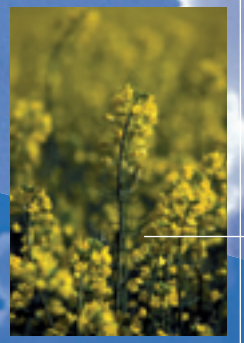
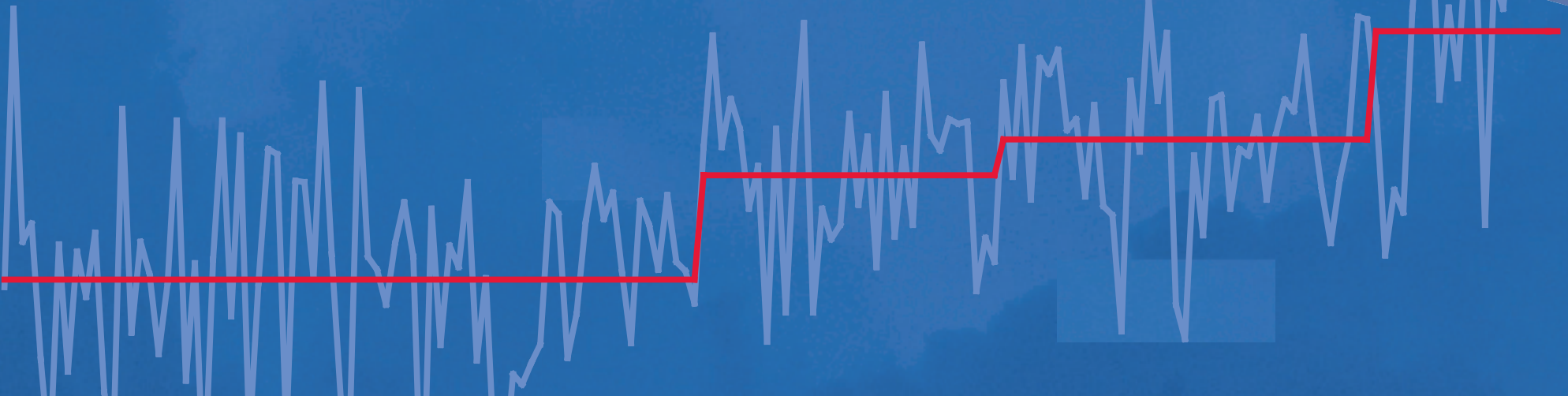


2006
Belgium

FOURTH NATIONAL COMMUNICATION ON

CLIMATE CHANGE

Under the United Nations Framework Convention on Climate Change



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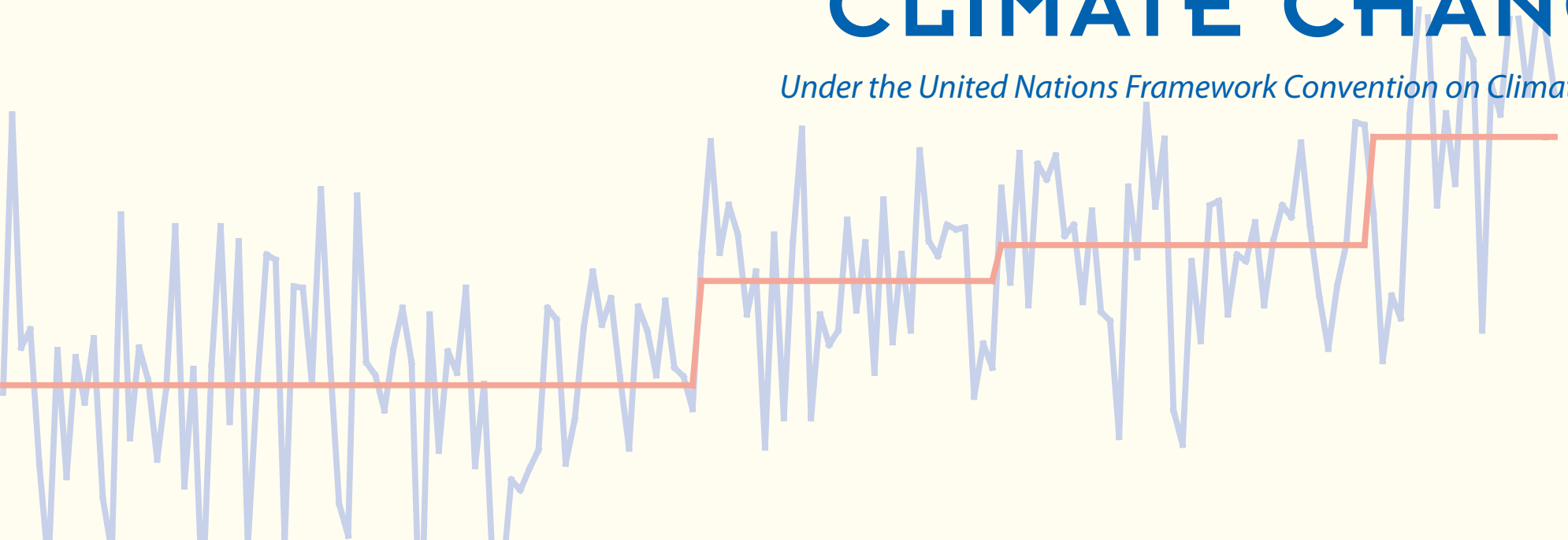

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1. Executive summary

National circumstances relevant to greenhouse gas emissions and removals

Geography & Climate

Belgium has a relatively limited territory with moderate elevation levels. It is crisscrossed by an important network of waterways and a very dense communications network (roads and railways). The country is bounded by the North Sea. Belgium is highly urbanised and densely populated. The population's low growth rate results primarily from immigration. Belgium has a temperate maritime climate, characterised by moderate temperatures, predominantly westerly winds, cloudy skies and frequent rains. The evolution of temperatures in the past century reveals an upward trend, a phenomenon that has been accentuated in recent years. Flora and fauna in Belgium are typical of other areas of Europe with a temperate climate. Presently, only 20% of Belgian territory is still covered in woodland (forests of broad-leaved trees or conifers). This surface area has decreased slightly since 1990, as has agricultural land, which nevertheless still occupies the greater part of the territory.

Institutions

Belgium is a federal state, composed of three language-based communities and three regions, each with its own executive and legislative bodies. Given the complexity of the structure of the country's institutions and of the division of powers between the different levels of power, the implementation of climate policy is decentralised. Cooperation bodies provide coordination and integration of the policies conducted by the different authorities, and ensure the consistency of national climate policy. Cooperation structures in the area of climate policy have been strengthened in recent years, in particular through the negotiation of a cooperation agreement for implementation of the National Climate Plan and the creation of a National Climate Commission charged with implementing the agreement.

Economy

Belgium has a very open economy, situated at the heart of a zone of intense economic activity. Exports of goods and services represented 81.5% of GDP in 2003 and imports nearly 78%. The Belgian economy is currently dominated by the services sector. The importance of the manufacturing industries has gradually declined over the last 30 years. For the third consecutive year in 2004, Belgium registered growth equal (2002) or superior (2003 and 2004) to average euro zone growth. GDP at current prices in 2004 amounted to € 283.472 billion, i.e.

per capita GDP 18.5% above the European Union average (25 countries). Over the last 10 years, Belgium has registered average real economic growth of 2.22%.

