSTC). Within the OSTC, the departments that are e.g. concerned with climate research are:

- Research programmes
- Space research and applications
- International co-operation

Climate Research in the OSTC is mostly integrated into a *Scientific Support Plan for a Sustainable Development* (SPSD). SPSD 1 (1996-2000) has just ended and SPSD II (2000-2005) has started. A partnership accord is in operation between the federal and regional authorities concerning the first and second SPSD. Projects under SPSD I and II are selected on the basis of an evaluation by foreign experts and the advice of an accompanying committee. They are briefly presented hereafter:

i. The First Scientific Support Plan for a Sustainable Development Policy (SPSD I) (1996-2000)

The *First Scientific Support Plan for a Sustainable Development Policy* (SPSD I), approved by the Council of Ministers on 7 March 1996, in particular covers relevant programmes associated with Climate Change:

GLOBAL CHANGE AND SUSTAINABLE DEVELOPMENT

This programme was granted a budget of EUR 16 million, covered 24 projects and involved 67 teams. The programme concentrated primarily on the needs arising from the *UN Framework-Convention on Climate Change*. It established a balance between the basic research needed to resolve uncertainty and

more urgent research designed to support the political decision-making process. The programme therefore consisted out of 2 parts:

Part 1: Reducing uncertainties

This part aimed at obtaining a clearer understanding through both descriptive (experimentation) and predictive (modelling) work, of the state and evolution of the environment in relation to socio-economic activities, within the context of climate change. Four priority themes were defined:

- Atmospheric physico-chemical and dynamical processes (troposphere and stratosphere)
- Climate system
- Terrestrial ecosystems
- Water cycles

Part II: providing scientific support for Belgian politics concerning climate change

The research carried out under this sub-programme aims to:

- define medium and long-term objectives to reduce emissions of greenhouse gases in Belgium, taking into account the risks of climate change and it consequences measured by the cost of damage and the means by which these emissions may be controlled;
- evaluate the instruments (economic, regulatory and other instruments) and the measures (practical arrangements) that will enable emissions of greenhouse gases to be reduced in our country, taking into account the international dimension of the issues ("burden sharing", "Activities Implemented Jointly").

In this context modelling tools were developed enabling scenarios of greenhouse gas reductions to be evaluated (see Section 5).

TELSAT (1996-2000)

The TELSAT programme links the space community with the Belgian user community and demonstrates the usefulness of satellite data. Global Change (including climate change) is one of the four central themes. See also http://telsat.belspo.be/

SCIENTIFIC RESEARCH ON THE ANTARCTIC - PHASE IV[68]

In 1985, the Government took the initiative to organise a structured action of scientific research on the Antarctic. Given the important role of the Antarctic zone with respect to the ozone hole and the climate changes as well as its importance as a reference ecosystem, the expertise which has already been acquired on the subject and Belgium's pioneering role with respect to the Antarctic Treaty, special attention is given to studies related to this zone. The selected research projects concerned mainly the mass balance and the dynamics of the Antarctic ice cap (a contribution to EPICA) and the Antarctic shelf-slope dynamics.

ii. The Second Scientific Support Plan for a Sustainable Development Policy (SPSD II) (2000-2005)

The second Scientific Support Plan for a Sustainable Development Policy (SPSD II) was approved by the Council of Ministers on the twelfth of May 2000 with a total budget of 2.335MBEF or 57.88 MEUR. It is partitioned in two co-ordinated structures:

Part I. 'Sustainable production and consumption patterns'

In the first call (2001), 14,15 MEUR have been committed to thirty four projects, of which ten projects (4,13 MEUR) are directly or indirectly related to climate change: four projects contribute to the development of models to evaluate different aspects of climate change policies; four projects analyse the possible role in terms of sustainability of new technologies related to energy and transport issues; three projects are concerned with the evaluation of the flexible mechanisms; one project analyses the relationship between the product policy and climate policy. 6,94 MEUR will be committed in 2003.

[68] More details can be found at : http://www.belspo.be/belspo/antar/

Part II. 'Global change, ecosystems and biodiversity'

Part II is divided into three sub-units: atmosphere and climate, ecosystems, biodiversity. In the first call (2000), 14,48 MEUR have been dedicated to 16 projects, whereby 13 directly related to climate change. Three projects concern the Antarctic (ice-sheet dynamics, late Quaternary climate history, biological pump in the Southern Ocean); the 10 other projects concern anthropogenic and biogenic influences on the oxidising capacity of the atmosphere, paleoclimatic studies in Chile and at Lake Tanganyika, the role of oceanic production and dissolution of calcium carbonate in climate change, carbon sequestration potential in different Belgian terrestrial ecosystems, strategic exploration, climate modelling. In the second call (2001), about 1,2 MEUR is foreseen to be devoted to projects dealing with impact of climate change on water resources and the watercycle.

Besides these 2 co-ordinated structures, *Supporting Actions* and *Mixed Actions* are planed:

- *Supporting actions* are intended to meet the increased need for information gathering, the integration of research and its findings, and the communication of information about sustainable development amongst the various players. These support actions lead to the consolidation of information systems and data banks, the spread of integrated research, the development of mechanisms to get the public involved in the debate surrounding sustainable development, and the development of interfaces between science and policy (for example, the creation of thematic platforms).
- *Mixed actions* are intended to promote the integration of policies (in the environment, social and economic fields) - a strategy with high political priority at both the European and the international level. These mixed actions are inter-disciplinary research projects relying on a balanced mixture of the natural and human sciences.

iii. Other federal research programmes and activities

STEREO

The STEREO programme (2001-2006) aims to support the exploitation and research of earth observation data. It is based on a 15 year long expertise and it will support various 'poles of expertise', each of which are specialised in a strategic niche, i.e., atmospheric chemistry, vegetation and associated parameters, land management, meteorology and climatology, and coastal studies. These 'poles' will cover both research and pre-operational applications in their specific domains. The total budget for the programme is approximatively EUR 1 100 000.

Scientific support for the exploitation of the VEGETATION instrument (2001-2004)

Covering a 4-year period, the programme "Scientific support for the exploitation of the VEGETATION instrument" was launched in parallel to Belgium's participation in the development of the VEGETATION instrument aboard the SPOT 4 and 5 satellites and is intended for basic research as well as for the development of (pre-) operational developments in the domain of "monitoring of vegetation and related parameters on a global and regional scale". The total budget for this programme is EUR 300 000, of which EUR 200 000 is being assigned for research.

ESA - PRODEX

Belgium participates to several climate related projects of the *Scientific Experiment Development Programme* (PRODEX) of the *European Space Agency* (ESA) since 1988. PRODEX finances proposals addressing the development of new instruments for ESA satellites, the calibration and validation of these satellite data, their processing including the development of algorithms, the development of specific applications and the general scientific data use of the instrument.

ESA - DUP

Belgium is one of the four States that took part in the voluntary *Data User Programme* (DUP) of ESA (1996-2003). This programme specifically supports initiatives that aim at bridging the gap between earth observation researches on the one hand, and the provision of an operational product on the commercial market on the other hand. The subjects of Belgian DUP projects in the field of climate change issues are: global aerosol mapping, forestry mapping, Ozone monitoring, draught early warning, climate analysis maps, carbon flux estimation, and tropospheric emission services. After 2003, this programme will be integrated into the EOEP programme.

ESA - EOEP

Belgium participates since 1999 to the volontary *Earth Observation Envelope Programme* of ESA. Several of the scientific missions developed through this programme are relevant for climate studies, e.g. GOCE (observation of global ocean levels), ACE (Atmospheric Climate Explorer), CRYOSAT (ice melting).

ECMWF

The European Centre for Medium-range Weather Forecasts (ECMWF) is specialised in medium-range and seasonal weather forecast. It is also committed to modelling and predicting greenhouse gases, aerosols and the carbon cycle. Belgium is a member of this organisation and contributes to ECMWF amounts for about 40 MFB for the year 2000.

For further information on these or other programmes see: http://www.belspo.be.

8.2.3. WALLOON REGION

i. Research conducted in the energy area

The budget of the Walloon Region for research and development related to energy reached an amount of EUR 8.676 million in 1999. The main themes of research are: the conservation of energy, which received the largest contribution (40%), followed by the production, transport and distribution of electricity (32%), and renewable energy sources (14%, of which 58% went on solar energy and 34% on hydroelectricity).

The Walloon Region conducts a number of research programmes related to energy technologies. The most important programme, “Decree”, was introduced in 1990. It applies to all sectors, including energy. The budget allocation is not determined by sector, but depends on project initiatives. In addition to this approach, the Region also regularly launches calls for R&D projects on pre-defined themes, such as CHP (see below). The support for technology in renewable energy sources has been increased, with the production of energy from biomass and waste, small-scale hydroelectricity schemes, “climate” architecture and techniques for passive solar energy in buildings receiving priority status. The “Action Plan to prepare Wallonia for the Future” adopted in 1996 reflects the R&D strategy that the Walloon Government wishes to promote. This plan being adopted, the efforts of the Regional Government have to be oriented towards clearly identified technological niches, to be defined with all the players concerned. The reorganization of the support given by the Region to R&D will enable the regional policy to be better integrated into the European R&D programmes.

The programme “CHP – total energy” has been set up with the intention of encouraging universities, centres of research and companies to develop new products or processes in this area and to open up new markets. It encourages research and development projects in types of installations that are absent or underrepresented on the market at present:

- micro-CHP (CHP units with an electric power of the order of 100 kW or less, running with fossil fuels);
- CHP from biomass (CHP units with an electric power of the order of 1.5 MW or less)

Following the first call for projects, five projects, which notably cover these topics, are funded up to a limit of BEF 72 million.

A larger call for projects, the "PIMENT Call" (*Innovative Projects to Control Energy using New Techniques*), is being prepared. This new programme is targeted at engaging creativity and imaginative capacity in research centres, universities or companies, and at giving promising projects a chance that are not always provided in existing programmes. Three facets may be distinguished: technological (specific equipment), technical (specific ways of assembling things, design of buildings, etc.) or behaviour/ education.

The Walloon Region also finances, in collaboration with the other Regions via the CONCERE/ENOVER group, the participation of the *Scientific and Technical Centre for Construction* (CSTC) to the IEA studies. In this framework, the Walloon Region supports the projects on *Energy Conservation in Solar Heating and Cooling* (UCL) and *Energy Conservation in Buildings and Community Systems* (Ulg). In addition, the Walloon Region is financing a project (2000-2003 period) aiming firstly to create software for optimising double skins (a window in front of the façade), shading devices and ventilation systems that can be used by architects and consultants. Secondly it will develop a guide and tools that will help produce better designs for office furniture. This project will enable the Walloon Region to initiate a demonstration operation in the office sector, similar to the PLEIADE house (*Passive Low Energy Innovative Architectural Design* – 1993/1994), a demonstration house with a very low level of energy consumption.

ii. Other initiatives

The *General Directorate of Natural Resources and the Environment* (DGRNE) has asked for a serie of scientific studies to be performed that are more directly related to the implementation of policies and measures. The main programmes undertaken recently in this connection are the following:

- The potential of forest ecosystems to sequester carbon (1999-2001): This study is targeted at continuing the work begun in 1997 by the Agricultural University of Gembloux on the impact of forest ecosystems on climate change. The purpose of this extension of the study is to deepen our understanding of the sequestration of carbon by root biomass and to improve the experimental devices and the system for using the data from the Vielsam site. The cost of operations for 1999-2001 reached BEF 20 million.
- To estimate emissions of atmospheric pollutants by the agricultural sector (2000-2001). Two recent studies aimed at refining our understanding of the emissions of NH_3, CH_4, and N_2O from the agricultural sector have been performed by SITEREM and the Agricultural University of Gembloux. These investigations have been supported by the Walloon authorities up to a limit of BEF 3.5 million and BEF 5 million respectively.
- The DGRNE also financed a serie of studies regarding the projected analysis of CO_2 emissions (1997) and CH_4 and N_2O emissions (1997) by the EPM micro-economic model developed by ECONOTEC.
- The Walloon Region is working on defining a plan for the air industry. This project will enable the Walloon Region to meet the international obligations regarding atmospheric pollution and climate change. Additional studies have been financed to complete this plan (2000-2001):
    - o New predictive analytical studies including proposed measures for all the sectors concerned.
    - o The analysis and synthesis of regulations
    - o An analysis of the impact of multi-pollutant and multi-sector measures.

  Econotec and the University of Liège have been asked to undertake this research at a cost of nearly BEF 20 million.

In 2000 the Walloon Region also performed a study regarding the European Commission's Green Paper on the establishment of an internal market of emission trading.

8.2.4. FLEMISH REGION

i. Programme of Policy-Oriented Research (AWI)

The ongoing *Programme of Policy-Oriented Research* (PBO) of the *Science and Innovation Administration* (AWI) consists of climate-related research associated with specific questions arising from the policy areas of the economy, agriculture and the environment. It is an initiative that was started by the Flemish Government in 1997. With this programme, the Flemish Government had a double set of goals. The first aim of this programme was contribute substantially to the scientific establishment of the policy.

The second aim of the Flemish Government was for the PBO to boost research in social sciences and cultural and educational sciences. In the form of an annual call for projects, in 1997, '98, and '99, the programme offered a transparent, objective, coherent and cost-effective approach to policy-oriented research in all areas in which the Flemish government had authority. Each call took shape after a wide-ranging enquiry by the Flemish Government and administration to identify which research was needed. The main areas of research identified were:

- Knowledge acquisition for policymakers;
- Development of policy scenarios;
- Development of policy indicators and measuring instruments;
- Evaluation of policy impact.

Most of the climate relevant projects in this programme are set up in view of the assessment of the reduction potential of GHG in 2003-2007 en 2008-2012 via emission reduction of greenhouse gases (GHG) and volatile organic compounds (VOC) (in relation with ozone) and halogenated greenhouse gases, but also via C storage.

ii. The INTERREG III programme

The *Flemish Institute for the Sea* (V LIZ) has applied to take part in two projects within the INTERREG III programme sponsored by France / the Walloon Region /the Flemish Region. The first project concerns the extension of the ongoing AEROSOL project, that will reach completion at the end of 2001 under INTERREG II, namely "The exposure of groups of people living in the heart of the EU to atmospheric particles: the case of fine dust particles". The second investigates "Spatial determinations of high resolution depth profiles making use of new sampling techniques".

iii. The Flemish Programme for the Promotion of Energy Technology (VLIET)

The R&D budget of the Flemish Region dedicated to energy related research rose to EUR 14 million in 1999. Energy saving represented the largest item (37%) followed by renewable energy (26%, of which 77% was spent on solar energy) and the demonstration projects (9%).