Energy

Primary energy intensity has declined on the whole in Belgium since 1996, reflecting the uncoupling of economic growth and primary energy consumption. Buildings constitute the leading end consumer of primary energy (35%), followed by industry (30%, of which one third for iron and steel) and transport (24%). Total final energy consumption increased at a yearly rate of 0.6% between 1998 and 2003. The increase was significant in transport and industries (other than iron and steel; final consumption by that industry has continued a downward trend since 1979). Petroleum remains the dominant energy (51% in 2003) at end consumer level, followed by gas (26%), electricity (16%), solid fuels (6%) and heat (1.1%). Petroleum covers primarily the needs of the transport and residential sectors as well as non-energy uses (feedstocks). Electricity and natural gas, on the other hand, play a major role in industry and the residential sector, while the use of solid fuels is mainly confined to the iron and steel industry. Electricity generation rose an average of 0.3% a year from 1998 to 2003. Nuclear plants generate 58% of electricity and classic thermal power stations 38%; the remaining 4% is generated by pumping power stations, hydraulic energy and renewable energy. The share of liquid fuels in electricity generation has been declining for a number of years (from 52.7% in 1971 to 1.2% in 2003). Electricity consumption is almost identical for the industrial sector (50.2%) and the residential and tertiary sectors (48%). Renewable energy constitutes a very small share of primary energy generation (1.5% in 2004), notably due to the relatively low potential for this type of energy in Belgium (small territory and limited availability of hydraulic, geothermal and solar resources). In time, renewable energy, which is being developed intensely, is nevertheless expected to constitute a substantial share of primary energy generation. Wind energy in particular is being developed through numerous projects. Renewable energy currently (2003) represents 2.3% of primary electricity generation (of which 83% biomass and 13% hydro-electricity).

Transport

Transport is a constantly growing sector given Belgium's situation as a country of transit, with an economy geared largely to export. This growth particularly concerns road and air transport. The number of passenger cars has risen spectacularly (motorisation rate in Belgium: one car for every two inhabitants). Growth is even higher for goods transport vehicles. Demand for fossil energy in the sector is expected to continue to rise. The development of new technologies to improve vehicle energy efficiency is taking a long time producing an impact on emissions in the sector. Road is by far the main mode of transport in Belgium, both for passengers (81% of total motorised mobility in 2004, compared to 7.8% for public transport) and goods (84%).

Industry

Industry in Belgium has changed profoundly since 1960 and its weight in the economy has declined. The metallurgy sector, constituted mainly of large companies situated in the heart of the former industrial areas of Wallonia, has undergone considerable restructuring as a result of the crisis that began in the sector in the 1970s. The textile sector, which has also had to cope with major difficulties during the same period, has tended to merge its activities. In contrast, the agri-foods industry has evolved into Belgium's third largest industrial sector. Chemicals account for one fifth of the turnover of Belgian industries; Belgium ranks tenth worldwide in this sector. The automotive industry in Belgium is limited to assembly, which takes place mostly in large plants owned by multinationals. Railway construction and the highly technological aviation sector also have a strong presence in Belgium.

Waste

Considerable improvements have been made in the waste sector. The volume of waste dropped by 7.8% between 1995 and 2000 due to the decrease in industrial waste. There has also been remarkable progress in the recycling of packaging. In 2004, the rate of recycling and recovery of packaging reached 92.9%, making Belgium a pioneer in this field.

Housing

Belgian housing stock is characterised by a high proportion of old buildings (especially in the big cities). The presence of central heating in Belgian housing has risen some 25% in the past decade. Natural gas has now surpassed fuel oil as the main source of heat. Coal has also shown a marked decline (2.8% in 2001). Major progress has been made in insulating buildings: more than seven out of 10 households now have dual-glazed windows, around six out of 10 have an insulated roof, four out of 10 have insulated outer walls and in 6 out of 10 cases heating pipes are insulated.

Agriculture

Belgian agriculture is specialised in market-garden and horticultural crops, cereals, potatoes, sugar beets, livestock and milk production. Fishing has relatively limited importance in the economy. Although agricultural land in use has remained relatively stable, the number of farms and the active population in this sector have continued to decline significantly in recent years, continuing a trend under way since the Second World War. The active population in agriculture and fisheries currently represents barely 1% of the population. In spite of this decline, agriculture and fisheries are still important economic sectors.

Greenhouse gas inventory information

Total greenhouse gas emissions (without LUCF) in Belgium amounted to 147.7 Mt CO_2 eq. in 2003, which is 1.4% above 1990 emissions. The major greenhouse gas in Belgium is carbon dioxide (CO_2), which accounted for 86% of total emissions in 2003. CO_2 emissions increased by 6% from 1990 to 2003, while N_2O, CH_4 and fluorinated gas emissions dropped by 8%, 21% and 67%[1] respectively during the same period. The main sectors responsible for the emissions are the energy industries (21%), industry (31%), transport (18%), residential and commercial (20%) and agriculture (8%).

Under the Kyoto Protocol and the EU 'burden sharing' agreement, Belgium is committed to reducing its GHG emissions by 7.5%. Compared to the base year[2], emissions increased by 0.6% in 2003. This apparent stability actually masks contrasting evolutions in the sectors.

The increase in Belgian emissions is due to the sharp rise in emissions from road transport and the residential and commercial sectors. Since 1990, those sectors have been responsible for a 7.1% increase in emissions. This trend is counterbalanced by declining emissions (-6.5%) in the other sectors, particularly in industry, giving an overall trend of +0.6%.

CO_2 emissions from road transport have risen constantly since 1990 due to the growing number of cars and increased traffic. Emissions from the reside e switch from solid fuel to gaseous fuels is observed in all fuel combustion sectors. Together with the development of biomass fuels in some sectors, such as cement kilns, this has resulted in a reduction of CO_2 emissions since 1990 by reducing the average CO_2 emission factor for an equal level of energy consumption. The more rational use of energy is also developing but it often goes together with greater use of electricity, so its impact on actual emissions is generally more difficult to quantify.

In agriculture, CH_4 and N_2O emissions are decreasing, reflecting the evolution of the livestock population and certain changes in agricultural practices. The other main source of N2O is the chemical industry, where process improvement combined with increased production led to fairly stable emission levels. In solid waste disposal, biogas recovery and use has resulted in a net reduction of CH_4 emissions in recent years.

Policies and measures

In the Belgian **federal system**, policies and measures to reduce greenhouse gas emissions are mapped out at different levels of responsibility based on the division of powers between the federal government and the regions. Each level of power establishes its own priorities for environment and climate policy. Coordination bodies have been set up to harmonise and create synergy between the policies implemented by the federal government and the three regions, the National Climate Commission being the most important. The general context for the preparation of climate change policies and measures is consequently determined by the plans established by the federal and regional authorities setting out policy objectives and strategies. These plans are described below.

In the context of the Act on coordination of federal policy for sustainable development (5 May 1997), a new version of the Federal Plan for Sustainable Development (2004-2008) was adopted by the federal government (14 September 2004). This Plan defines the measures to be taken at federal level to achieve SD objectives. One of the six areas of action of the Federal Plan for Sustainable Development (FPSD 2004-2008) is the 'limitation of climate change and more intensive use of clean energy'. A number of specific actions under the Plan are aimed at: strengthening federal coordination, implementing a green tax system, developing a strategy for fair prices, developing solidarity through 'flexible mechanisms', promoting alternative energies and 'clean buildings', improving the public transport supply, developing clean car technologies, etc. This Plan is characterised by both prescriptive and indicative planning. The FPSD also provides for the promotion of mobility compatible with sustainable development, based on managing the growing need for mobility and increasing the security of travel, technological innovation and modal transfer. Furthermore, the Council of Ministers of 19-20 March 2004 approved a set of measures for reducing greenhouse gas emissions. These measures constitute the core of the federal climate policy. As a whole, this set of measures should guarantee a reduction in national greenhouse gas emissions of 4.8 million tonnes (Mt) CO_2 equivalent/year for the period 2008-2012. These measures are currently being assessed and will be adapted if necessary.

The **Flemish Climate Plan** 2002-2005 was approved by the Flemish government on 28 February 2003 and is intended to give an overview of all climate related policies and measures in the Flemish Region. The Plan was the first result of the policy integrating work of the Flemish Taskforce on Climate, established by the government in 2001. The central part consists of 33 projects, divided into three categories: projects with a certain emission reduction potential, research and policy studies, and communication campaigns. The third Environmental Policy Plan (MINA-plan 3) 2003-2007, approved on 30 September 2003, follows the same approach as the

[1] Compared to 1995 emissions.

[2] The base year under the Kyoto protocol is 1990 for CO_2, CH_4 and N_2O, but 1995 for fluorinated gases.

Climate Plan, promoting three strategic elements for an integrated Flemish climate policy: optimisation of the foundations on coordination and reporting (Taskforce, emission inventories, projections and monitoring), a sectoral approach with actions for each key source sector and a clear strategy on the use of flexible mechanisms, including implementation of the EU emissions trading scheme. A second Climate plan 2006-2012 is being prepared and will be approved in spring 2006. The preparation phase is accompanied by a wide consultation process with all relevant stakeholders and will be harmonised with the Second Allocation Plan 2008-2012 under Directive 2003/87/EC.

On 19 July 2001, the **Walloon government** adopted the Walloon Region Action Plan for Climate Change'. Among the many corollaries to this plan, some recent policies and measures should be emphasised. First, the scheme for GHG emission allowance trading was adopted in 2004, in application of Directive 2003/87/EC. 128 industries received a maximum greenhouse gas emission quota based on energy audits performed at each site. The incentives to reduce industrial GHG emissions were reinforced by voluntary branch agreements under which the main industry sectors made an undertaking to improve their energy efficiency. Second, the Walloon Plan for Sustainable Management of Energy (18 December 2003) proposed ways of enhancing the policy of rational use of energy (RUE) and developing renewable energy sources (RES). RUE is promoted by various grants (energy audits, etc.) or tax deductions on investments (insulation of houses, replacement of old boilers and so on). The plan's target is to produce 8% of electricity and 12% of heat from RES by 2010. Attaining that objective involves the promotion of 'green' electricity through the attribution of a minimum quota of RES certificates to each energy supplier ('green certificates'). Third, recent measures taken in the transport sector are essentially structural in nature, e.g. improvement of public transport and the multimodal transport of goods. Finally, two legislative instruments have come into force in the agriculture and forestry sectors: the decrees implementing the decree on environmental permits (11 March 1999) and the decree on the Walloon Sustainable Management Programme for nitrogen in agriculture (10 October 2002). In the waste sector, implementation of the waste plan has led to a decrease in total waste placed in landfills and of its biogenic content. Biogas recovery is also encouraged by the plan and has developed considerably since 1993, leading to a substantial decrease in net methane emissions from landfills.

The **Brussels-Capital government** adopted on 13 November 2002 an eight-year air and climate plan, the Plan for Structural Improvement of Air Quality and the Fight against Climate Change, 2002-2010. The legal basis of the Plan is the ordinance on the evaluation and improvement of ambiant air quality (25 March 1999), which transposes European Directive 1996/62/EC. Since the region is a city, the main sources of most atmospheric pollutants are also the sources of greenhouse gases: the heating of buildings (residential and tertiary) and transport. That is why the Air Plan has been combined with a Climate Plan. The Air and Climate Plan is managed by the Brussels Institute for Environmental Management (IBGE/BIM) in collaboration with the other regional administrations such as the Administration for Infrastructure and Mobility (AED) and the Administration for Land Management and Housing (AATL). This Plan comprises 81 provisions focusing on reducing the main pollutants and greenhouse gas sources.

There are synergies between the different plans and programmes of the federal government and the three regions. Together, all these measures make up the National Climate Plan that is currently being updated. The main actions being implemented (or that have been adopted) to reduce greenhouse gas emissions in the various sectors are listed below by sector:

Energy

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

These measures are supplemented with a number of provisions, in particular concerning energy pricing, energy audits, insulation standards for buildings, the promotion of renewable energy sources and new infrastructure (notably wind energy).

Transport

In the transport sector, the actions undertaken by the federal and regional authorities focus basically on checking the growth of car traffic and promoting a 'modal shift' (to rail and waterway):

- Better public transport systems: improvement of infrastructure, higher frequency of service, better connections and combined tickets (train, tram, bus, underground), as well as improved personal safety, passenger information systems, etc.
- Promotion of alternative means of transport: a set of measures to encourage people to use public transport, car-pool-

ing, bicycling or walking for everyday mobility; business transport plans.
- Reduction of pollution from vehicles: taxation based on vehicle performance in terms of pollution and ecodriving.

Industry

Measures designed to reduce industrial non-energy-related greenhouse gas emissions come within the scope of regulations on environment permits (restriction on the use of fluorinated gases, introduction of best available technologies, etc.) and the voluntary agreements negotiated between the regional authorities and industrial federations (iron, steel, chemistry and paper).

Agriculture and Forestry

Actions in agriculture focus primarily on reducing the factors of production (establishing new land application standards for animal manure, limiting growth of the livestock population) and improving farming practices (treatment, storage and spreading of manure, recovery of waste, combating soil degradation, etc.). Reforestation and forest conservation are encouraged by specific laws.

Waste

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

Allocation plans and flexible mechanims

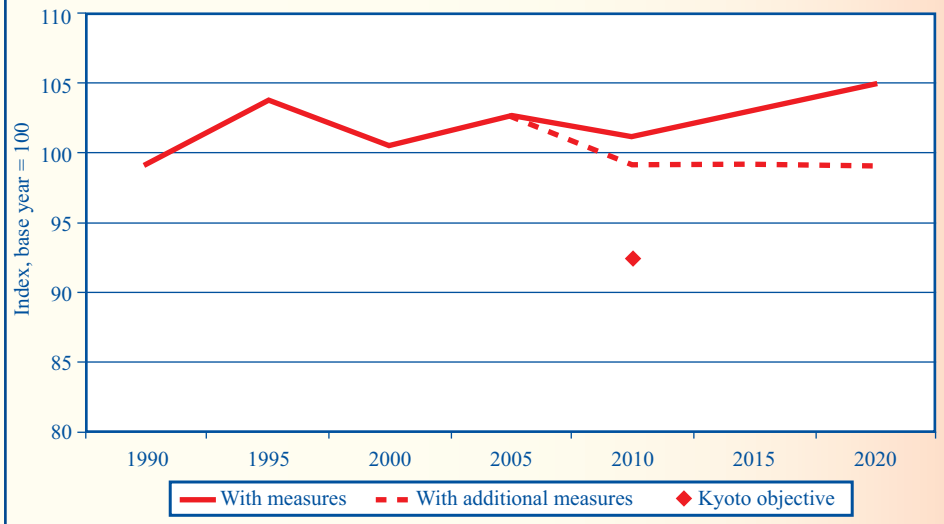
For implementation of Directive 2003/87/EC, the regions are in charge of issuing greenhouse gas emission permits and implementing the allocation plan for installations on their territories, excluding nuclear plant support and safety installations, which are the responsibility of the federal government. The Belgian National Allocation Plan is based on the sum of the three regional plans and the federal plan.

Belgium will use the Kyoto mechanisms to fulfil its emission reduction commitment. The National Climate Commission has been designated as the Belgian Designated National Authority (DNA) and Focal Point. The priority of the regions is to use the flexible mechanisms based on projects (CDM or JI). The federal and Flemish governments launched in 2005 the first JI/CDM tender in order to purchase emission reductions from JI and CDM projects. The Walloon and Brussels-Capital Regions have invested in the World Bank's CDCF (small-scale CDM projects).

Projections and total effect of policies and measures

The 'with measures' scenario includes all policies and measures either adopted or under implementation by the end of April 2004, including the National Allocation Plan. Under these policies, greenhouse gas emissions in Belgium (without capture by LUCF) are expected to increase from 146.8 Mt CO_2e in the base year (see note under Table 5.14 for definition of the base year) to 154.0 Mt CO_2e in 2020, an in-

Figure 1.1. Total GHG emission projections for Belgium



Sources: National inventory (base year, 1990 to 2000) and national projections (2005-2020)

Note: Emissions for the base year are computed by adding the 1990 emissions of CO_2, CH_4 and N_2O, and 1995 emissions of F-gas.

crease of 4.9% (see Table 5.14). The largest contributor by far to this increase is CO_2 emissions from energy used in transport, electricity generation, and the residential and services sectors.