The *Flemish Programme for the Promotion of Energy Technologies* (VLIET) is managed by the *Flemish Institute for the Promotion of Scientific and Technological Research in Industry* (IWT). This programme, which ran during the period 1993-96, was given a total budget of EUR 19.831 million. As a general rule 10 % at least of the budget was awarded to projects supporting the Flemish energy policy and to the *Flemish Institute for the Rational Use of Energy* (VIREG) and at least 25% of the budget was awarded to projects in the area of renewable energy resources.

Box 8-1The Flemish Institute for Technological Research (VITO)

The *Flemish Institute for Technological Research* (VITO[69]) is a specialised research centre, with a semi-private status, under the auspices of the Flemish Government. It employs more than four hundred people. The VITO conducts market-oriented technological investigations, develops innovative products and processes and provides specialised services in the area of energy, the environment and new materials. The Energy Division is made up of several centres of expertise covering the areas of energy, transport, the environment and the evaluation of products and processes. The VITO takes part in European research programmes on energy and in several of the agreed projects that will be carried out under the IEA.

[69] 'Vlaamse Instelling voor Technologisch Onderzoek'

As the VLIET budget was not entirely spent, the VLIET-bis programme began in 1997. By mid-1998 the Flemish Government had agreed to finance twelve research projects helping policy decisions and sixteen research projects on the RUE and renewable energy resources. As the typical length of a project is two years, the projects are in the final phase. The Flemish Government is not considering launching new technology-oriented programmes.

8.2.5. BRUSSELS-CAPITAL REGION

The research in Brussels-Capital Region aims in particular at drawing up the annual energy balance and atmospheric emissions inventory and updating the emissions calculation model COPERT for the Region. These studies are fully part of the working plan of the *Brussels Institute for Environmental Management* (IBGE/BIM) and are realised and funded by the same institute (with the help of the *Walloon Institute* as a consultant). Other studies and demonstration projects related to transport are:

- Studies on air pollution related to car traffic (IBGE/BIM);
- The dynamics and management of the public transport network (STIB/MVIB[*Brussels Public Transport Company*]/AED);
- Testing of the use of gas-powered buses by the STIB/MVIB and drawing up of a technical-economic balance sheet (STIB/MIVB);
- Testing of the use of electrical vehicles in different public administrations and private companies;
- The comparative study of the energy and environmental achievement of various gas and diesel technologies (IBGE/BIM);
- A study of the real fuel consumption and emissions of vehicles in Brussels (IBGE/BIM).

8.3. SYSTEMATIC OBSERVATION

An overview of the current status of national programmes and support for ground- and space-based climate observing systems in Belgium is presented in Annex D.

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1. POLICY ACTION REGARDING EDUCATION, TRAINING AND PUBLIC AWARENESS

An effective policy of combating climate change cannot be achieved without the support of the public. Education, training and public awareness must enable the public and civil society to have access to information about climate change; only they will they be empowered to play their role in a democratic society. Moreover every person should be encouraged to modify his/her behaviour towards a more rational use of energy.

These priorities are reflected in the *Federal Plan for Sustainable Development* (FPSD), which specifically provides measures taken in the area of limiting energy consumption by a wide dissemination of information aiming to modify consumers' behaviour. Likewise, regarding transport, the PFDD/FPDO puts the accent on promoting cultural models promoting public transport and "soft" transport modes (bicycles and walking), through public awareness policies.

In the Walloon Region, a series of actions based on communication and public awareness are integrated in the *Action Plan for Climate Change*. These actions are integrated into the existing structures for making people aware of environmental issues; they are aimed at both the general public and specific target groups (children, companies, etc.).

In the Flemish Region, the theme of environmental education is explicitly included in the *MiNa plan*[70] *1997-2001* (initiative 146). The aim is to develop an *Environmental Education* (ERE) network, to introduce environmental education into schools, of being vigilant about quality, to introduce ERE in public authorities, to promote ERE in non-schools target groups, etc. The majority of public awareness actions relating to the rational use of energy are implemented under the *CO_2/RUE Plan*.

9.2. EDUCATION

Education is a responsibility of the Communities. Different initiatives are taken by the French, Flemish and German-speaking Communities to incorporate climate change into the school syllabuses.

9.2.1. SCHOOL CONTENT

i. Flemish Community:

Environmental Education (ERE), and more particularly climate change related aspects, will from now on become an integral part of the responsibility and objectives of primary education (since 1997) and the first cycle of secondary education (since 1996). Climate change will receive particular attention from the transversal domain (education about the environment) and in various disciplines.

In the FlemishCommunity, a systematic approach to the environment called "Green School" designed for secondary and higher education, has been in place since 1995. The "Green School" project centres around 7 themes: waste, energy, water, green spaces, traffic, materials catering and the canteen. In 2000, a specific system of environmental protection focussing on 7 teaching areas within technical and vocational education was developed, including "the air" and "water". In 2001, 40% of secondary schools were already taking part in the "Green School" project.

The "Environmental Protection at School" project kicked off in 2001 at the primary level and focuses on the same areas as the Green School programme.

[70] The Flemish programme for environnemental policy

ii. The French Community:

School syllabuses in the French Community do not contain a specific chapter on climate change, but sustainable development, energy production and use and citizenship are part of the educational programmes. The theme of climate change is thus tackled transversally at school.

A reform of the science courses at the first level of French Community secondary schools, aiming to amalgamate the different branches of science into one course, will enable the issue of climate change to be included more easily. The Walloon Region, which is responsible for climate change policy, has already decided to establish partnerships with the Ministers of Education of the French Community in order to implement an educational programme on the issue of climate change[71].

9.2.2. "GREEN CLASSES"[72]

In the French Community, 36 centres for "green classes" in addition to 80 independent centres provide environmental education, and receive each year a very large number of pupils. They constitute a very effective tool for awareness raising and education relating to the environment and sustainable development. The Minister of Secondary Education of the French Community and the Minister of the Environment of the Walloon Region have already agreed to collaborate further in order to increase the amount of time spent in these centres by the pupils. A circular has been sent out to a number of schools.

9.2.3. SPECIFIC ACTIONS AIMED AT YOUNG PEOPLE

In addition to education about climate change provided in a structural manner at school, an increasingly large number of individual initiatives have been taken in collaboration with a range of associations or organisations in order to make young people aware of the issues of climate change. Some of the initiatives are outlined below:

- Since 1995, several Environmental Education centres ("ERE-NME centres") have been operational in the Flemish Region, put in place by various levels of authority, including 19 regional centres. One-day programmes for school or non-school groups are available. Some of the courses have a direct link with climate change (and all the syllabuses fall within the educational domain and meet objectives). Two of these centres offer a minimum half-day programme to approximately 35,000 primary and secondary school pupils annually; to these pupils may be added approximately 10,000 other visitors. Educational exhibitions are also held for school or non-school groups. Some examples are[73] : "Ozone", "Waste and waste prevention", "Water".
- the Flemish Region regularly arranges educational programmes about the environment in partnership with the provinces. The "Environmental Discovery Programme" is an example of such a programme: approximately 150,000 children in primary school have a "discovery" outing to an agricultural business, an organisation, etc. to gain first hand knowledge of the environment and nature, in the hope that they will acquire behaviour respectful to the environment. Such programmes are set up every two years.
- Between 1991 and 1999, the Brussels Institute for Environmental Management (IBGE/BIM) organised an annual education campaign about the environment in the Brussels schools. The campaign conducted in the course the 1997-1998 school year was entitled "For a quality city, I watch how I go". One of the themes dealt with was air pollution and included an explanation of the greenhouse effect and the impact of pollutants contained in exhaust gases.

[71] Walloon Region Action Plan for Climate Change, p. 190
[72] "Classes vertes" (system by which a week of the school term is spent in the countryside)
[73] see also www.mina.vlaanderen.be//milieu-educatie/provcentra

9.2.4. TEACHING MATERIALS

During recent years, different types of teaching materials have been produced:

AUDIOVISUAL

A short film about the *Federal Plan for Sustainable Development* has been made in direct partnership between the Ministers of secondary Education of the three Communities and the State Secretary for Energy and Sustainable Development: this short film, designed for 15 to 18-year-old pupils, serves to introduce the theme of sustainable development, and especially the issues of climate change. It has been distributed to almost all establishments of secondary education in the country.

SCHOOL BOOKS AND EDUCATIONAL BROCHURES

The Walloon Region realized and published school books, in collaboration with the Ministers of the Education of the French Community. These textbooks are designed to teach the issues of climate change in an interdisciplinary manner, both at primary and secondary school level. In the Flemish Community, brochures to support the teaching effort have been produced: “Quality indicators for Environmental Education” and “VLAREM for schools”, a brochure regarding measures to be taken by the schools that want to comply with the *Flemish environmental legislation* (VLAREM).

WEB SITES

- Two organizations[74] realized a web-site (http://www.billy-globe.org), under the impetus of the State Secretary for Energy and Sustainable Development; this site has been set up as a portal for sustainable development, and also tackles the theme of climate change; it is especially designed to be a teaching tool for teachers and pupils.
- The Web site http://www.digilife.be/schoolnet/lespakketten, developed in the Flemish Community, provides a section for educational projects relating to the environment, including climate and energy. Regarding the RUE, a helpful programme is available for youth workers and teachers (http://www.spelinfo.be)

EDUCATIONAL PACKAGES

The *Flemish Environmental Agency* (VMM) realized educational environment packages on the topic “air and water”, designed for both the primary and secondary school. These packages include information folders, games, video-tapes,... The atmospheric pollution, greenhouse effect, climate changes, RUE, are part of the topics taken up in these educational materials.

[74] « Réseau Idée », « NME-link »

9.2.5. EDUCATION ABOUT CLIMATE CHANGE IN HIGHER EDUCATION

The issues of climate change are being given more and more attention in higher education. For example the degree in Physics at the *Katholieke Universiteit Leuven* (KUL)[75] contains an investigatory module about "Earth and Space Physics" (ASTR Unit) that concentrates on climate changes linked to human activities; the *Vrije Universiteit Brussel* (VUB) offers courses on climate change[76]; the University of Liège (ULg) has a climatology and topoclimatology laboratory [77]; the *Katholieke Universiteit Leuven* (KUL) is participating in the development of models supporting the national policies to combat climate change; the *Université Libre de Bruxelles* (ULB) possesses units researching polar glaciology[78]; and the University Foundation of Luxembourg (FUL), which specialises in environmental matters, has integrated classes designed for students whose entire study is devoted to climate change during the 2000-2001[79] academic year.

In addition, the public authorities have the desire to intensify their awareness campaigns concerning climate change in schools in the months and years to come. As such, the Ministry of Energy of the Walloon Region published an exploratory study on 8 May 2001 "making people aware of energy issues at school"[80].

9.3. TRAINING

Several training initiatives, aimed at specific target groups, have surfaced in recent years:

9.3.1. TRAINING OF BUILDING PROFESSIONALS

- In Brussels-Capital Region, the IBGE/BIM has organised professional training courses on the thermal insulation of buildings. Since 1st January 2000, specific regulations have existed in this matter in Brussels-Capital Region (see Section IV "Policies and Measures"). Starting with the principle that it is not sufficient to issue edicts on standards for them to be observed, accompanying measures such as information mechanisms have been scheduled. To this end, seminars have been held to inform architects about the regulations on thermal insulation of buildings in Brussels. A seminar cycle is also scheduled during the year 2001 on practical aspects of applications. Other training courses are specifically intended for those responsible for public entities. Furthermore, software to calculate the K level (coefficient of thermal insulation of buildings) has been sent out to architects.
- An Internet site relating the regulations about, and characteristics of, products applicable to the thermal insulation of buildings plus updates, was set up (http://www.bbri.be/webcontrole) by the Brussels-Capital Region. This site targets building professionals.
- In Brussels-Capital Region, heating technicians who install, repair or maintain heating installations, are required to have an official certificate issued by the IBGE/BIM. The purpose of this measure is to keep a certain control over the emissions caused by heating installations. In this context, the IBGE/BIM has contacts with the schools for heating technicians who must, furthermore, be accredited by the IBGE/BIM by virtue of this same legal obligation.
- The Flemish Region sent architects a brochure ("Modern Offices – more comfort, less energy") prepared in collaboration with the *Belgian Building Research Institute* (BBRI) . A manual has also

[75] http://www.ucl.ac.be
[76] http://www.vub.ac.be/DGGF/onderzoek.html
[77] http://phypc9.geo.ulg.ac.be/climato/ac4.htm
[78] http://www.ulb.ac.be
[79] http://www.ful.ac.be
[80] Exploratory study – raising energy awareness in education, studies performed by the APERe on behalf of the Energy Division– DGRTE of the Minister of the Walloon Region (addressee: 7, av. Prince de Liège, 5100 Namur - Tel: +32 (0)81 33 56 40 – email: energie@mrw.wallonie.be)

been created in the context of the 'E-GIDS' project, regarding the establishment specifications for offices with low energy consumption.

9.3.2. TRAINING THE TRAINERS

In 1997, an ERE network which includes all stakeholders was launched in the Flemish Region in order to establish a homogeneous approach. A consultation system for this network has been established by the Flemish public institutions. The courses offered by the OVAM (Flemish Public Waste Management Agency), the VMM (Flemish Environmental Agency), the VLM (Flemish environmental conservation company), VIREG (Flemish Institute for the rational use of energy), etc. and the provinces are communicated through the network. The collaboration of the Education Department of the Ministry of the Flemish Community will ensure that all courses offered meet the educational objectives.