The impact of changing certain key assumptions of these projections has been tested. This sensitivity analysis covered the following issues: warmer or colder climate, slower or faster economic growth, higher energy prices, higher import of electricity and lower electricity demand. In the analysis performed for this report, these changes do not exceed, on an individual assumption basis, 3 Mt CO2e in 2020, i.e. less than 2% of total emissions. It is thus likely that, even if some of the key assumptions of the 'with measures' scenario were to change in the future, GHG emissions would still increase between 1990 and 2020, although the amount of this increase could vary to a limited extent.

The additional measures presented in this report allow further emission reductions in 2020 in the amount of 8.4 Mt CO_2e. The most significant additional measures focus on transport policy, the substitution of wood and biofuels for fossil fuels, the reduction of F-gas emissions and further reduction of N_2O emissions from nitric acid production.

The figure 1.1 illustrates these aggregated projections for the 'with measures' scenario and the impact of the additional measures. At this point, it is expected that, over the period 2008-2012, GHG emissions in Belgium will remain higher than the level committed to under the Kyoto Protocol. The National Climate Plan is currently being revised to take this into account and to propose new measures, including the use of flexible mechanisms that would allow the country to meet its Kyoto objective.

Vulnerability assessment, climate change impacts and adaptation measures

Climate change projections

Projections for the regional evolution of climate involve considerably more details, and thus more sources of uncertainty, than global or continental projections. The present assessment of impacts is mainly based on two emission scenarios for which a number of climate simulations are available, namely the IPCC A2 and B2 marker scenarios. It must be kept in mind, however, that these do not cover the complete range of socio-economic scenarios and do not include climate mitigation policies. We use results from global circulation models presented in the IPCC third assessment report and a set of regional climate simulations across Europe from the EU PRUDENCE project.

For the Belgian area, with these scenarios and models,

- temperatures would rise significantly by 2050 in both summer and winter
- at the end of the 21st century, the average temperature rise in relation to the end of the 20th century would be between 1 and 5°C in winter and between 1.5 and 7°C in summer; The larger changes are reported only for scenario A2 with the higher emissions.
- the projections for the change in precipitation until the end of the 21st century show a rise of 3 to 30% for winter (with few results under 10%) and a change for summer between zero and a drop of up to about 50%.

The probability of severe heat waves is expected to rise significantly. Projections for the end of the 21st century (A2 scenario) show that about every second summer could be as warm or warmer (and as dry or dryer) than the summer of 2003. It is very likely that we will experience more frequent episodes of heavy rain, but this change cannot be reliably quantified at the moment. In the framework of the PRUDENCE project, extreme winds were also projected to increase.

Sea-level rise during the 21st century is estimated at +14 to +93 cm, with an additional uncertainty due to the lack of knowledge of regional effects. However, the sea-level rise may reach 4 to 8 metres after a millennium even in a moderate emission scenario.

Ecosystems and biodiversity

Due to the migration of species to the north, the number of southern species in a given area is increasing (this has already been observed for specific cases in Belgium), while the number of species requir-

ing a colder climate will decrease in the future. The arrival of species adapted to a warmer climate is a source of competition with existing local species. Climate change causes complex disruptions to ecosystems, for example due to broken food chains following different changes among species. Efforts have been made to draw up a (partial) classification of species found in Belgium in relation to their climate requirements. Some adaptation is possible in the form of the reduction of non-climate stresses on ecosystems, creation of new protected areas, and possibly other measures in the future. This adaptation process has limitations, however. More research and observations are needed to provide a better assessment of the vulnerability of the natural environment, which is potentially high.

Agriculture and forests

As long as the temperature increase remains below about 3°C, the expected impacts on agriculture are limited. The warming would reduce yield for a number of existing crops, but increasing carbon dioxide concentration would have positive effects on most yields. In addition, current agricultural choices in Belgium are widely affected by policy measures and adaptation seems possible in the future. Forestry seems to be more at risk, notably due to the timescale of tree growth. Current forest management focuses on planting species adapted to mild and rainy winters such as Douglas pine and broad-leaved trees. Both sectors will face impacts from the increased frequency of summer drought and heat waves, and may be affected by the migration of pests. Warming contributes to the decomposition of the organic matter contained in soils, reducing fertility. The expansion of biofuel production would have consequences on land use and landscapes.

Risk of floods

Studies carried out on several hydrographic basins in Belgium conclude that there will be a general rise in the risk of flooding during this century, due to increased winter precipitation. Occurrence of intense rainfall will also likely contribute to a widespread increase in the risk of flooding. Current adaptation measures include policies banning construction in flood sensitive areas, promoting practices for better infiltration of water in soils, and the building of storm-basins.

Coastal area

Climate change is expected to increase coastal erosion. The addition of sand to beaches is currently used to remedy erosion, and is believed to remain an acceptable solution for the coming decades. Following past flooding in the Scheldt estuary, a set of measures mainly based on the definition and construction of a controlled flooding area was completed. A new phase was recently planned to reduce the risk further, taking into account a 60 cm rise in sea level. While the risk appears to be under control for this century, further sea-level rise, reaching several meters within a millennium, is a much more serious threat.

Water resources

In summer, increased evaporation and the possible reduction of precipitation contribute to a decrease in groundwater level. In winter, the projected increase of precipitation has the opposite effect. Due to large uncertainties in precipitation projections, the balance of these changes is not known, although increased evaporation due to warmer temperature is certain. As water availability is already limited in parts of the country (specifically Flanders), future changes are a growing concern.

Human health

The projected rise in the frequency or intensity of heat waves increases mortality and morbidity rates; conversely, a fall in the number of cold days in winter decreases the rate of mortality (e.g. from cardio-vascular problems). Air quality is also affected: heat promotes the formation of ozone and extends the season during which allergenic pollens are released, etc. Climate change is suspected to have contributed to the increase in the prevalence of Lyme disease observed in the country. A federal plan for the mitigation of the effects of heat waves and ozone was set up after the heat waves of 2003, which caused about 1 300 additional deaths of elderly people. The first regulations in favour of the structural protection of buildings are also being put into place.

Infrastructure, energy and industry

Increasing temperatures will reduce energy demand in winter while increasing cooling demand in summer. Difficulties may arise in industries and sectors adapted to a colder climate (e.g. power stations cooled by river water) and the probable increase in extreme storms will increase the risk of damage.

Tourism

In Belgium, a moderate temperature increase is expected to have mostly positive impacts. Reduced river flow in summer should have a negative impact on river sports and associated activities. A further reduction in the amount of snow in winter and a possible increase in rainy or cloudy days will reduce the attraction of outdoor activities.

Cooperation on adaptation

The priorities of Belgian development cooperation in the environmental field include several aspects that contribute to adaptation to climate change, particularly for water supply and treatment. Aid focusing on reducing the vulnerability of underprivileged people, in particular in the fields of education, basic health care

and infrastructure, are also contributing to improve the adaptation capacity of populations. A trend towards better integration of climate change adaptation measures in cooperation programmes has been initiated in the framework of the Development Assistance Committee of the Organisation for Economic Cooperation and Development (DAC/OECD), in which Belgium is actively participating.

Assessment of vulnerability and further research

Vulnerability is the degree to which a system is capable of coping with the adverse effects of projected climate change. Vulnerability is thus a function of many factors, cumulating uncertainties from several sources. Knowledge of impacts in Belgium is still limited because very few impact studies are available and issues are generally covered incompletely. More thorough studies, including observation of ongoing changes, will be needed to have a clear picture of vulnerability in the country. These should account for all relevant climatic and non-climatic parameters and refer to a common set of regional climate change scenarios where required.

Currently available information suggests that ecosystems and forestry have some vulnerability even below a 3°C increase in the regional mean temperature (in summer, from end 20th to end 21st century). The coastal area, water resources, risks of flooding, and human health may also become causes for concern in this scenario, although this involves more uncertainty.

With a temperature increase of about 3°C and more, ecosystems and forests would likely face severe threats, while droughts and heat waves would be a serious concern in the fields of health and water availability (particularly in Flanders), and there may also be negative effects for agriculture and soils. Because sea-level rise is slow, the vulnerability of the coastal area should not be high during the 21st century, but very large and rapid cuts in emissions are needed to avoid a sea-level rise of several meters during the coming centuries.

Financial resources and technology transfer

The Law of 25 May 1999 on international cooperation is the reference for Belgium's development cooperation policy. The most important goal is sustainable human development, to be achieved by combating poverty on the basis of partnership and in compliance with the criteria on relevance to development, as defined by the Development Assistance Committee of the Organisation for Economic Cooperation and Development (DAC/OECD).

The law introduced the principle of geographical and sectoral concentration of aid. Belgium's direct bilateral ODA targets 18 countries, 13 of which are located in Africa. Ten of these countries belong to the group of Least Developed Countries (LDCs). Five sectors are given priority: i) basic health care; ii) education and training; iii) agriculture and food security; iv) basic infrastructure; and v) conflict prevention and the consolidation of society.

There has been an appreciable upturn in public funding of aid since 1999. In 2004, Belgium ranked ninth among DAC/OECD countries in terms of the percentage of GNI, with a ratio above the DAC average (0.25%) and almost equal to the average figure by country (0.42%). Belgium is therefore in line with the target the European Union Member States have set of devoting 0.33% of their GNI to ODA by 2006.

On the basis of statistics for the period 2001-2004, Belgian ODA specifically earmarked for environment protection amounted to € 82 million, while interventions for which environment was one of the main objectives represented € 162 million (i.e. 3.14% and 6.17% of total ODA respectively). For the time being, however, there are no indicators or specific markers available to identify contributions from development cooperation targeted at sustaining specific efforts in the field of climate change. It can only be assumed that actions to decrease the vulnerability of disfavoured populations, in the fields of education, health and basic infrastructure, contribute partly and implicitly to adaptation to climate change. A better integration of climate change in development cooperation programmes and strategies is a priority.

Since 2003, the Belgian contribution to the GEF has been substantially increased, to over € 10 million a year. Belgium is thus meeting its obligations deriving from international environmental treaties. Belgium also contributed € 273 371 to the core budget of the UN Framework Convention on Climate Change and the Kyoto Protocol in 2003. In 2004, the total amount of 212 234 EUR was divided between the federal level (30% for DGCD) and the regions and communities (70%).Technology transfer and capacity building are important aspects of bilateral and multilateral cooperation in the area of environment and climate change. Most activities in this field are conducted by multilateral and indirect capacity-building and technology-transfer actors.

Although it is difficult to estimate accurately the share of programmes and projects related to climate change, Belgian financial contributions related to technology transfer and capacity building amounted to € 22.2 million for the period 2002-2003 (of which € 5.6 million targeted for adaptation). Most activities relate to agriculture, water, energy and the environment. Sustainable agriculture and land management, integrated water management, environmental education projects, small renewable energy systems and sustainable electrification are a few examples of programmes and

projects related to climate change, which are supported by the Belgian authorities.

Most bilateral projects initiated by the federal agency in charge of development cooperation (DGDC) include training segments, either in the developing country itself, in Belgium or both. DGDC also supports international course programmes and international training programmes at Belgian universities. In April 2003, Belgium also organised a regional UNFCCC workshop on technology transfer (EGTT-meeting) in Ghent. The University of Ghent took this opportunity to organise five lectures on the different aspects of technology transfer under the UNFCCC and the Kyoto Protocol for a wide audience from the government and private sector.

Research and systematic observation

Science, technology and innovation are policy areas that come under the authority of all the federated and federal entities of Belgium. Cooperation and consultation between the federated entities is organised through the Interministerial Conference on Science Policy. Research activities cover the climate system and effects of climate change, socio-economic aspects as well as technological aspects (energy).

Belgian scientists participate actively in the following international research programmes:

- European Community Sixth Framework Programme for Research and Technological Development.
- International Geosphere and Biosphere Programme (IGBP)
- Land Use and Land-Cover Change (LUCC) programme
- 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)
- 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
- Network for the Detection of Stratospheric Change (NDSC)
- Energy Technology Systems Analysis Programme (ETSAP - IEA and OECD)
- Global Monitoring for Environment and Security (GMES)

Belgium contributes to international efforts in the field of scientific integration and assessment through the participation of Belgian experts in international panels and 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 Coordination Unit (EORCU).

Climate research at the federal level is primarily integrated into the Scientific Support Plan for Sustainable Development, SPSD I (1996-2000) and SPSD II (2000-2005), and will be pursued in the framework of the Science for Sustainable Development programme, which has a total budget of € 65.4 million for the period 2005-2009. A partnership agreement is in force between the federal and the federated authorities concerning the definition of research priorities under these programmes.

Different calls for proposals, covering periods of two or four years, are planned or have been prepared by interdisciplinary networks of two to five teams. Call 1 (mid-2005) concerned climate and atmospheric research projects. Research to support measures for greenhouse gas emission reduction in specific sectors such as energy, transport and land use, as well as studies on the biological, physical and chemical consequences of climate change on ecosystems and biodiversity will be addressed within the framework of call 2 (end 2005 – begin 2006).

At the federal level, remote sensing research programmes and activities also contribute greatly to climate related research.

The budget of the Walloon Region for research and development in the field of energy amounts to around € 10 million a year. It encompasses grants for research projects. Following the IEA classification, the major research areas are oriented towards renewable energy (45%) and energy savings (35%) followed by power and storage technologies (15%).

The Walloon Region regularly launches invitations to tender to enterprises and universities on specific research thematic priorities. The region participates in implementing International Energy Agency agreements.

Various studies are conducted in other sectors as well (agriculture, town and country planning, transport, etc.).

The Flemish innovation policy intends to extend and deepen scientific know-how and technological skills in order to strengthen Flanders' integrated innovation capacity and to achieve by 2010 a leading position in Europe's knowledge economy. This is being implemented through a system in which the Flemish government provides specific horizontal financing instruments that are open to all technological disciplines.

The Flemish R&D policy is based on three pillars:

- Supporting short- and medium-term research (RTD projects for industrial basic research activities, projects for industrial development activities and projects for strategic basic research of industrial relevance)
- Supporting medium-term and long-term research (strategic basic research projects with the perspective of creating industrial or societal value within 5 to 10 years)
- Providing venture capital (creation of high and medium technology spin-offs)

The Flemish government devotes considerable effort to stimulating international cooperation.

With respect to content, energy-related projects can be divided into three main categories:
- traditional energy-generation systems, transport and management (40%);
- new and/or renewable energy sources (34%);
- energy saving and rational use of energy (26%).

The Brussels-Capital Region supports research on, among other subjects, mobility, the environment and sustainable development. Several studies on the region's climate policy have been financed within the framework of its Air and Climate Plan. Research on development and implementation of the concept of eco-construction has also been conducted.

Although Belgium has no particular policy yet with respect to the GCOS, it takes part in various climate-related monitoring schemes, both nationally and within European programmes. These monitoring activities are not formally included in the GCOS, although a number of procedures are implemented to guarantee the continuity and long-term homogeneity of the data.

Education, training and public awareness

The climate change issue is an important preoccupation of the Belgian population and ranks high in public debate. In a survey conducted in 2005, 45% of Belgian respondents named climate change when asked to list the five items of greatest concern in a list of 15 environmental issues. Awareness of the link between the combustion of fossil fuels for energy generation and climate change phenomena is on the rise. However, in order to keep the general public informed, to ensure transparency of policy and to trigger the necessary behavioural changes, different governments in Belgium are continuing their efforts in the field of education, training and public awareness of climate change.