The Flemish ERE network, "NME-Vlaanderen", has an estensive Internet site, including an inventory of the organisations involved in ERE and the courses they offer (www.mina.vlaanderen.be/milieueducatie/)

And in addition, the ERE courses offered by the municipalities, the provinces, the NGOs and private organisations are increasing in number, as a result of the environmental agreement between the Flemish Government and the municipalities and provinces (option 7 - sustainability).

This year, a series of projects designed for members of the general public are launched. They are targeting the youth organizations, ERE in the context of the year of voluntary help, and a guide for purchasing environmentally friendly goods (for schools and other target groups).

For a dozen years now the Walloon Region has been subsidising the *Interdisciplinary Centre for Training the Trainers of the University of Liège* (CIFFUL) for retraining teachers from technical and vocational schools. The FFC (*Construction Training Fund*) is taking part in the project by financing training teams and financing the publication and distribution of teaching tools and practical guides. By now, approximately 1200 teachers have been trained in insulating cavity walls and sloping roofs, and 80 in household ventilation (this last course started on 1st January 2001). To support the training courses, teaching aids have been created for the teachers of technical and vocational schools (on cavity walls, sloping roofs, and ventilation), as well as practical guides (notes to help technical and vocational students: cavity walls, sloping roofs, ventilation, thermal insulation and renovation). Matters relating to the insulation and ventilation of buildings are now becoming more and more integrated into the professional profiles and the course syllabuses of the technical and vocational schools.

9.3.3. OTHER TARGET GROUPS

- In the period 1997-1999 as well as in 2000-2001 the Flemish government offered local authorities to sign in a voluntary agreement 'Milieuconvenant' which deals with several aspects of a sustainable environmental policy with sustainable use of energy as one of them. Local authorities working on the implementation of a local energy policy plan can receive financial and technical support. A new but similar agreement has been started up for the period 2002-2007.
- Since 2001 the CIFFUL (*Interdisciplinary Centre for Training the Trainers of the University of Liège*) has been organising training courses on building insulation, SME training institutes, training courses designed for the unemployed).
- In the Walloon Region, public authorities promote awareness building through training and other courses using existing structures . They provide financial support to the *Eco-Advisory Institute* to enable it to develop its policy of training and employment creation of Environmental Advisors. They envisage providing continuous training for trainers and eco-advisors about climate change. They also envisage developing the theme "greenhouse gas emissions – climate change" via

existing structures and organisations such as the Regional Centres for Introduction to the Environment, environmental NGOs, consumers associations and municipal eco-advisors.

- Finally the Walloon Region organises training programmes designed for managers of public buildings; a manual for energy managers has been published; a CD-ROM (Energy+) assists these managers in taking the right decisions for energy efficiency.

9.4. AWARENESS CAMPAIGNS

i. Federal State

The publication of the first *Federal Plan for Sustainable Development* has been the occasion for a huge effort to make the general public aware of the issues of sustainable development. This plan contains a separate chapter on energy, transport and the atmosphere. As laid down by law[81], the draft of this plan was submitted to a public consultation exercise. This consultation took place in February/March 2000 and was accompanied by posters in all municipal council buildings, an Internet site was set up (http://www.billy-globe.be), advertisements on radio and television, advertising inserts in the press. Announcements advertising the public survey were sent to a large number of associations and organisations. In addition, a budget of EUR 50 000 was granted to 20 NGOs for the organisation of events to to raise public awareness. Here are some numbers to indicate the size of this effort:

- 14,000 printed copies of the draft PFDD/FPDO were sent out and 4200 people downloaded information from the official site.
- More than one hundred public debates, workshops, information meetings and presentations of the draft PFDD/FPDO were held throughout the country
- More than 2100 recommendations were sent in by members of the public and from a broad spectrum of associations, totalling 16,000 specific remarks, 27.3 % of which concerned the chapter “energy, transport, ozone and climate”.

ii. French Community

Television and radio campaigns: Since 1997, the official French speaking television and radio channels annually (between September and December) stage a campaign on rational use of energy aimed at the general public.

iii. Flemish Region

In 2000 the Flemish Government began a large-scale campaign about the rational use of energy to make people aware of the issues and modify their behaviour via newspapers, magazines and radio.

After the start with a general campaign and the creation of a rationale for saving energy, in the spring of 2001 the campaign focused more on energy saving by private individuals building houses and doing renovations. Contractors and architects are being encouraged to think in energy-saving terms as soon as they start to work on planning the building. The brochure material and Web site ‘www.energysparen.be’ about building and living in an energy-efficient manner have been brought completely up to date.

In the latter half of 2001 a television advert came out with the theme ‘wasting energy is as daft as wasting food” to encourage people to be energy-conscious when it comes to using energy within the family. This emphasised that saving energy is as good for your own purse as it is for the environment. So the slogan is: Saving energy: profitable for you and the environment.

Another important communication moment is the biennial organisation of the Energy Saving Month. In October 2002 this event will take place again, which is held every two years. The Energy Saving Month will be supported in 2002 by an extensive communication campaign. The slogan of the campaign will be ‘It’s October - keep it sober’.

[81] The law of 5 May 1997 relating to the co-ordination of the federal policy for sustainable development

In the course of 2001 a large number of new publications about energy saving were published and distributed on a wide scale. In total some 230,000 brochures were distributed in 2001. The following publications were involved:

- Modern offices: more comfort for less energy;
- Energy in greenhouse horticulture: from knowledge to savings;
- Ideas for an energy-saving lifestyle;
- Ideas for energy-saving building and renovations;
- Ideas for driving in an energy-conscious and safe way;
- Saving energy at home and in your company: options and actions from your electricity and natural gas suppliers in 2001;
- Heat from sunlight;
- Electricity from sunlight;
- 75% subsidy for photovoltaic solar panels;
- Biomass;
- Sustainable energy: 2001 guide
- Energy calendar 2002.

Since 2000 the Flemish Government has been represented at a great many building fairs with a stand entitled 'Ideas for energy-efficient living'. On this trade stand a wide range of practical applications are presented in an educational way, by which energy saving in the home is shows in real situations.

Furthermore, the free periodical "de verrekijker" of the VMM attempts to make environmental information (notably on water and air) accessible for a large public. The topic "climate changes" is often raised in this periodical.

iv. Walloon Region

"Accessibility cards":

The Walloon Region envisages the creation of "accessibility cards". The purpose of these cards is to facilitate the modal transfer from the motor car towards other modes of transport thanks to better information on the alternatives that are available. These A4 format cards present practical information about trains, buses, the motor car, bicycles and/or walking and a plan showing where these elements are located. They are designed to be faxed to visitors or to be consulted on the Internet.

"Air Quality Year":

The Walloon Region decided to make the year 2002 the year of air quality under the catchphrase "happy air" ("l'AIR heureux"). This campaign will be promoted by a number of Walloon personalities, and will include two days of events, on 3 June 2002 (World Environmental Day) and 16 September 2002 (International Day for the Preservation of the Ozone Layer) and a variety of multi-media supporting materials.

Information designed to inform SMEs in the area of energy:

Actions designed to inform SMEs are scheduled, pointing out a large range of opportunities for improvement as well as the availability of new grants for audits and for energy accounting.

v. Brussels-Capital Region

"Pollumeter":

In 1990, the *Brussels Institute for Environmental Management* (IBGE/BIM) launched its action "Air Transparency". Its objective was to make available to the general public information about air quality in Brussels via an automatic answerphone message that gave the concentrations of pollutants measured in the different stations of the region. This campaign was accompanied by a variety of information brochures and by raising awareness of the impact of these pollutants at different levels: from the local level (quality of the air and public health) to the world level (hole in the ozone layer and climate change).

Since 2000, the evolution of pollution can even be followed almost directly via the "pollumeter". This is an interactive internet tool for informing the public about air quality, both globally (using indexes of

pollution) and locally (information coming from measuring stations) in figures, accompanied by explanatory text.. This "pollumeter" can be consulted on the IBGE/BIM Internet site http://www.ibgebim.be.

Company guide:

The IBGE/BIM encourages Brussels' companies to reduce pollutionrelated to business travel , and in particular to home-work journeys, by adopting a *Company Transport Plan*. Companies are also invited to encourage or support the personnel in adopting alternative modes of transport to the individual motor car (use of bicycles, public transport, car-pooling, etc.)[82].

In addition to these continuing actions, the IBGE/BIM organised different media actions aimùed at the general public:

- In 1997, the action "Preserve the environment, drive without gassing it" offered motorists the opportunity to get their exhaust gases checked at different places in the city.
- In 1998, an action "A ticket for clean air: pedal for free" encouraged people to use public transport in combination with the bicycle. 400 bicycles were made freely available to the public at different points situated near to metro stations.
- An "Energy Fortnight in the Brussels-Capital Region" was held in October 2000, together with an "Energy Week in the Brussels-Capital Region" in October 2001; these events were aimed at the general public and schools.

9.5. INFORMATION / RESOURCE CENTRES FOR THE USE OF THE PUBLIC AND COMPANIES

i. Flemish Region

INFORMATION SYSTEM ON ENERGY AND THE ENVIRONMENT

- In the Flemish Region, the VITO maintains an *Information System on Energy and the Environment* (EMIS) for raising awareness on energy issues with the industrial sector, and the public. This system is founded mainly on access to three types of information: figures and statistical data related to energy and environmental matters; contacts (data bases containing public and private sector organisations ; process information (a technological database will be established containing economic and technological information on clean and efficient technologies about processes that may be used in the industrial sector).
- The VIREG (Flemish Institute for the rational use of energy) organises an annual "energy efficiency month" in October with several seminars, workshops, a major publicity campaign, etc.
- The VMM (Flemish Environment Agency) is given the task of drawing up environmental reports (MIRA), which include climate change; the biennial MIRA T reports (1997, 1999, 2001) describe the state of the present situation while the MIRA S reports contain projections and scenarios of the future (MIRA S 2000).

FLEMISH INFOLINE

The Flemish Infoline provides first line information about available information on the rational use of energy and the use of renewable energy sources. The Flemish Infoline is also a point that will guide you to the appropriate service.

ODE - FLANDERS

[82] the "eco-dynamic companies" Charter can be consulted on the site : http://www.ibgebim.be/ENTREPRISES/eco_management/texte_charte.html#mobilité

The *Organisation for Sustainable Energy* – Flanders is the central transmitter of information about renewable energy in Flanders. The ODE provides a permanent secretariat for the general public through which either the appropriate information is given directly or the caller will be referred to a specific contact person.

Continuous efforts to make people aware of the issues, internal and external communication are the core tasks of this organisation. In first instance a variety of high quality brochures published last year by the ODE - Flanders about different forms of sustainable energy could be mentioned. In addition a number of workshops were arranged and ODE - Flanders takes part in energy and environmental fairs.

ODE - Flanders has set up three sectorial platforms: a PV platform, a wind working party and a solar hot water platform. These local and regional discussion forums supply very important information about points of friction and views from different levels to the Flemish Government.

At the same time ODE - Flanders participates in the Flemish 'biomass' and 'heat pumps' working groups and is an associated member of the *Professional Association for Solar Energy* BELSIA.

The organisation also monitors the proportion of renewable energy in energy consumption in Flanders. At a national level it maintains contacts with the *Walloon Institute*, enabling it to present an inventory of sustainable energy for the whole of Belgium.

FLEMISH PROMOTIONAL BODY FOR CHP

In 1997 the first Flemish promotional body for combined heat and power was set up at the initiative of the Flemish Government, within the structure of the non-profit organisation WEL. It aims at potential CHP-users and the general public.

Feasibility studies were conducted, inventories have been drawn up, actions to encourage interest were taken and seminars organised. The combined heat and power manual and other sector-specific publications by this promotional body have been widely distributed.

In 2001 it was decided to redirect the resources available to a newly set up and completely autonomous promotional body , namely the non-profit organisation Cogen Flanders.

ii. Walloon Region

THE "PATH OF ECOMANAGEMENT"

This programme of the Walloon Region aims to identify and specify the stage of the process of environmental audits by companies in such a way as to create the transition points that will encourage companies to progress towards ISO 14001 certification. Or, better still, towards EMAS recording; it is targeted at facilitating moves towards more environmental actions that will relieve the difficulties that a number of companies experience during the initial phase of the process, especially in assembling the information and identifying the most appropriate tools.

THE "ENVIRONMENTAL ADVISERS CELL"

The "Environment Advisers Cell", managed by the Walloon Business Federation (UWE), helps SMEs in the Region to integrate the environment into their day-to-day management. This is done by means of an environmental audit of their activities, which is the initial step for putting in place an Environmental Management System (EMAS or ISO 14001). In the context of this programme, 299 audits have been performed from 1994 to 1997, 217 for the period 1998-2000 and 28 for the first quarter of 2001. The cell also undertakes communication actions on environmental management in companies. In this vein, a workshop was organised, on 28 April 2000, on Environmental Management Systems.

ENERGY COUNTERS

Thirteen Energy Counters are distributed throughout the Walloon region. The Energy Counters are a free and independent public service. They're a broad and continuous operation for the promotion of rational use of energy. The consultants at Energy Counters inform people, make them aware, educate them and

inform them about the regulatory basics. To do this, they have an abundant supply of general and technical documentation (free brochures designed for the general public and/or professional and basic documentation). In addition, they can perform four types of audits:

- qualitative audits for construction/renovation projects
- quantitative electrical audits (household appliances, lighting, heating electricity)
- quantitative audits for the preparation of hot water by an active solar technique (panels and solar tubes)
- quantitative thermal audits (the performance of buildings and systems)

These Energy Counters have been quite successful with the public, as is shown by the attendance figures in the Walloon Region:

	1996 (without the 1st quarter)	1998	2000
Number of visitors	4534	8565	8598
Number of telephone calls	9870	18 732	14 975
Number of incoming letters to do with the mission of sustainable use of energy	NA	6368	4157

It is difficult, however to quantify the real impact of this service on individual behaviour because of the very low information feedback from advice given orally or via the dissemination of documentation. On the other hand, the public appreciates and seeks out the neutrality, the quality and the individual nature of the advice given by this service.

iii. Brussels-Capital Region

INFORMATION COUNTERS

An information counter has also opened its doors in Brussels (ABEA, the *Brussels Energy Agency*). This counter functions similarly to the Energy Counters in the Walloon Region presented above and offers the same services. In addition, the Brussels counter organises thematic information evenings.

List of acronyms

AED	Administration for Infrastructure and Travel
Aminal	Flemish Administration for Environment, Nature, Land, and Water management
AMPERE	Commission for the analysis of the means of producing electricity and the evaluation of energy vectors
AWI	Science and Innovation Administration
BEF	Belgian franc
BIRA-IASB	Belgian Institute for Space Aeronomy
CAFE	Cost Accounting of Fluids and Energy
CCD	Convention to Combat Desertification
CCEG	Control Committee for Electricity and Gas
CCIEP	Co-ordination Committee for International Environmental Policy
CFCs	Chlorofluorocarbons
CFDD - FRDO	Federal Council of Sustainable Development
CH_4	Methane
CHP	combined heat and power
CIDD - ICDO	Interdepartmental Commission on Sustainable Development
CIFFUL	Interdisciplinary Centre of the University of Liège for Training the Trainers
CIMPS-IMCWB	Inter-Ministerial Conference on Science Policy
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-eq.	Carbon dioxide equivalent
CREG	Commission for the Regulation of Electricity and Gas
CSTC - WTCB	Scientific and Technical Centre for Construction
DGENORS	Directorate General for non-compulsory Education and Scientific Research of the Ministry of the French Community
DGRNE	General Directorate for natural resources and environment
DGTRE	Directorate General for Technology, Research and Energy
ECMWF	European Centre for Medium-range Weather Forecasts
EEA	European Environment Agency
ESA	European Space Agency
EUR	Euro
FNRS-NFWO	National Fund for Scientific Research
FPB-BFP	Federal Planning Bureau
FPSD	Federal Plan for Sustainable Development
FUSAGx	Gembloux Agricultural University
GDP	Gross domestic product
Gg	Giga gramme (109g)
GHG	Greenhouse gas
HFCs	Hydrofluorocarbon
IBGE - BIM	Brussels Institute for Environmental Management
ICE	Inter-Ministerial Conference on the Environment
IDD	Institute for Sustainable Development
IEA	International Energy Agency
IGBP	International Geospere and Biosphere Programme
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
IRM-KMI	Royal Meteorological Institute
IWT	Institute for the Advancement of Scientific and Technological Research in Flanders

KMMA-MRAC	Royal Institute for Middle Africa
ktoe	Kilo tonnes oil equivalent
KUL	Katholieke Universiteit Leuven
MBP	Environmental policy plan
MCI	Ministry for Communications and Infrastructure
MEA	Ministry of Economic Affairs
MiNa	Flemish Environment Policy Plan
Mtoe	Mega tonnes oil equivalent
MUMM	Management Unit of the Mathematical Model of the North Sea
N_2O	Nitrous oxide
NIS	National Institute of Statistics
NMVOC	Non-Methane Volatile Organic Compounds
NO_X	Nitrogen oxides
ODS	Ozone depleting substances
OECD	Organisation for Economic Co-operation and Development
OSTC	Federal Office for Scientific, Technical and Cultural Affairs
OVAM	Flemish Public Waste Management Agency
PAMs	Policies and measures
PBO	Policy Oriented Research
PFCs	Perfluorocarbons
PTE	Company Transport Plan
RDP	Rural Development Plan
REN	Regional Express Network
RES	Renewable Energy Sources
RUE	Rational Use of Energy
SF_6	Sulphur hexafluoride
SME	Small and Medium sized Companies
SNCB/NMBS	Belgian National Railway Company
SO_2	Sulphur dioxide
SPSD	Scientific Support Plan for a Sustainable Development
SPSD	Scientific support plan for a sustainable development policy
SRI-DOI	Research and Innovation Office
STI	Science, Technology and Innovation
STIB-MIVB	Brussels Public transport Company
UCL	Université Catholique de Louvain
ULB	Université Libre de Bruxelles
Ulg	University of Liege
UNFCCC	UN Framework-Convention on Climate Change
VIREG	Flemish Institute for the Rational Use of Energy
VITO	Flemish institute for technological research
VLAREM	Flemish environmental legislation
VLIET	Flemish Programme for the Promotion of Energy Technology
VLM	Flemish environmental conservation Agency
VMM	Flemish Environmental Agency
VOC	Volatile Organic Compounds
VUB	Vrije Universiteit Brussel
WMO	World Meteorological Organisation

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Contact adresses

Ministry for Social Affairs, Health and Environment
Federal Department of the Environment
Studies and Coordination Office
Boulevard Pacheco 19 box 5
B-1010 Brussels
Belgium
Telephone +32 (0)2 210 64 32
Fax +32 (0)2 210 48 52
http://www.environment.fgov.be
E-Mail: climate@health.fgov.be

Ministry of the Flemish Community
AMINAL (Afdeling Algemeen Milieu- en Natuurbeleid)
Graaf de Ferrarisgebouw
Koning Albert II-laan 20 bus 8
1000 Brussel
Belgium
Telephone +32 (0)2 553.80.98
Fax +32 (0)2 553.76.95
http://www.mina.vlaanderen.be
E-Mail: els.vandenbroeck@lin.vlaanderen.be

General Directorate for natural resources and environment
Av. Princes de Liège 15
5100 Jambes
Belgium
Telephone +32 (0) 81-33 51 84
Fax +32 (0) 81 33 51 22
http://environnement.wallonie.be
E-Mail: st.cools@mrw.wallonie.be

Brussels Institute for Environmental Management
Gulledelle 100
1200 Brussel
Belgium
Telephone +32 (0)2 7757827
Fax +32 (0)2 775 76 79
http://www.ibgebim.be
E-Mail: jdh@ibgebim.be

Flemish Environmental Agency (Vlaamse Milieumaatschappij)
Alfons Van de Maelestraat 96
9320 Erembodegem
Belgium
Telephone +32 (0)53 72.66.52
Fax +32 (0)53 70.63.44
http://www.vmm.be
E-Mail: m.vandenhende@vmm.be

Ministry of Economic Affairs - Energy Administration
Kon. Albert II-laan 16 - North Gate 3
1000 Brussel
Belgium
Telephone +32 (0)2 206 42 61
Fax +32 (0)2 206.57.32
http://www.mineco.fgov.be
E-Mail: gabriel.michaux@mineco.fgov.be

Federal Planning Bureau
Kunstlaan 47-49
1000 Brussel
Belgium
Telephone +32 (0)2 507.74.80
Fax +32 (0)2 507.74.86
http://www.plan.be
E-Mail: bt@plan.be

Federal Office for Scientific, Technical and Cultural Affairs
Wetenschapsstraat 8
1000 Brussel
Belgium
Telephone +32 (0)2 238 36 71
http://www.belspo.be
E-Mail: vdwe@belspo.be

Directorate General for International Cooperation
Brederodestraat 6
1000 Brussel
Telephone +32 (0)2 519 07 11
Fax +32 (0)2 519 05 70
http://www.dgic.be
E-Mail: JBuys@badc.fgov.be

Cabinet of the Secretary of State for Energy and Sustainable Development
Koloniënstraat 56
1000 Brussel
Belgium
Telephone +32 (0)2 227.07.00
Fax +32 (0)2 219.79.30
E-Mail: mhlahaye@deleuze.eunet.be

ANNEXES

ANNEX A. SUMMARY OF EMISSIONS AND REMOVALS 1990-2000

Annex A - Summary of emissions and removals 1990-2000

EMISSIONS TRENDS (CO_2)
(Sheet 1 of 5)

Belgium
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[5]
	(Gg)											
1. Energy	**0,00**	**109 209,53**	**113 142,60**	**112 238,53**	**110 343,74**	**111 951,32**	**114 470,29**	**117 519,75**	**112 894,67**	**116 520,71**	**113 121,75**	**114 125,81**
A. Fuel Combustion (Sectoral Approach)	0,00	109 209,53	113 142,60	112 238,53	110 343,74	111 951,32	114 470,29	117 519,75	112 894,67	116 520,71	113 121,75	114 125,81
1. Energy Industries		28 572,49	30 033,61	30 019,03	29 293,21	28 384,79	29 822,20	29 292,33	27 960,34	30 010,99	26 950,00	27 356,87
2. Manufacturing Industries and Construction		33 022,71	32 404,90	30 146,72	28 932,74	31 709,69	32 013,89	29 866,03	30 648,30	31 545,38	31 489,74	32 344,32
3. Transport		19 609,66	20 339,56	21 718,62	21 608,07	21 535,37	21 727,49	22 195,24	22 902,78	23 275,71	23 831,54	23 999,33
4. Other Sectors		28 004,66	30 364,53	30 354,16	30 509,71	30 321,47	30 906,72	36 166,15	31 383,25	31 688,64	30 850,46	30 425,29
5. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Oil and Natural Gas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Industrial Processes	**0,00**	**7 672,62**	**9 335,94**	**9 371,37**	**9 444,68**	**10 993,99**	**11 983,39**	**11 225,69**	**11 164,51**	**10 816,12**	**10 812,24**	**11 208,95**
A. Mineral Products		4 569,40	4 915,25	4 921,36	5 038,82	5 223,16	5 619,54	5 620,35	5 253,61	5 327,39	5 297,74	5 297,74
B. Chemical Industry		778,04	790,57	1 061,84	1 163,91	1 441,45	1 574,60	1 504,49	1 525,24	1 477,12	1 536,45	1 563,41
C. Metal Production		1 671,10	1 679,03	1 556,23	1 543,65	1 574,98	1 604,41	1 591,91	1 500,27	1 616,70	1 610,48	1 601,49
D. Other Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Production of Halocarbons and SF_6												
F. Consumption of Halocarbons and SF_6												
G. Other		654,08	1 951,09	1 831,94	1 698,30	2 754,40	3 184,84	2 508,94	2 885,39	2 394,90	2 367,56	2 746,30
3. Solvent and Other Product Use		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Enteric Fermentation												
B. Manure Management												
C. Rice Cultivation												
D. Agricultural Soils[2]												
E. Prescribed Burning of Savannas												
F. Field Burning of Agricultural Residues												
G. Other												
5. Land-Use Change and Forestry[3]	**0,00**	**-1 600,00**	**-1 600,00**	**-1 818,00**	**-1 876,00**	**-1 933,00**	**-1 911,00**	**-1 889,00**	**-1 867,00**	**-1 845,00**	**-1 823,00**	**-1 823,00**
A. Changes in Forest and Other Woody Biomass Stocks		-1 600,00	-1 600,00	-1 818,00	-1 876,00	-1 933,00	-1 911,00	-1 889,00	-1 867,00	-1 845,00	-1 823,00	-1 823,00
B. Forest and Grassland Conversion												
C. Abandonment of Managed Lands												
D. CO_2 Emissions and Removals from Soil												
E. Other												
6. Waste	**0,00**	**1 083,77**	**1 091,97**	**1 104,41**	**1 098,93**	**1 126,97**	**1 192,90**	**1 621,51**	**1 519,84**	**1 270,12**	**1 705,02**	**1 705,02**
A. Solid Waste Disposal on Land		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Waste-water Handling												
C. Waste Incineration		1 083,77	1 091,97	1 104,41	1 098,93	1 126,97	1 192,90	1 621,51	1 519,84	1 270,12	1 705,02	1 705,02
D. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Total Emissions/Removals with LUCF[4]	**0,00**	**116 365,92**	**121 970,52**	**120 896,31**	**119 011,35**	**122 139,28**	**125 735,59**	**128 477,95**	**123 712,02**	**126 761,96**	**123 816,01**	**125 216,77**
Total Emissions without LUCF[4]	**0,00**	**117 965,92**	**123 570,52**	**122 714,31**	**120 887,35**	**124 072,28**	**127 646,59**	**130 366,95**	**125 579,02**	**128 606,96**	**125 639,01**	**127 039,77**
Memo Items:												
International Bunkers	**0,00**	**16 397,65**	**16 056,94**	**15 840,23**	**16 180,06**	**16 897,87**	**15 372,44**	**18 485,25**	**21 516,96**	**22 868,41**	**18 967,14**	**19 720,36**
Aviation		3 094,56	2 597,81	2 583,65	2 529,53	2 685,94	2 417,71	3 109,35	3 912,15	4 709,29	4 381,13	3 674,66
Marine		13 303,08	13 459,13	13 256,58	13 650,53	14 211,93	12 954,73	15 375,90	17 604,81	18 159,12	14 586,00	16 045,70
Multilateral Operations									**0,00**	**0,00**	**0,00**	**0,00**
CO_2 Emissions from Biomass									**959,77**	**895,74**	**1 018,50**	**1 018,50**

[1] Fill in the base year adopted by the Party under the Convention, if different from 1990.
[2] See footnote 4 to Summary 1.A of this common reporting format.
[3] Take the net emissions as reported in Summary 1.A of this common reporting format. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[4] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.
[5] data for 2000 are provisional

EMISSIONS TRENDS (CH_4)
(Sheet 2 of 5)