Responsibility for raising public awareness and providing information on the climate change issue is shared by all governmental levels in Belgium. Education policies, for example, are the responsibility of the three Communities. In formal primary and secondary education settings, the climate change issue is usually tackled transversally as part of larger environmental education (EE) or education for sustainable development (ESD) schemes. EE has become firmly rooted in the Belgian educational landscape and also comprises a wide range of initiatives outside the school context. ESD activities, both in schools and in a wider context, are being carried by a growing number of societal actors and will be amplified during the United Nations Decade of Education for Sustainable Development (2005-2014).

In addition to education, the climate change debate touches many different policy fields at different levels of government, such as energy, transport/mobility, waste, spatial planning, housing, etc. The aim of different governmental actors in these fields has been to develop strategies and activities capable of raising people's awareness about their own lifestyles and to stimulate behavioural changes where needed. Most of the initiatives concern the rational use of energy and the promotion of a modal shift in transport.

To get the message across to all Belgians, a wide range of tools and methods are used. Wide-scale campaigns and information resources (internet websites and information 'desks') target the public at large. For example, an 'energy saving day/month' and European Mobility Week activities are organized yearly throughout the country. These wide-scale initiatives are matched with more specific information efforts or practical, easy-to-implement solutions for specific target groups, such as young people, energy managers of enterprises or certain professionals (architects, teachers, heating installers, mobility managers, etc.). Some of the information tools and methods used in recent years include press releases, magazines, dissemination of brochures, exhibitions and information fairs, marketing events, animations and games, training packs, energy audits, workshops, software, label awards, etc. Many of these initiatives involve collaboration between government, non-governmental organizations, community-based projects and the private sector.

In short, the need for a sustained effort to provide information on climate change is recognized and many different actors are contributing to the effort. The global objective is to give the general public access to information about climate change and to encourage everyone to modify her or his behaviour to ensure more rational use of energy. ■

2. National circumstances relevant to greenhouse gas emissions and removals

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A brief overview of Belgium [1]

Population (on 1 January 2004):	10 396 421 inhabitants
Surface area:	32 528 km^2
Federal capital:	Brussels
Head of State:	HM King Albert II
Prime Minister:	Guy Verhofstadt
National languages:	French, Dutch and German
Currency:	Euro (€)
GDP 2004 (current prices):	€ 283.472 billion
Annual GDP growth (constant prices 1995):	2.9% (2004)
Active population by sector (thousands of persons, 2004): agriculture: industry: services:	 96.3 856.6 3 214
Population density:	341 inhabitants per km^2 (2004)
Highest point:	Signal de Botrange (694 m)
Average temperature (Uccle, 2000-2004):	11.0º Celsius
Precipitation (Uccle, 2000-2004):	921 mm
Hours of sunshine (Uccle, 2000-2004):	1 570

Institutional structure

Federal structure of the state

Belgium is a federal state composed of communities and regions[3]. After becoming independent in 1830, Belgium gradually evolved from a unitary to a federal structure. Five successive constitutional reforms (in 1970, 1980, 1988-89, 1993 and 2001) have resulted in the present-day governing structure [2].

The division of powers under the successive reforms evolved on the basis of two main criteria. The first is language, and more broadly, culture, which gave rise to the communities. The concept of 'community' refers to the people that make it up and the ties which unite them, namely language and culture. Belgium has three official languages: French, Dutch and German. Current-day Belgium is therefore composed of three Communities: the Flemish Community, the French Community and the German-speaking Community. They correspond to population groupings. The French Community exercises its authority in the Walloon provinces, with the exception of the German-speaking municipalities, and in Brussels; the Flemish Community exercises its authority in the Flemish provinces and in Brussels; the German-speaking Community exercises its authority in the municipalities of the German-speaking region, all of which are situated in the Province of Liege (Figure 2.1).

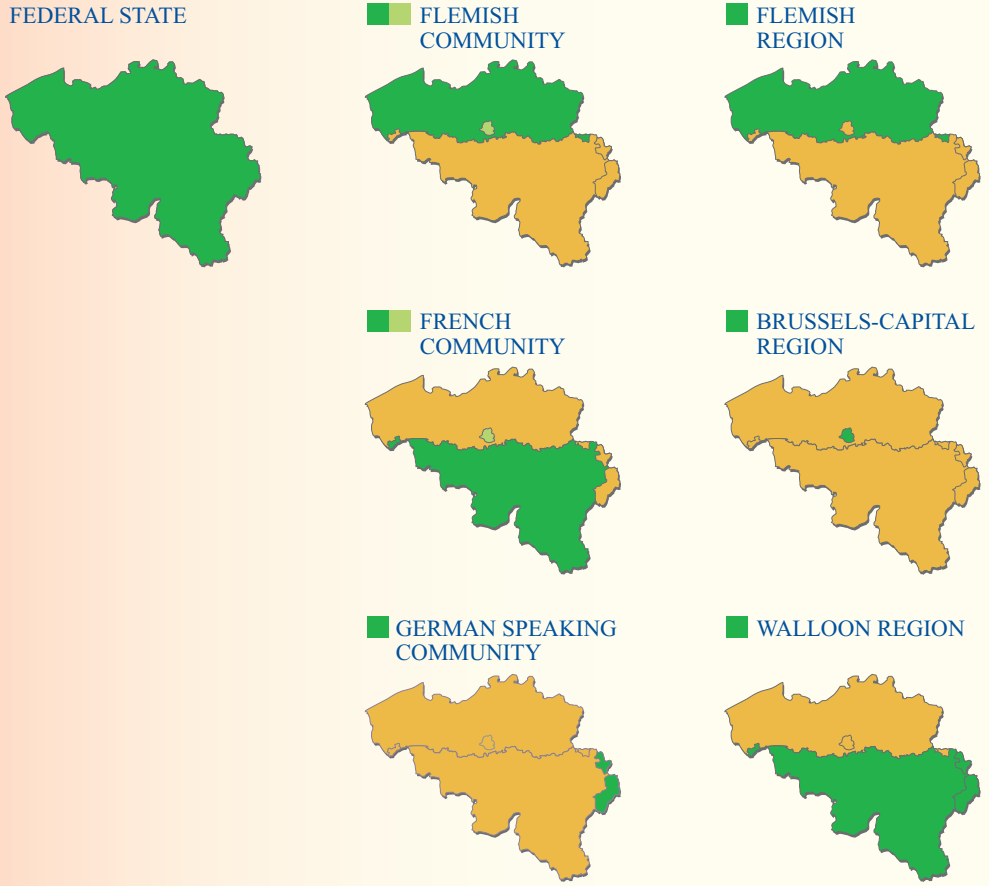
The second main thrust of the constitutional reform is rooted in history and in particular the aspiration of some for greater economic autonomy. The creation of three regions is the result of those aspirations. The three regional institutions are named after their territories, i.e. from North to South, the Flemish Region, the Brussels-Capital Region and the Walloon Region (Figure 2.1). Their powers have expanded during the different phases of the reform. Currently, each of the three regions has legislative and executive bodies: the regional council and the regional government. In Flanders, the community and regional institutions have merged, so there is only one Flemish council and one Flemish government.

The constitutional reform has thus created a three-tiered system. The upper tier comprises the federal state, the communities and the regions, all equal under law. They intervene on an equal footing but in different areas.

The middle tier comprises the 10 provinces. They act within the framework of the federal, community or regional powers and are subordinate to all higher authorities.

The bottom tier of the edifice comprises the municipalities (589 in all), which are the level of power closest to the citizen. Like the provinces, they too are subordinate to the higher authorities. Depending

Figure 2.1. Belgium, a federal state



Source : FPS Chancery of the Prime Minister

[3] Article 1 of the Belgian Constitution

on the area of power being exercised, they are therefore accountable to either the federal government, the community or the region. They are financed and controlled primarily by the regions.

Division of powers

The federal government is responsible for key policies such as foreign affairs, defence, justice, finance, social security and an important part of public health matters and internal affairs. The communities and the regions are nonetheless responsible for establishing foreign relations for matters under their authority.

The powers of the communities concern matters related to 'persons': culture (theatre, libraries, audiovisual, etc.), education, use of languages and matters that can be 'personalised', including health policy (preventive and curative medicine) and assistance to individuals (child protection, social assistance, family assistance, reception of immigrants, etc.). The communities are also responsible for scientific research and international relations in the areas under their authority.