Belgium
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[5]
	(Gg)											
Total Emissions	**0,00**	**550,33**	**552,20**	**555,26**	**552,87**	**559,29**	**552,11**	**547,94**	**542,80**	**543,32**	**536,63**	**523,61**
1. Energy	**0,00**	**47,14**	**50,45**	**51,37**	**53,47**	**53,92**	**44,85**	**48,50**	**47,24**	**53,02**	**55,28**	**54,59**
A. Fuel Combustion (Sectoral Approach)	0,00	10,36	11,28	11,72	11,53	11,33	11,23	12,03	11,11	12,59	11,67	11,47
1. Energy Industries		0,50	0,44	0,38	0,23	0,26	0,28	0,29	0,26	0,32	0,24	0,21
2. Manufacturing Industries and Construction		1,81	1,97	2,01	1,88	1,95	2,02	1,92	2,06	2,17	2,18	2,19
3. Transport		3,69	4,07	4,46	4,73	4,70	4,59	4,96	4,71	6,30	5,61	5,45
4. Other Sectors		4,36	4,80	4,86	4,68	4,42	4,34	4,85	4,08	3,80	3,64	3,61
5. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	36,78	39,17	39,65	41,94	42,59	33,62	36,47	36,13	40,43	43,61	43,12
1. Solid Fuels		1,21	1,21	0,96	0,88	0,83	0,83	0,83	0,63	0,65	0,62	0,62
2. Oil and Natural Gas		35,57	37,96	38,69	41,06	41,76	32,79	35,64	35,50	39,79	42,99	42,50
2. Industrial Processes	**0,00**	**2,29**	**2,26**	**2,03**	**2,12**	**2,37**	**2,15**	**2,08**	**2,14**	**2,17**	**2,11**	**2,18**
A. Mineral Products		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Chemical Industry		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C. Metal Production		2,29	2,26	2,03	2,12	2,37	2,15	2,08	2,14	2,17	2,11	2,18
D. Other Production												
E. Production of Halocarbons and SF6												
F. Consumption of Halocarbons and SF6												
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture	**0,00**	**340,54**	**337,13**	**337,17**	**342,43**	**341,95**	**345,64**	**342,69**	**336,51**	**336,95**	**336,01**	**330,42**
A. Enteric Fermentation		219,86	219,53	218,29	220,12	219,61	220,82	218,06	212,01	212,21	210,42	208,76
B. Manure Management		113,56	110,51	111,80	115,30	115,36	117,87	117,71	117,61	117,88	118,77	114,84
C. Rice Cultivation		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Agricultural Soils		7,12	7,09	7,09	7,02	6,98	6,95	6,92	6,89	6,86	6,83	6,83
E. Prescribed Burning of Savannas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F. Field Burning of Agricultural Residues		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5. Land-Use Change and Forestry	**0,00**	**5,07**	**5,07**	**5,07**	**5,04**	**5,00**	**4,98**	**4,97**	**4,95**	**4,94**	**4,93**	**4,91**
A. Changes in Forest and Other Woody Biomass Stocks												
B. Forest and Grassland Conversion		5,07	5,07	5,07	5,04	5,00	4,98	4,97	4,95	4,94	4,93	4,91
C. Abandonment of Managed Lands												
D. CO_2 Emissions and Removals from Soil												
E. Other												
6. Waste	**0,00**	**155,30**	**157,29**	**159,63**	**149,80**	**156,06**	**154,49**	**149,70**	**151,96**	**146,25**	**138,30**	**131,51**
A. Solid Waste Disposal on Land		151,85	153,83	155,51	145,51	151,04	148,49	141,10	139,25	132,11	122,69	115,90
B. Waste-water Handling		0,27	0,40	0,38	0,38	0,38	0,25	0,25	0,00	0,27	0,27	0,27
C. Waste Incineration		0,28	0,28	0,28	0,28	0,31	0,30	0,33	0,29	0,29	0,29	0,29
D. Other		2,91	2,77	3,46	3,64	4,33	5,44	8,02	12,43	13,57	15,05	15,05
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Memo Items:												
International Bunkers	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,01**	**0,02**	**0,00**	**0,00**
Aviation									0,01	0,02	0,00	0,00
Marine									0,00	0,00	0,00	0,00
Multilateral Operations									**0,00**	**0,00**	**0,00**	**0,00**
CO_2 Emissions from Biomass												

EMISSIONS TRENDS (N_2O)
(Sheet 3 of 5)

Belgium
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[5]
	(Gg)											
Total Emissions	**0,00**	**42,64**	**41,58**	**40,62**	**41,45**	**43,36**	**45,38**	**44,00**	**43,70**	**44,78**	**44,59**	**43,29**
1. Energy	**0,00**	**7,88**	**7,67**	**7,90**	**7,81**	**8,04**	**8,77**	**6,15**	**6,22**	**6,24**	**6,40**	**6,44**
A. Fuel Combustion (Sectoral Approach)	0,00	7,88	7,67	7,90	7,81	8,04	8,77	6,15	6,22	6,24	6,40	6,44
1. Energy Industries		1,12	1,18	1,20	1,05	1,07	0,95	0,92	0,92	0,96	0,86	0,92
2. Manufacturing Industries and Construction		3,18	2,53	2,55	2,51	2,60	3,19	1,25	1,36	1,32	1,23	1,25
3. Transport		0,86	0,99	1,13	1,33	1,47	1,61	1,74	1,86	1,95	2,26	2,35
4. Other Sectors		2,72	2,97	3,01	2,92	2,90	3,02	2,24	2,08	2,01	2,05	1,91
5. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Oil and Natural Gas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Industrial Processes	**0,00**	**11,48**	**11,16**	**10,13**	**10,92**	**12,60**	**13,75**	**15,05**	**14,49**	**15,10**	**14,40**	**13,32**
A. Mineral Products		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Chemical Industry		11,48	11,16	10,13	10,92	12,60	13,75	15,05	14,49	15,10	14,40	13,32
C. Metal Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Other Production												
E. Production of Halocarbons and SF6												
F. Consumption of Halocarbons and SF6												
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use		**0,00**	**0,00**	**0,00**	**0,00**	**0,19**	**0,19**	**0,24**	**0,24**	**0,24**	**0,24**	**0,24**
4. Agriculture	**0,00**	**21,97**	**21,67**	**21,51**	**21,66**	**21,47**	**21,61**	**21,50**	**21,71**	**21,83**	**22,18**	**21,92**
A. Enteric Fermentation												
B. Manure Management		6,13	6,13	6,13	6,13	6,13	6,13	6,13	6,01	6,02	6,15	6,15
C. Rice Cultivation												
D. Agricultural Soils		15,84	15,54	15,38	15,53	15,34	15,48	15,37	15,70	15,81	16,03	15,78
E. Prescribed Burning of Savannas		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
F. Field Burning of Agricultural Residues		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
G. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
5. Land-Use Change and Forestry	**0,00**	**0,77**	**0,77**	**0,77**	**0,76**	**0,75**	**0,75**	**0,75**	**0,74**	**0,74**	**0,74**	**0,73**
A. Changes in Forest and Other Woody Biomass Stocks												
B. Forest and Grassland Conversion		0,77	0,77	0,77	0,76	0,75	0,75	0,75	0,74	0,74	0,74	0,73
C. Abandonment of Managed Lands												
D. CO_2 Emissions and Removals from Soil												
E. Other												0,00
6. Waste	**0,00**	**0,53**	**0,31**	**0,32**	**0,31**	**0,31**	**0,31**	**0,31**	**0,30**	**0,63**	**0,63**	**0,63**
A. Solid Waste Disposal on Land												
B. Waste-water Handling		0,23	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33	0,33	0,33
C. Waste Incineration		0,30	0,31	0,32	0,31	0,31	0,31	0,31	0,30	0,29	0,30	0,30
D. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Memo Items:												
International Bunkers	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Aviation												
Marine												
Multilateral Operations												
CO_2 Emissions from Biomass												

EMISSION TRENDS (HFCs, PFCs and SF_6)
(Sheet 4 of 5)

Belgium
2000
Submission 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	(Gg)											
Emissions of HFCs[6] - CO_2 equivalent (Gg)	**0,00**	**NE**	**NE**	**NE**	**NE**	**NE**	**332,15**	**417,93**	**526,72**	**631,38**	**804,06**	**804,06**
HFC-23							0,00	0,00	0,00	0,00	0,00	0,00
HFC-32							0,00	0,00	0,00	0,00	0,00	0,00
HFC-41							0,00	0,00	0,00	0,00	0,00	0,00
HFC-43-10mee							0,00	0,00	0,00	0,00	0,00	0,00
HFC-125							0,00	0,00	0,01	0,02	0,03	0,03
HFC-134							0,00	0,00	0,00	0,00	0,00	0,00
HFC-134a							0,25	0,30	0,35	0,37	0,41	0,41
HFC-152a							0,02	0,02	0,02	0,07	0,07	0,07
HFC-143							0,00	0,00	0,00	0,00	0,00	0,00
HFC-143a							0,00	0,00	0,01	0,02	0,05	0,05
HFC-227ea							0,00	0,00	0,00	0,00	0,00	0,00
HFC-236fa							0,00	0,00	0,00	0,00	0,00	0,00
HFC-245ca							0,00	0,00	0,00	0,00	0,00	0,00
Emissions of PFCs[6] - CO_2 equivalent (Gg)	**0,00**	**NE**	**NE**	**NE**	**NE**	**NE**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
CF_4							0,00	0,00	0,00	0,00	0,00	0,00
C_2F_6							0,00	0,00	0,00	0,00	0,00	0,00
C_3F_8							0,00	0,00	0,00	0,00	0,00	0,00
C_4F_{10}							0,00	0,00	0,00	0,00	0,00	0,00
c-C_4F_8							0,00	0,00	0,00	0,00	0,00	0,00
C_5F_{12}							0,00	0,00	0,00	0,00	0,00	0,00
C_6F_{14}							0,00	0,00	0,00	0,00	0,00	0,00
Emissions of SF_6[6] - CO_2 equivalent (Gg)	**0,00**	**NE**	**NE**	**NE**	**NE**	**NE**	**206,26**	**206,26**	**206,26**	**95,60**	**95,60**	**95,60**
SF_6							0,01	0,01	0,01	0,00	0,00	0,00

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

[6] Enter information on the actual emissions. Where estimates are only available for the potential emissions, specify this in a comment to the corresponding cell. Only in this row the emissions are expressed as CQequivalent emissions in order to facilitate data flow among spreadsheets.

EMISSION TRENDS (SUMMARY)
(Sheet 5 of 5)

Belgium
2000
Submission 2002

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1]
	CO_2 equivalent (Gg)											
Net CO_2 emissions/removals	0,00	116 365,92	121 970,52	120 896,31	119 011,35	122 139,28	125 735,59	128 477,95	123 712,02	126 761,96	123 816,01	125 216,77
CO_2 emissions (without LUCF)	0,00	117 965,92	123 570,52	122 714,31	120 887,35	124 072,28	127 646,59	130 366,95	125 579,02	128 606,96	125 639,01	127 039,77
CH_4	0,00	11 557,00	11 596,22	11 660,55	11 610,21	11 745,16	11 594,33	11 506,64	11 398,76	11 409,74	11 269,23	10 995,81
N_2O	0,00	13 217,78	12 890,62	12 591,77	12 850,80	13 441,19	14 068,34	13 640,01	13 548,39	13 880,76	13 822,19	13 421,73
HFCs	0,00	NE	NE	NE	NE	NE	332,15	417,93	526,72	631,38	804,06	804,06
PFCs	0,00	NE	NE	NE	NE	NE	0,00	0,00	0,00	0,00	0,00	0,00
SF_6	0,00	NE	NE	NE	NE	NE	206,26	206,26	206,26	95,60	95,60	104,00
Total (with net CO_2 emissions/removals)	**0,00**	**141 140,70**	**146 457,36**	**145 148,63**	**143 472,36**	**147 325,63**	**151 936,67**	**154 248,79**	**149 392,15**	**152 779,44**	**149 807,09**	**150 542,38**
Total (without CO_2 from LUCF)[7]	**0,00**	**142 740,70**	**148 057,36**	**146 966,63**	**145 348,36**	**149 258,63**	**153 847,67**	**156 137,79**	**151 259,15**	**154 624,44**	**151 630,09**	**152 365,38**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	CO_2 equivalent (Gg)											
1. Energy	0,00	112 643,26	116 580,35	115 765,48	113 886,95	115 575,13	118 130,56	120 444,38	115 814,51	119 567,34	116 268,14	117 269,78
2. Industrial Processes	0,00	11 279,72	12 843,69	12 552,67	12 874,44	14 948,78	16 830,36	16 560,08	16 434,26	16 270,51	16 218,68	16 292,69
3. Solvent and Other Product Use	0,00	0,00	0,00	0,00	0,00	58,90	58,90	74,40	74,40	74,40	74,40	75,08
4. Agriculture	0,00	13 961,65	13 797,70	13 749,04	13 905,07	13 837,60	13 956,38	13 860,79	13 797,45	13 843,61	13 932,01	13 734,02
5. Land-Use Change and Forestry[8]	0,00	-1 254,83	-1 254,83	-1 472,83	-1 534,56	-1 595,50	-1 573,92	-1 552,13	-1 533,65	-1 511,86	-1 490,07	-1 492,46
6. Waste	0,00	4 510,90	4 490,45	4 554,28	4 340,46	4 500,72	4 534,38	4 861,28	4 805,18	4 535,44	4 804,74	4 662,21
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

[7] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.
[8] Net emissions.