The regions have powers in areas related to occupation of the 'territory' in the broad sense. The Flemish Region, the Brussels-Capital Region and the Walloon Region are thus responsible for the economy, employment, agriculture, water policy, housing, public works, energy, transport (with the exception of the national railway, SNCB), the environment, town and country planning, rural revitalisation, nature conservation, credit, foreign trade, and provincial, municipal and intermunicipal administration. They are responsible for research and international relations in the above-mentioned areas.

Coordination structures relating to climate policy

The Interministerial Conference for the Environment and the Coordination Committee for International Environment Policy

Given Belgium's federal structure and the division of powers, several structures have been created to promote consultation and cooperation between the different levels of power and to ensure consistency in the action of the federal state and its entities. Sixteen interministerial conferences, each related to a particular policy area, have been created. The interministerial conferences are specialised committees whose members are the ministers concerned from the different governments.

One of these bodies, the Interministerial Conference for the Environment (ICE), is made up of the Federal Minister for the Environment, the Environment Ministers of each of the three regions (Brussels-Capital, Flanders and Wallonia) and the Federal Minister for Science Policy. Depending on the matter being addressed, and given the transversal nature of many environmental issues, this conference can be enlarged to include other ministers concerned. The ICE focuses on matters for which intergovernmental cooperation is required to implement environment policies. It plays a key role in climate policy. The decisions of the ICE are prepared and implemented by different working groups, which are answerable to the Coordination Committee for International Environment Policy (CCIEP), comprised of representatives of the different departments of the Federal and Regional public administrations concerned.

The CCIEP is the main body responsible for coordinating international environment policy, with the exception of matters related to European environment policy, which is the responsibility of the Directorate-General Coordination and European Affairs (DGE) of the Federal Public Service Foreign Affairs, External Trade and Development Cooperation. DGE plays a pivotal role, providing coordination for follow-up of Belgium's European policy, and consulting and collaborating with the partners of the federal and federated entities. It approves Belgium's positions for meetings of the Council of the European Union. The ICE and the CCIEP operate on the principle of consensus, which rules out unilateral decisions.

The principal CCIEP working group dealing with climate policy is the Greenhouse Effect Coordination Group. It is made up of representatives of all the federal and regional administrations and policy units as well as the federal and regional cabinets concerned with Belgian and international climate policy. This group's main task is to participate, by providing coordination for Belgium, in the development of strategy papers, decisions, recommendations, legislation and other European and multilateral regulations on climate change or on policy in the broad sense when climate change is one of the subjects addressed. The Greenhouse Effect Coordination Group also maintains contacts with other relevant Belgian policy and consultation bodies. It organises consultation with stakeholders on the above-mentioned subjects. The Coordination Group secretariat is provided by the Climate Change Department of the Federal DG Environment, which also serves as the National Focal Point for the UNFCCC.

The CCIEP Emissions Working Group is charged with preparing the national inventories of atmospheric pollutant and greenhouse gas emissions, in accordance with European and international reporting obligations. Methodology related to estimating historical emissions, including the harmonisation of the methodologies used by the three regions, is handled by this group, which also contributes to emission inventories and reporting at European and multilateral level. The CCIEP Emissions Working Group contributes to efforts to implement obligations relating to inventories of atmospheric pollutant and greenhouse gas emissions.

The National Climate Commission

Established by the Cooperation Agreement of 14 November 2002 between the federal level and the three regions, the National Climate Commission, which was put into place at the end of 2003, is responsible for a number of tasks related to national implementation of climate policy. Its central responsibilities are implementation and follow-up of the National Climate Plan, follow-up and adaptation of the Plan's policies and measures, and the preparation of compulsory reports. The National Climate Commission can also advise the CCIEP on international policy on climate change and greenhouse gas emissions. It is made up of four representatives of each of the Contracting Parties, appointed by their governments.

It is assisted by a permanent secretariat and thematic working groups which are mandated by the National Climate Commission to address different issues. Working groups have been set up to:

- provide monitoring of the policies and measures contained in the National Climate Plan;
- harmonise the energy audits developed by the regional and federal authorities;
- prepare the Fourth National Communication and Report on Demonstrable Progress;
- draw up a cooperation agreement for the establishment of the national registry, in application of European Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community;
- develop a cooperation agreement for the implementation of flexible mechanisms;
- harmonise GHG emission projections drawn up by the federal government and the three regions.

Flanders Climate Policy Task Force

In Flanders, the Flanders Climate Policy Task Force (established on 20/04/2001) is the consultation platform on climate policy involving the various levels of government. This Task Force covers all climate-relevant policy areas and is primarily responsible for drawing up, implementing and monitoring the Flemish climate policy plan. The 2002-2005 Flemish climate policy plan was approved in 2003 and evaluated in 2 progress reports. The 2006-2012 Flemish climate policy plan is in the midst of being drawn up and is accompanied by an extensive social consultation process. The Task Force also ensures the preparation of the Flemish policy standpoint concerning the national and international climate policy. A number of working groups reporting to the Task Force are examining specific technical dossiers, such as the working group on 'emissions and forecasts', 'allocation plan', 'flexibility mechanisms' and 'post-2012'.

Kyoto Platform in the Brussels-Capital Region

In 2005, the government of the Brussels-Capital Region decided to create a Kyoto Platform made up of representatives of the entire regional government, with the goal of improving implementation and follow-up of the region's Air and Climate Plans.

Population profile

Distribution of the population

Belgium is presently one of the most densely populated countries in Europe, with average density (2004) of 341 inhabitants/km² (third highest in Europe). This density varies considerably from one part of the country to another, however. The highest densities are found in a central triangle formed by Antwerp, Brussels and Ghent. The Brussels-Capital Region has a density of 5 975 inhabitants/km². High population densities are also found in other areas, particularly in the coastal region and along an axis that passes through Wallonia from Mons to Liege. Inversely, a large part of the south of the country does not exceed 50 inhabitants/km². The Province of Luxembourg is the least densely populated.

Belgian territory is highly urbanised with 135 towns, the largest of which are Brussels (999 899 inhabitants), Antwerp (455 148), Ghent (229 344), Charleroi (200 608) and Liege (185 488). The eight biggest towns in the country make up 25% of the population. The major demographic process at work is the redistribution of urban populations in the new suburbs of cities or even in rural regions. Currently, the Flemish Region makes up 57.9% of the population, the Walloon Region 32.5% and the Brussels-Capital Region 9.6% (Table 2.1). Fertility is currently lower in Flanders than in Wallonia.

Growth and composition of the population

The Belgian population is growing yearly at the rate of 0.4% (Table 2.1). This growth, which is more sustained in the Brussels Region (1%) than in Flanders or Wallonia (0.3%), results in particular from immigration (nearly 10% of the population is of foreign origin). The declining birth rate, a decrease in the balance of immigration, marked improvement in medical treatments and a more selective immigration policy have gradually led to a reduction in natural growth and the ageing of the population (Figure 2.2). Foreigners, nearly two thirds of whom are from European Union countries, reside primarily in Brussels (nearly 30% of the population of Brussels-Capital), and in the industrial regions of the Sambre and Meuse valleys, Belgian Lorraine, the mining regions of Limburg and in border regions.

Geographic and climate profile

Geographic situation and relief

Belgium is a small country (surface area of 30 528 km²) in north-west Europe. It has 1 444 km of borders with the Netherlands, Germany, Luxembourg, France and the North Sea (its coastline is 65 km long). The Walloon Region occupies the biggest part of the territory (55%), followed by the Flemish Region (44%) and the Brussels-Capital Region (0.5%). Belgium has three zones of elevation, oriented east-west and south-west: the coastal plain, the central plateau and the uplands. The highest points of the uplands constitute a ridge peaking at 694 metres at the 'Signal de Botrange'.