EMISSION TRENDS (NO_x , CO, NMVOC, SO_2)

Belgium
2000
Submission 2002

NO_x

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (1)
	(Gg)										
Total National Emissions	**308,22**	**325,78**	**338,21**	**337,48**	**342,13**	**334,24**	**323,85**	**315,73**	**315,88**	**295,59**	**297,56**
1. Energy	**305,50**	**323,13**	**335,66**	**334,71**	**339,56**	**330,99**	**319,57**	**311,69**	**311,50**	**291,35**	**293,52**
1.A.1. Energy Industries	70,10	71,05	68,64	62,63	67,00	61,45	59,01	53,67	54,90	40,37	45,84
1.A.2. Manufacturing Industries and Construction	60,26	63,04	67,66	69,89	67,85	70,84	69,23	68,49	69,64	71,43	70,82
1.A.3. Transport	159,57	171,07	181,80	184,45	188,07	180,11	169,21	170,81	168,14	161,64	159,26
1.A.4. Other Sectors	15,56	17,96	17,57	17,73	16,64	17,58	21,12	17,96	18,05	17,21	16,90
1.B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	1,00	1,00	0,76	0,78	0,70	0,70
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
3. Solvent and Other Product Use	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture (3)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
5. Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
6. Waste	**2,73**	**2,65**	**2,56**	**2,78**	**2,57**	**3,25**	**4,27**	**4,03**	**4,38**	**4,24**	**4,04**
7. Other	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**

CO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (1)
	(Gg)										
Total National Emissions	**1 106,65**	**1 128,86**	**1 155,05**	**1 145,66**	**1 085,33**	**1 022,84**	**1 056,26**	**925,69**	**1 038,66**	**993,44**	**995,91**
1. Energy	**1 099,23**	**1 121,50**	**1 147,59**	**1 138,45**	**1 077,78**	**1 015,25**	**1 055,35**	**925,04**	**1 038,05**	**993,01**	**995,48**
1.A.1. Energy Industries	16,25	20,64	19,55	21,69	26,54	19,61	28,39	8,01	6,01	4,72	8,14
1.A.2. Manufacturing Industries and Construction	403,65	377,03	366,15	341,13	326,31	329,40	339,73	333,04	299,89	347,15	373,61
1.A.3. Transport	607,85	643,06	676,69	690,55	642,72	597,96	605,16	516,53	667,60	579,40	553,06
1.A.4. Other Sectors	71,47	80,77	85,21	85,07	82,20	68,29	80,08	65,96	63,01	60,30	59,22
1.B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	1,98	1,50	1,54	1,45	1,45
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
3. Solvent and Other Product Use	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture (3)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
5. Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
6. Waste	**7,41**	**7,36**	**7,46**	**7,22**	**7,55**	**7,59**	**0,91**	**0,65**	**0,62**	**0,42**	**0,43**
7. Other	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**

NMVOC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (1)
	(Gg)										
Total National Emissions	**317,77**	**319,67**	**332,38**	**328,46**	**327,82**	**318,31**	**303,57**	**299,82**	**308,07**	**291,38**	**287,18**
1. Energy	**143,75**	**152,78**	**161,43**	**161,06**	**159,17**	**150,62**	**148,86**	**138,78**	**152,39**	**134,86**	**130,41**
1.A.1. Energy Industries	1,55	1,63	1,47	1,27	1,28	1,33	1,25	1,23	1,13	1,14	1,14
1.A.2. Manufacturing Industries and Construction	2,67	2,67	2,77	2,21	2,24	2,44	2,25	2,27	2,93	2,96	2,96
1.A.3. Transport	103,65	111,44	117,70	118,69	116,54	110,42	104,07	96,45	108,72	92,10	87,26
1.A.4. Other Sectors	7,67	8,83	8,92	8,92	8,40	8,57	10,12	8,30	8,02	7,62	7,47
1.B. Fugitive Emissions from Fuels	28,21	28,21	30,57	29,96	30,72	27,86	31,17	30,52	31,60	31,03	31,57
2. Industrial Processes	**35,65**	**35,31**	**35,75**	**35,14**	**33,90**	**33,14**	**33,02**	**33,09**	**32,28**	**32,27**	**33,10**
3. Solvent and Other Product Use	**88,91**	**85,15**	**85,96**	**87,02**	**81,70**	**81,20**	**78,63**	**77,91**	**76,85**	**72,80**	**73,05**
4. Agriculture (3)	**13,11**	**11,88**	**12,58**	**11,61**	**14,31**	**14,44**	**11,35**	**13,21**	**12,06**	**13,45**	**12,49**
5. Land-Use Change and Forestry	**36,10**	**34,30**	**36,40**	**33,40**	**38,50**	**38,70**	**31,50**	**36,60**	**34,30**	**37,80**	**37,80**
6. Waste	**0,25**	**0,25**	**0,26**	**0,23**	**0,23**	**0,22**	**0,21**	**0,23**	**0,19**	**0,19**	**0,33**
7. Other	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**

SO_2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (1)
	(Gg)										
Total National Emissions	**288,20**	**302,94**	**301,39**	**290,08**	**245,57**	**236,63**	**235,21**	**208,07**	**194,29**	**157,15**	**158,53**
1. Energy	**286,39**	**301,04**	**299,58**	**288,49**	**244,34**	**235,32**	**234,13**	**207,36**	**193,54**	**156,77**	**158,06**
1.A.1. Energy Industries	141,62	139,44	136,03	126,71	120,84	116,09	114,04	107,74	95,69	62,62	64,60
1.A.2. Manufacturing Industries and Construction	90,57	100,26	104,38	101,82	71,56	64,56	61,73	57,04	55,75	54,02	55,07
1.A.3. Transport	15,43	15,80	15,98	16,80	18,18	18,83	14,83	6,20	6,24	6,38	5,50
1.A.4. Other Sectors	38,74	45,53	43,19	43,16	33,76	35,81	43,49	36,36	35,82	33,71	32,85
1.B. Fugitive Emissions from Fuels	0,03	0,00	0,00	0,00	0,00	0,04	0,04	0,03	0,03	0,03	0,03
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
3. Solvent and Other Product Use	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
4. Agriculture (3)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
5. Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
6. Waste	**1,81**	**1,90**	**1,82**	**1,59**	**1,23**	**1,31**	**1,08**	**0,70**	**0,76**	**0,39**	**0,48**
7. Other	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**

(1) data for 2000 are provisional

ANNEX B. MODELS USED FOR THE PROJECTION OF GREENHOUSE GASES

The information in this annex should give readers an understanding of the methodologies followed in the different models. It presents additional information on the type of models that are used, for what original purposes they were built, identifies some of the strong and the weak elements of every model, explain how in the combination of models double counting between measures is avoided and gives suggestions for further reading on the models.

EPM model

The EPM model (Energy/Emissions Projection Model) is a technico-economic bottom-up simulation model. It predicts the demand for energy and the resulting atmospheric pollutants from the different sectors (industry, residential and commercial, transport). It has been developed progressively by ECONOTEC since 1993 within the framework of a number of studies performed for the public authorities, both national and regional.

Because of the heterogeneity of the steel sector, the chemical sector or the residential sector, EPM takes into account the differences in their internal structures and the differential evolution of subsectors or production methods. It does not contain an algorithm that minimises costs. The model explains the consumption of energy and the corresponding greenhouse gas emissions by looking at activity variables, expressed in physical units. To obtain emissions, the consumptions of every energy vector are multiplied with appropriate emission factors. The model contains a detailed representation of emission sources and of the main factors that determine the evolution in the demand for energy an the resulting emissions. Therefore, it can be used to make predictions of the demand for energy and the emissions that result from this. Because the model takes the expected technological developments into account, projections can be made for the short and medium term (5 to 10 years). The model can also simulate technical options for reducing greenhouse gas emissions. EPM also determines the amount of non-energy related emissions of CO_2, N_2O and CH_4. It uses a technical-economic databank that includes all existing emission reduction and energy conservation measures.

The projections are performed as follow:

- construction of a reference scenario, representing the most likely future evolution in the absence of any new policy initiatives for the reduction of the demand for energy;
- evaluation of the economic potential of reductions in consumption;
- construction of reduction scenarios, based upon all measures with a marginal cost lower than a certain cap;
- construction of cost functions, indicating the marginal or total costs as a function of the level of emission reductions or the consumption of energy.

As for the level of desagregation, EPM distinguishes between 90 industrial activities within the energy intensive industry (of which 10 for steel production and 20 for the chemical sector). For the residential sector, an independent module calculates the demand for heat for buildings from 14 different building types, based on size and thermal characteristics. It also distinguishes between 15 production, distribution and emission systems for heat. Furthermore, it takes into account the production of hot water and 10 specific usages for electricity. For the commercial sector, energy consumption and emissions are divided into 30 subsectors, regrouped into 8 categories (commerce, education, health services, ...).

For further reading about this model, please consult:

ECONOTEC, "Application du modèle EPM au développement de scénarios d'émissions de CO_2 à l'horizon 2010 pour la Belgique - rapport d'avancement", étude effectuée pour les Services fédéraux des Affaires scientifiques, techniques et culturelles, 2001.

HERMES model

HERMES is a macro-sectoral econometric top-down simulation model that was developed for Belgium by the Federal Planning Bureau. It gives a detailed macro-economic and sectoral analysis of the economy. It was originally developed under the initiative of the European Commission (DG Research) for 12 European countries, of which 6 countries disposed of detailed versions. The 6 detailed models could be linked to each other to calculate the international effects of measures. Currently, however, only the national version is used and the models can no longer be linked to one and other.

HERMES is a dynamic and annual model that allows for simulations to be performed of the impacts of macro-economic and sectoral policies, multinational economic policies, energy policies, new technologies, and so on. It's general construction is neo-Keynesian. The model is mainly oriented to the demand side, which is modelled in much detail: each of its components has been determined for every sector (agriculture, energy, intermediate goods, investment goods, consumption goods, construction and public works, transport and communication, commercial and non-commercial sector). But the model also contains mechanisms of supply. The substitution between production factors is also treated in detail (e.g. for the industrial sectors, two level putty-clay production functions allow only substitution ex ante. This often results in a complementarily of energy and capital).

The sectoral dimension of the model is important. The cohesion between sectors is complete and the macro-economic aggregates are obtained from their sum. The demand for energy is estimated through econometric analysis. The supply is modelled as one of the 11 sectors of the economy and does not contain a specific structure. 8 energy vectors are distinguished, but the technical detail is limited. The econometrically determined production functions of HERMES estimate the demand for four production factors (labour, capital, intermediate goods and energy). The model can make predictions, simulations and policy assessments over a period of 1 to 10 years.

The exogenous variables for the model are the detailed prices for energy products, monetary policy variables (interest rates, exchange rates), fiscal and budgetary variables, European policy and demographic variables. The output of the model consists of input/output tables for 9 sectors, the demand for production factors, the accounts of the economic agents, the detailed consumption structure for households (14 functions) and the equilibrium between supply and demand for 8 energy products.

In the most recent version of HERMES, the environmental component was further developed. This allowed the analysis to be extended to the evolution in CO_2-emissions per sector and the effects of fiscal and other measures. This was mainly done by adapting the equations for the calculation of energy prices, in the aim of adding an extra tax component. The model was also extended to estimate evolutions of other greenhouse gases, such as CH_4 and N_2O.

For further reading on this model, see:

"A description of the HERMES II model for Belgium", Working paper n° 05-00 of the Federal Planning Bureau, 2000. http://www.plan.be/en/pub/wp/wplist.stm

Integration of the effects of non-fiscal measures in the HERMES projections

To calculate the joint effect of non-fiscal (calculated by means of the EPM bottom-up model) and fiscal measures (calculated with the top-down HERMES model), the bottom-up estimations of non-fiscal measures have been integrated into the top-down macro-economic HERMES model. In doing so, possible synergies between fiscal and non fiscal measures have been accounted for as much as possible (e.g. the efficiency of non-fiscal measures would increase with rising energy prices). The intergation was performed in several steps:

- Sectorial analysis of the effects of non-fiscal measures by means of the bottom-up EPM model. This was done on the basis of the economic potential for energy conservation and consecutive emission reductions, estimations of the necessary investments and other costs for implementation and the

direct effects on employment. The measures relate to the residential and service sector, the manufacturing and construction sector and the transportsector.
- Integration of the outcome of this technical-economical analysis into the HERMES model, where micro-economical data had to be transposed into macro-sectoral terms.
- Simulation of the CO_2 emissions over the period 2000-2012 with the HERMES model.

In order to integrate the outcome of the techical-economical analysis into the HERMES model, a number hypothesis had to be made to eliminate double counting. The profile of energy savings that were achieved in the EPM simulation had to be modified so as to only include part of them into the HERMES model. In particular:

- measures having a neglegible effect or being seemingly irrealistic have been oimmited (e.g. enery substitution measures)
- part of ythe reduction potential proposed by Econotec was rejected because it was already included in the base scenario of the HERMES model.

For every sector, a comparison was made between the energy projections of HERMES and EPM for the period 2000-2010. For certain sectors, emissions were higher in the EPM model than in the HERMES model (20% in the manufacturing sector and 6% in the energy sector). This was due to the fact that the HERMES model already incorporated a number of non-fiscal measures (e.g. measures related to good management) through the natural evolution of the technological coefficients in the model. It was thus decided to reduce these differences in emissions from the results so as to avoid double counting.

MARKAL model

MARKAL is a long-term multi-period energy technology optimisation model. It contains a technology description of the main energy transformation and energy use processes in the Belgian energy system. Every potentially available energy technology is described by its technological characteristics, its costs and its current installed capacity. The level of the energy service demand depends on an exogenous growth component and on its marginal cost. The model chooses energy production and consumption options that maximises the net total welfare of the energy users, given exogenous bounds on availability of energy sources or technologies or on total emissions. A general update of the database has been done under the 'Global Change and Sustainable development' research programme of the Scientific Policy Office.

The systematic and integrated approach constitutes one of the main advantages of a MARKAL exercise. The model allows to trade off, be it in a crude way, investment in electricity production efficiency with improvements in electricity end use efficiency and also allows for increased end-uses of electricity in substitution for other carbon-intensive energy uses.

This global approach has a cost in terms of a simplified representation of energy users and producers in the model. It is assumed that all economic agents use the same objective function, that they have the same information which is freely available (no transaction costs) and the same subjective beliefs (perfect information) and finally they use 'prices' equal to the discounted marginal costs corrected for imputed shadow prices. There is therefore a perfect co-ordination between demand and supply and the economic agents always act in a cost-efficient way.

For more information on the model, please refer to:

MARKAL, a model to support greenhouse gas reduction policies. 2001. DWTC/SSTC – Final Report. CES-KULeuven, VITO

How to achieve the Kyoto target in Belgium – modelling methodology and some results. 2000. Working Paper Series n. 2000-09. KULeuven-CES

The GEM-E3 Model

The GEM-E3 model is an applied general equilibrium model, representing the European Union member-states one by one and linked through trade. It aims at covering the interactions between the economy, the energy system and the environment. The model computes simultaneously the different market equilibrium under the Walras law and within the macroeconomic equilibrium it determines the optimum balance for energy demand/supply and emission/abatement.

The model has the following general features:

- Its scope is general in two terms: it includes all simultaneously interrelated markets and represents the system at the appropriate level with respect to geography, the subsystem (energy, environment, economy) and the dynamic mechanisms of agent's behaviour, including expectation.
- It formulates separately the supply or demand behaviour of the economic agents which are considered to optimise individually their objective while market derived prices guarantee global equilibrium.
- It considers explicitly the market clearing mechanism and the related price formation in the energy, environment and economy markets: prices are computed by the model as a result of supply and demand interactions in the markets and different market clearing mechanisms, in addition to perfect competition, are allowed.
- The model is simultaneously multinational (for the EU) and specific for each country; appropriate markets clear European wide, while country-specific policies and distributional analysis are supported.
- Although global, the model exhibits a sufficient degree of disagregation concerning sectors, structural features of energy and policy-oriented instruments (e.g. taxation).

The projected energy demand derived from the GEM-E3 model is used as an input into the MARKAL model, which subsequently determines the least cost way to satisfy this demand.

For more information on the model, see:

Capros P., T. Georgakopoulos, D. Van Regemorter, S. Proost, T.F.N. Schmidt and K. Conrad (1997): "European Union: the GEM-E3 General Equilibrium Model", in: Economic & Financial Modelling, Special Double Issue, Vol. 4, No. 2&3, pp. 51-160

GEM-E3 (1997): The GEM-E3 model: Reference Manual (detailed technical documentation of the model), Capros et al., 1997, available on http://gem-e3.zew.de

ANNEX C. LIST OF ADDITIONAL NON-FISCAL MEASURES FOR REDUCING CO_2 EMISSIONS

The following list[83] includes all measures introduced in the technical-economical analysis of energy consumption reduction potentials performed by the EPM model. The measures are listed per activity sector (energy, manufacturing and construction, residential and services). Note that no specific measures have been formulated for the transport sector. As mentioned in Annex C, a number of these measures have not been taken into account in the final analysis when the micro-economic data resulting from the EPM simulations were integrated into the macro-economic framework of HERMES. This was done to avoid problems of double counting. The measures that were omitted in particular include measures that refer to 'better management practices' and 'fuel substitutions'. For a detailed presentation of the assumptions made for this integration, please refer to:

Federal Planning Bureau: "Evaluation de l'impact des mesures fiscales et non fiscales sur les émissions de CO_2", Working Paper n°01-02, http://www.plan.be

Energy sector

Electricity substitution
- Replacement of coal by natural gas in existing electricity plants

Renewable energy
- Biométhanisation de boues d'épuration
- Biométhanisation de déchets ménagers
- Biométhanisation effluents d'élevage
- Biométhanisation industrie agroalimentaire
- Cultures énergétiques
- Forest waste
- Hydro-electric energy
- Offshore wind energy
- Onshore wind energy

Manufacturing and construction

Good management
- Compressed air
- Good management of fuel - industry
- Good management of electricity - industry
- Heating of buildings
- Rational energy use process

Heat recovery
- Electric steel: gas for preheating of recycled steel
- O2 steel: heat of the gasses
- Agglomeration: recirculation of smoke
- Agglomeration: recovery on cooling air
- Agglomeration: recovery of heat from smoke
- Fonts: cooling liquids
- Dry coke quenching
- HF : residual heat of smoke from cowpers
- HF : chaleur du laitier
- HF : turbines de contrepression
- Laminoirs à chaud : chaleur de l'eau refroidissement
- Laminoirs : récupération sur fumées
- NH3 : récupération H2
- Préchauffe calcin
- Préchauffe des mat. premières - verre plat
- Heat recovery
- Vapeur et électricité par récupération sur fumées - verre plat
- Vapeur par récupération sur les fumées - verre plat

Fuel recovery
- HF : récupération gaz de torchère
- NH3 : export de vapeur
- Récupération gaz d'aciérie O2

[83] This list of measures has only partly be translated to English

Material recycling
- HF : augmentation ferrailles à l'aciérie

Motors with variable speeds
- Variateur de vitesse moteurs machines
- Variation de vitesse compresseurs
- Variation vitesse moteurs pompes
- Variation vitesse ventilateurs
- Variation vitesse ventilateurs réfrigération

Energy integration
- Energy integration

Thermal isolation
- Isolation de la partie statique des fours chaux rotatifs avec préchauffage
- Meilleure isolation partie stat. fours clinker

Efficient lighting systems
- Fficient lighting systems

Changes in the production process
- Chlore : membranes
- Métallurgie en poches
- Mout. ciment par presse à rouleaux
- Mout. presse rouleaux et boulets
- MVC alimentation
- MVC chimie
- Oxy-combustion autres verres
- Oxy-combustion verre creux
- Strip casting (Nucor)
- Transformation voie humide en voie sèche

More efficient equipment
- Agglomération : hottes d'allumage
- Amélioration préparation du cru
- HF : augmentation de la t° vent chaud
- HF : enrichissement vent chaud à l'O2
- Hot connection
- Moteur électrique HR (force motrice)
- Pompes plus performantes
- Remplacement fours à chaux droits simples
- Slabbing furnace (recup. burners)

Cogeneration
- Cogénération moteur à gaz - industrie
- Cogénération turbine à gaz - industrie

Energy substitution
- Substitution de combustibles solides ciment VH
- Substitution de combustibles solides ciment VS
- Substitution de fuel résiduel dans l'industrie

Residential

Behavioural changes
- Behavioural changes in residential heating (better use of thermostate, better maintainance of boiler, reduced temperature, ...)

Thermal insulation (installation of more performant windows in newly built houses)
- Double vitrage low E appartements neufs
- Double vitrage low E dans maisons neuves
- Isolation de la dalle de sol - résidentiel
- Isolation des murs extérieurs - résidentiel
- Isolation des toitures - résidentiel
- Remplacement de vitrage simple par vitrage double
- Vitrage super-isolant dans maisons neuves

Efficient lighting systems
- Higher penetration of fluo-compact bulbs

More efficient heating equipment (faster replacement of less efficient equipment)
- Chaudière à condensation - appartements existants
- Chaudière à condensation - appartements neufs
- Chaudière à condensation - maisons existantes
- Chaudière à condensation - maisons neuves
- Pommeau de douche économe - logements neufs
- Pommeau de douche économe - logements existants
- Vitrage super-isolant appartements neufs

Renewable energy (introduced at politically desired and not at BaU rate)
- Solar water heaters for existing houses
- Solar water heaters for new houses

Energy substitution
- Replacement of electric heating in existing appartments by natural gas heating

- Replacement of electric heating in existing houses by natural gas heating
- Replacement of electric heating in new houses by natural gas heating
- Replacement of electric heating in new appartments by natural gas heating

Services

Good practice
- Centralised technical management of heating temperature, consumption, ...

Behavioural changes
- Behavioural change in the use of heating
- Behavioural change in the use of lighting

Thermal isolation
- Double glazing in existing buildings
- Enhanced floor isolation in new buildings
- Enhanced external wall isolation in new buildings
- Enhanced roof isolation
- Double glazing in existing and new buildings

Efficient lighting systems
- Changement diffuseurs éclairage tertiaire
- Automatic control of lights
- Fluo-compact light bulbes

More efficient equiment
- Chaudière à condensation bâtiments existants tertiaire
- Chaudière à condensation bâtiments neufs tertiaire

Cogeneration
- Cogénération moteur à gaz Administrations publiques
- Cogénération moteur à gaz Banques, assur.
- Cogénération moteur à gaz Commerce
- Cogénération moteur à gaz Culture, sports & loisirs
- Cogénération moteur à gaz Enseignement
- Cogénération moteur à gaz Soins de Santé
- Cogénération moteur à gaz Transport & communications

Renewable energy
- Enhanced introducion of solar heat panels, closer to the political objectives than the BaU trend.

ANNEX D. GLOBAL CLIMATE OBSERVING SYSTEMS

Report by Belgium under the UNFCCC

1. GENERAL APPROACH TO SYSTEMATIC OBSERVATION

As agreed by the *World Meteorological Organization* (WMO), the *Intergovernmental Oceanographic Commission* (IOC) of UNESCO, the *United Nations Environment Program* (UNEP) and the *International Council for Science* (ICSU), the *Global climate observing systems* (GCOS) is made up of the climate observing components of the *World Weather Watch* (WWW), the *Global Atmosphere Watch* (GAW), the *World Hydrological Cycle Observing System* (WHYCOS), the *Global Ocean Observing System* (GOOS), the *Global Terrestrial Observing System* (GTOS), and the relevant observation systems established under the *World Climate Research Program* (WCRP) and the *International Geosphere-Biosphere Program* (IGBP).

GCOS is intended to meet the needs for:

- Climate system monitoring, climate change detection and monitoring the impacts of and the response to climate change, especially in terrestrial ecosystems and mean sea-level;
- Climate data for application to national economic development;
- Research toward improved understanding, modeling and prediction of the climate system.

It covers in situ measurements as well as remote sensing measurements.

1.1. Belgium and GCOS

Although Belgium has no particular policy yet with respect to the GCOS, it takes part in various climate-related monitoring, both nationally and within the European programs. These monitoring activities are not formally included in the GCOS, although a number of procedures are pursued to guarantee the continuity and long-term homogeneity of the data. Belgium is an observer in the *Committee on Earth Observations Satellites* (CEOS), an international program aiming at co-ordination and data- and information management.

Until now Belgium has no focal point for GCOS nor has it an active Focal Point for the GTOS. With respect to GOOS, the situation is different. The *Federal Office for Scientific, Technical and Cultural Affairs* (OSTC) launched early 2001 a feasibility study with respect to the optimization and the modalities of the Belgian participation in EUROGOOS. EUROGOOS is an association of marine operational research agencies in Europe, whose members seek to foster European co-operation on GOOS. At this moment the *Management Unit of the Mathematical Model of the North Sea* (MUMM), a department of the *Royal Belgian Institute of Natural Sciences* (RBINS), is the only Belgian member of EUROGOOS.

A preliminary analysis of the Belgian expertise showed that most of the expertise was found in universities and in the areas of geology and physical oceanography. There is also a reasonable potential in the areas of biology, chemistry and remote sensing. The technological expertise appears to be relatively weak.

The preliminary recommendations of the feasibility study are the following: Belgium should continue to participate in the international community and networks of oceanographers because of its commitments regarding the international monitoring systems and the common advantages of data exchanges. Therefore the study proposes to set up a task force on operational oceanography where stakeholder/actors are involved. Members of this task force should then take part in EUROGOOS. Although it is difficult, if not impossible to estimate precisely the financialadvantages, the indirect advantages are clear: a greater international visibility of Belgian expertise, job creation, an improvement of the expertise, a greater involvement in international programs and possibly a contribution to the

limitation of adverse effects to natural ecosystems and humankind. Other aspects include the prospect of offering present and future products (e.g. user friendly models) to end users in the academic world, industry (shipping and offshore activities) as well as to the citizens.

1.1.1. Ministries and Institutions in charge

There are no specific Ministries or Institutions in charge of the GCOS. But the following organisms could possibly play a role in the future. The *Federal Office for Scientific, Technical and Cultural Affairs* (OSTC) acts as a national space agency. The federal institutions in charge of systemic observations are the *Royal Meteorological Institute* (RMI), the *Belgian Institute for Space Aeronomy* (BISA), the Manage*ment Unit of the Mathematical Model of the North Sea and the Estuary of the Scheldt* (MUMM) all three depending of the OSTC.

1.1.2. Actions to strengthen international and intergovernmental programs related to global climate observing systems.

BELGIUM AND THE *GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY* (GMES) INITIATIVE

The GMES initiative is an ambitious concept that seeks to bring together the needs of the society related to the issue of environmental and security with the advanced technical and operational capability offered by terrestrial and space borne observation systems. The goal of the GMES initiative is to establish a coherent, operational and long-term user-driven system that meets the specific needs for policy-making and research. It involves the European Commission, the *European Space Agency*, the *European Environmental Agency*, the (national) space agencies, the industry, the national authorities (environment, civil protection, foreign affairs), the scientific community and NGOs. It was launched by the European Commission and a group of Space Agencies in May 1998, under the name of the Baveno Manifesto. Belgium has been very actively involved in the preparation of this initiative.

Finally, Members States' Heads of Government and Heads of State decided at the Gotheburg European Summit in June 2001 that the European Community should contribute to establishing, by 2008, a European capacity for Global Monitoring of the Environment and for the benefit of (civil) Security, because the availability of timely, unbiased and accurate information about the local, regional and global environment is an essential condition for a sound decision making process with respect to sustainable management of the environment, natural resources and security issues.

Belgium organised during its EC Presidency a conference on 15/10/2001 in Brussels ('GMES: Towards Implementation') with the following main objectives:

- to increase the overall awareness in Europe about the GMES concept and its relevance to the emerging global governance role for Europe;
- to widen the political support from the R&D domain towards those responsible for the implementation of Environment, External Relations, Regional and Sectorial Policies;
- to recommend the timely implementation and the appropriate resources, involving all key players in Europe.

The Council of the European Union adopted the Commission's outline of the GMES action Plan by end November 2001 and urged the Commission to start, in close co-operation with the ESA, the initial period of GMES aimed at achieving by 2008 an operational autonomous European capability for global monitoring for the environment and security.

The ESA Council of Ministers of Edinburgh approved in November the ESA Implementation proposal on GMES.

In practice GMES will be deployed on the basis of three main strands of activity:

- The delivery of information services meeting users' needs;
- Ongoing assessments of needs and production processes and establishment of a dialogue between providers and users;
- Developing the infrastructures required and improving services.

For the initial period (2001-2003) nine priority themes have been identified. One of these, relevant within the context of GCOS, is "Global atmosphere monitoring" aiming at delivering regular assessments of the state of the atmosphere, in support of e.g. the Climate Convention.

Operational services in the future will be delivered by GMES Service Centers which will be organised per GMES priority topic and each of which will be composed of a network of specialized institutes and industries.

The objective of Belgium is to play a leading role in the future operational thematic Service Center for global vegetation monitoring especially regarding the carbon cycle. It is within this context that a possible activity with regard to the GCOS as well as to GTOS might be considered.

2. METEOROLOGICAL AND ATMOSPHERIC OBSERVATIONS

2.1. Observation networks

The *Royal Meteorological Institute of Belgium* (RMI) has a number of networks for systematic observation of meteorological variables. Some of these networks (such as the synoptic network) are essentially used for operational purposes, while others are mainly intended for research work.

The networks of RMI for meteorological observations are the following:

- 6 synoptic stations; the data are transmitted to weather forecasting centers, through the *Regional Meteorological Data Communication Network* (RMDCN).
- About 240 climatological stations for daily measurements of precipitation: about 140 of these stations are also equipped with a Stevenson screen (daily measurements of maximum and minimum temperature); 24 hydrometeorological stations are equipped with a pluviograph (continuous recording of precipitation and temperature); 6 of these stations are completely automatic and provide also other meteorological data such as wind and temperature at and below the surface; the whole set of the daily pluviometric observations are monthly reported to the *European Center for Medium-Range Weather Forecasts* (ECMWF) for the quality assessment of the European Forecast Model.
- 22 radiometric stations (measurement of solar and infrared radiation), among which one Regional Radiometric Center of WMO; the data of all of these stations are provided to the *World Radiation Data Center* (WRDC) of WMO at St.- Petersburg.
- One radiosonde station for the measurement of vertical profiles of temperature, humidity and wind up to about 30 km (two times per day: at 00h and 12h UT).

The general quality of the Belgian climatological database has been recently reassessed at the daily scale over the period 1950-2000 to eliminate outliners and isolated missing data. Around 40 thermometric and 100 pluviometric stations have long observational series (over 30 years) and are therefore suitable for climate monitoring. Moreover, a project has been initiated to reconstruct a few regional climatological time series at the century scale by digitizing handwritten data available in the archives of the Royal Meteorological Institute of Belgium.

2.2. Participation to the Network for the Detection of Stratospheric Change (NDSC) and observation of the ozone layer

The *Network for the Detection of Stratospheric Change* (NDSC) was created in 1989. This network consists out of 5 primary stations and 40 complementary stations that are spread all over the world. This network is equipped with instruments to observe the physical properties of the atmosphere and to measure its chemical composition. On the policy level these observations could support and evaluate the effectiveness of the *Protocol of Montréal* and the *United Nations Framework Convention on Climate Change* (UNFCCC). On the short term, these observations are used to calibrate instruments on board of airplanes and satellites and to test chemical- and transport models of the atmosphere. Belgium observes at the international Scientific Station Jungfraujoch that is one of the five primary NDSC-stations, and at the Observatoire de Haute Provence, Harestua and Uccle which are complementary stations. Series of NDSC-relevant molecules (e.g. HCl, $ClONO_2$, HF, COF_2, HNO_3, NO_2, NO, O_3, CFC-12, HCFC-22), measured from 1989 to present, are archived at NOAA Data Host Facility (Washington, D.C.) and at NILU (Norway).

BIRA-IASB has taken the leadership in the exploitation of NDSC data on a global scale in the validation of satellite data, in particular of GOME and the upcoming ENVISAT mission and is co-chairman of the NDSC Satellite Working Group.

A station for observation of the ozone layer is locaterd at the *Royal Meteorological Institute of Belgium* (RMI). This station comprises the following observations:

- Several times per day: observation of the total ozone amount by means of a Brewer and a Dobson spectrophotometer. These observations are reported to the *World Ozone Data Center* (WODC) of WMO at Toronto. The spectrophotometers are included, on a regular basis, in campaigns for comparison to standard instruments, organised by WMO.
- Several times per day: observation of the spectrum of UV-B radiation, by means of two Brewer spectrophotometers. These observations are used as input in a model for forecasting the UV Index. During the summer months daily forecasts of the UV Index are provided to the media. Three times per week: balloon sounding for observation of the vertical distribution of ozone and meteorological parameters up to about 35 km, by means of an ozonesonde coupled to a radiosonde. The results of these soundings are provided to a database at the *Norwegian Institute for Air Research* (NILU - Norway) for input in a forecasting model of the *European Center for Medium-Range Weather Forecasts* (ECMWF). A procedure is going on for inclusion of the ozone station of the *Royal Meteorological Institute of Belgium* (RMI) in the *Network for the Detection of Stratospheric Change* (NDSC).

3. OCEANIC OBSERVATIONS

INTEGRATED AND DYNAMICAL OCEANOGRAPHIC DATA MANAGEMENT (IDOD)

The purpose of this five-year project is to establish, manage and promote a marine environmental geographical information system, ensuring a smooth and scientifically sound flow of data between the data producers (scientists in the field and in the laboratory, modelers, public authorities, etc.) and the end users (policymakers, scientists, sea professionals and the general public).

The categories of data to be considered cover a wide range of natural processes and human activities connected with the North Sea. Up to date Quality Control procedures will be followed in entering and processing the information to be included in the database. The tools and products to be developed in the course of the project will make it possible to gain a better understanding of the structure and functioning of the marine ecosystem and the influence upon it of human activities, by providing a basis for scientific assessments in the perspective of the definition of a sustainable management policy of the North Sea.

4. TERRESTRIAL OBSERVATION

Particularly worth mentioning in the field of terrestrial observation is the fact that Belgium has been contributing to the construction and exploitation of the SPOT satellite since 1979, together with Sweden and France.

One of the instruments on board of the SPOT satellite is the VEGETATION instrument. The VEGETATION instrument is a joint initiative by the EC and Belgium. The images that are produced are used to monitor the world vegetation cover, deforestation and desertification, to forecast agricultural production, to study effects of climate change and, in combination with ecosystem models, to estimate carbon sequestration. The major asset of the VEGETATION program is the daily coverage of the entire globe together with the rapid delivery of top quality satellite images.

With the support of the OSTC and the Flemish Community, the CTIV (*VEGETATION image processing center*) is hosted in the *Flemish Institute for Technological Research* (VITO). The CTIV processes and archives the data and operates the VEGETATION image catalogue.

The space department of OSTC established a national research program: "VEGETATION scientific support program", funding in particular projects which aim at increasing our knowledge and our management capacity in the area of forest and savanna fires, land cover changes, wetlands, the vegetation processing chain, etc., based on data from the VEGETATION instrument.

In 2002 SPOT-5 will be launched with on board the VEGETATION-2 instrument.

5. SPACE BASED OBSERVING PROGRAMS

5.1. European Space Agency

Belgium participates in the optional programs of the European Space Agency (ESA) that manage the ERS (European Remote Sensing) and ENVISAT (ENVIronmental SATellite) satellite missions. Concerning the study of the atmosphere, the main instruments are GOME (Global Ozone Monitoring Experiment) on ERS-2 and GOMOS (Global Ozone Monitoring by Occultation of Stars), MIPAS (Michelson Interferometric Passive Atmospheric Sounder) and SCIAMACHY (SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY) on ENVISAT. These instruments measure trace gases and ozone in the atmosphere and detect changes in the atmospheric concentrations. The ATSR (Along-Track Scanning Radiometer) instrument, included in both missions, measures the temperature of the ocean surface with accuracy better than 0.5 K, necessary for climate research. Belgium participates in particular in the scientific preparations of the GOMOS instrument and provided additional financing for the SCIAMACHY instrument.

Belgium has had a strong participation in the PRODEX optional program of ESA since 1988. PRODEX finances proposals addressing the development of new instruments for ESA satellites, the calibration and validation of these satellite data, their processing including the development of algorithms, the development of specific applications and the general scientific data use of the instrument. Belgian climate related projects financed by this program are:

- Earth Radiation Budget studies in the context of the EUMETSAT SAF (Satellite Application Facility) Climate;
- Data processing for the GERB (Geostationary Earth Radiation Budget) instrument on board of the MSG (Meteosat Second Generation) satellite of EUMETSAT;
- Monitoring the solar constant with the experiments: SOLCON (Solar Constant Experiment, on the Shuttle), SOVA (SOlar Variability, on Eureca), SOVIM (Solar experiments, on ISS), SOVA-P (SOlar VAriability experiment for measuring solar constant) (on Picard, for which Belgium will also host

the scientific Mission Control Center), DIARAD (Differential Absolute Radiometer, on SOHO (SOlar and Heliospheric Observatory);
- Ozone validation campaigns in the context of the EUMETSAT SAF Ozone;
- Evapo-transpiration studies in the context of the EUMETSAT SAF Land;
- Atmospheric Chemistry validation for the ERS and ENVISAT satellites;
- Forest degradation and desertification studies.

Belgium is one of the four participating states in the optional Data User Program (DUP) of ESA (1996-2003). This program specifically supports initiatives that aim at bridging the gap between Earth Observation application research, and the provision of an operational product destined for the commercial market. The subjects of Belgian DUP projects in the field of climate change issues are: global aerosol mapping, forestry mapping, ozone monitoring, draught early warning, climate analysis maps, carbon flux estimation, and tropospheric emission services. After 2003, this program will be integrated into the optional *Earth Observation Envelope Program* (EOEP) of ESA, in which Belgium participates since 1999. Several of the scientific missions developed through this program are relevant for climate studies, e.g. GOCE (observation of global ocean levels), ACE (Atmospheric Climate Explorer), CRYOSAT (ice melting).

Belgium strongly supports the GMES initiative of the EC and ESA and participates actively in the related Program 'GMES Services', which is part of the optional ESA *Earth Watch* program.

5.2. EUMETSAT

Through its membership of EUMETSAT, Belgium contributes to the development of the *Meteosat Second Generation* (MSG) and the *METeorological OPerational satellite* (METOP). On MSG, Belgium contributes more particularly to the data processing of the Geostationary Earth Radiation Budget (GERB) instrument. Several instruments on board of METOP.

The *Royal Meteorological Institute* (RMI) of Belgium participates in three Satellite Application Facilities (SAF) : Ozone, Land and Climate. The purpose of these SAFs is to develop a whole range of specialized data products from the EUMETSAT satellite raw data, e.g. the upper soil humidity by the SAF-Land.

Belgium will probably participate to the Jason-2 optional program of EUMETSAT which aims at determining precise ocean altimetry and physical parameters, relevant e.g. for climate studies.

5.3. Others

The *Royal Meteorological Institute* (RMI) participates actively in the climate monitoring using space-based observations, monitoring both incoming solar radiative energy, the so-called « solar constant » and the outgoing terms of the Earth radiation budget (see also §5.1). These factors are of fundamental importance in climate change research.

Solar constant monitoring is achieved using absolute radiometers designed and built at RMI. These measurements are performed to monitor the radiant energy input from the Sun to the Earth, more particularly to the ocean-atmosphere system. This program started in 1983 with the SOLCON instrument during the SPACELAB-1 flight. An improved version of the SOLCON instrument was a part of the ATLAS (ATmospheric Laboratory for Applications and Science) program of NASA (1992, 1993 and 1994) and is used in a series of Hitchhiker flights: STS-85 (1997), STS-95 (1998), STS-107 (2002). The same type of radiometer was part of the SOVA experiment on the EURECA platform of ESA (1993-1993) and has been operating on the SOHO spacecraft (DIARAD, part of the VIRGO (Variability of solar IRradiance and Gravity Oscillations experiment) since 1995. The long duration flights (SOVA and VIRGO) significantly contribute to the constitution of long time series of total solar irradiance monitoring, while the short

flights on board of the NASA space shuttle also have a meteorological goal, as reference instrument for the calibration of other radiometers.

The monitoring of outgoing radiation from Earth is another important parameter for climate change monitoring and studies. The GERB instrument on board of EUMETSAT MSG satellites will monitor the Earth Radiation Budget, short wave (reflected solar radiation) and long wave (thermal terrestrial radiation) will be measured every 15 minutes from a geostationary satellite. The RMI is responsible for a part of the ground segment (the data processing chain) and will provide data on fluxes in near real time for forecasting models as well as for climatological studies. Combining geo-stationary observations with measurements from low orbiting satellites, RMI will produce homogeneous data sets for the Climate Monitoring Satellite Application Facility of EUMETSAT.

More information concerning these activities can be found at:

- http://www.belspo.be
- http://www.iasb.be/
- http://www.meteo.be/
- http://www.oma.be/BIRA-IASB/
- http://www.mumm.ac.be/
- http://www.vgt.vito.be
- http://www.belspo.be

Liste des abréviations

OSTC	Federal Office for Scientific, Technical and Cultural Affairs
WMO	World Meteorological Organization
IOC	Intergovernmental Oceanographic Commission of UNESCO
UNEP	United Nations Environment Program
ICSU	International Council for Science
GCOS	Global climate observing systems
WWW	World Weather Watch
GAW	Global Atmosphere Watch
WHYCOS	World Hydrological Cycle Observing System
GOOS	Global Ocean Observing System
GTOS	Global Terrestrial Observing System
WCRP	World Climate Research Program
IGBP	International Geosphere-Biosphere Program
CEOS	Committee on Earth Observations Satellites
MUMM	Management Unit of the Mathematical Model of the North Sea
RBINS	Royal Belgian Institute of Natural Sciences
RMI	Royal Meteorological Institute
BISA	Belgian Institute for Space Aeronomy
GMES	Global Monitoring for Environment and Security
RMDCN	Regional Meteorological Data Communication Network
ECMWF	European Center for Medium-Range Weather Forecasts
WRDC	World Radiation Data Center
NDSC	Network for the Detection of Stratospheric Change
UNFCCC	United Nations Framework Convention on Climate Change
FTIR	Fourier Transform Infrared Spectrophotometer
NOAA	National Oceanic and Atmospheric Administration
GOME	Global Ozone Monitoring Experiment
ENVISAT	ENVIronment SATellite
NILU	Norwegian Institute for Air Research
WODC	World Ozone Data Center

IDOD	Integrated and dynamical oceanographic data management
CTIV	VEGETATION image processing center
VITO	Flemish Institute for Technological Research
ESA	European Space Agency
PRODEX	Scientific Experiment Development Programme
DUP	Data User Program
EOEP	Earth Observation Envelope Program
GOCE	observation of global ocean levels
ACE	Atmospheric Climate Explorer
CRYOSAT	ice melting
SOLCON	Solar Constant Experiment
SOVA	SOlar Variability
SOVIM	Solar experiments
SOVA-P	SOlar VAriability experiment for measuring solar constant
DIARAD	Differential Absolute Radiometer
SOHO	SOlar and Heliospheric Observatory
VIRGO	Variability of solar IRradiance and Gravity Oscillations experiment
GERB	Geostationary Earth Radiation Budget
BIRA	Belgisch Instituut voor Ruimte Aëronomie
ECMWF	European Centre for Medium-range Weather Forecasts
Eureca	European Retrievable Carrier
GOMOS	Global Ozone Monitoring by Occultation of Stars
ISS	International Space Station
METOP	METeorological OPerational satellite
NASA	National Aeronautics and Space Administration
Picard	advanced polar-orbiting Earth observation satellite

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