Climate

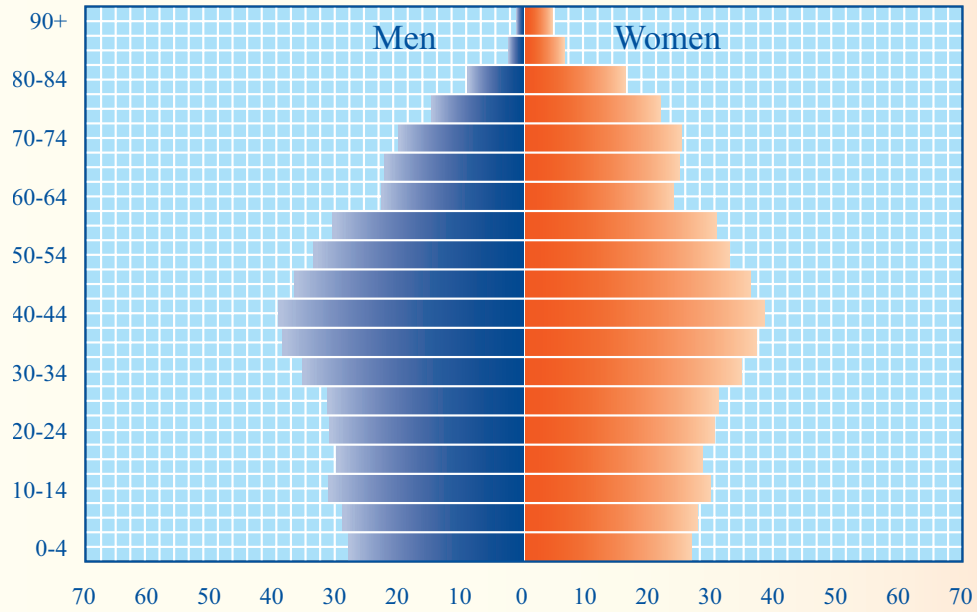
Its latitude and the proximity of the sea warmed by the Gulf Stream give Belgium a temperate maritime climate character-

Table 2.1. Population on 1 January 2005 and yearly evolution

	Population	Annual change (2000-2005)
Belgium	10 445 852	0.4%
Flemish Region	6 043 161	0.3%
Walloon Region	3 395 942	0.3%
Brussels-Capital Region	1 006 749	1.0%

Source: FPS Economy - NIS, Demographic statistics

Figure 2.2. Structure of the population on 1 January 2004 (by five-year age categories, for 1,000 inhabitants)



Source: FPS Economy - NIS, Demographic statistics

ised by moderate temperatures, prevailing westerly winds, abundant cloud cover and frequent precipitation. Inland, the months of July and August are the rainiest, while on the coast the autumn months have the highest precipitation levels. The widest temperature range in the course of the year occurs in Belgian Lorraine, in the southern, most continental part of the country, and in Campine, owing to the type of soil [3].

Wind

Winds are predominantly southerly to westerly across the entire country. Average speeds are relatively uniform for the entire territory, except on the coast where they are higher. Storms can occur throughout the country between November and March, but are often most violent along the coast.

Temperature

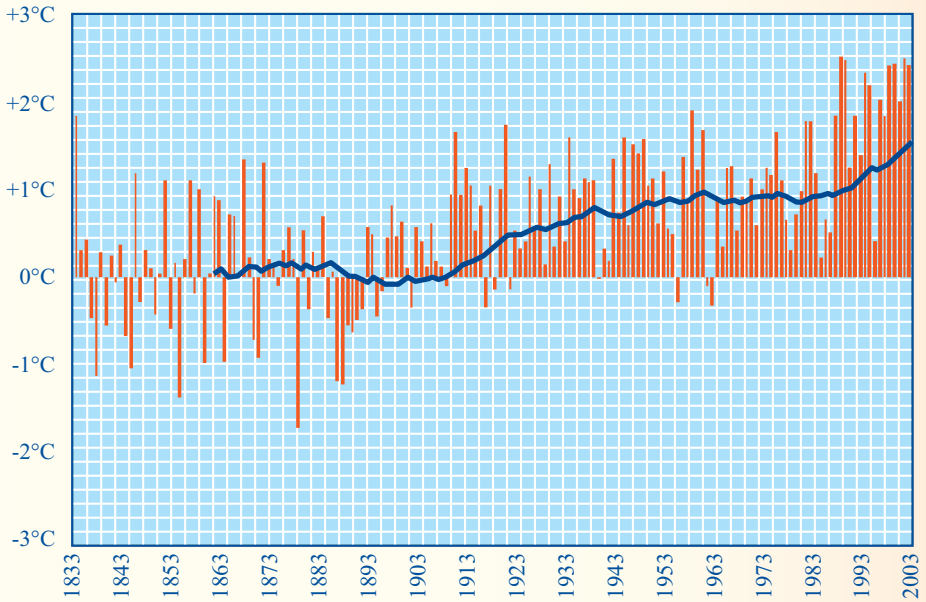
In spite of its small surface area, Belgium presents temperature variations according to its geographic zones. The primary factor responsible for variations is the distance from the sea. The climate is the most continental in the south-east, in Belgian Lorraine, and is characterised by a greater temperature range between summer and winter. The second factor is elevation, from the coast to the Ardennes. The highest regions have colder average temperatures than the lower-lying lands. The diversity of the relief also gives rise to local differences between the plains and valleys. The different types of soil can also explain regional differences in extreme temperatures. The

Table 2.2. Meteorological data: normal values (1961-1990) and averages for the last five years (2000-2004) (readings taken at Uccle, in the centre of the country)

	Normal values	Average 2000-2004
Sunshine (hours)	1 555	1 570
Average real temperature (0-24h) (°C)	9.8	11.0
Average maximum temperature (°C)	13.5	14.6
Average minimum temperature (°C)	6.3	7.3
Total precipitation (mm)	780	812
Number of days of precipitation (rain >= 0.1 mm)	203	195
Number of days of frost (min < 0°C)	52.6	41.2
Number of days of winter (max < 0°C)	9.9	3.6
Number of days of summer (max >= 25°C)	21.3	26.2
Number of days of heat wave (max >= 30°C)	3.3	4.2

Source: Royal Meteorological Institute of Belgium.

Figure 2.3. Evolution of the average annual temperature at Uccle (1833-2003) – Differences with conditions in the mid-19th century (1833-1862) (in red: moving average over the last 30 years)



Source: NIS calculations based on data from the Royal Meteorological Institute of Belgium

range of temperatures between the north and south of Belgium is not large in summer. During the winter months, however, the contrast is slightly more pronounced between the coastal region and the Ardennes, the latter combining the effects of altitude and an inland situation.

The average annual temperature for the 20th century, with readings taken at Uccle, has evolved in an ascending curve in parallel with global warming (Figure 2.3). This evolution is characterised by an abrupt initial warming during the first half of the 20th century, followed by a second from the 1980s. The average temperature for the period 2000-2004 is 1.2°C above the normal value for the period 1961-1990. It is also remarkable that the 11 warmest years since meteorological readings began being recorded at Uccle have all occurred since 1989.

Precipitation

In the north of the country, precipitation increases from west to east, up to the Scheldt estuary. The region with the highest elevation, in the east of Belgium, has the highest precipitation levels. The Hautes Fagnes region has an annual average of 1 400 mm of precipitation, while the centre and north of the country receive from 700 to 900 mm. It rains an average of 220 days a year in the highest points of the Ardennes, compared to 180 to 200 days in the rest of the country. The characteristics of snowfall in Belgium depend first and foremost on the altitude of the location, but also on the trajectories of air masses.

Hydrography

The abundant precipitation occurring throughout the year in Belgium and the presence of often impermeable soil have favoured the creation of an important network of waterways. Along with an abundant groundwater supply, these provide the national territory with an important quantity of drinking and industrial water, especially in Wallonia.

Two large rivers, the Scheldt and the Meuse, occupy a major place in the Belgian waterway system. They drain most of the territory although neither river has its source or mouth in Belgium. The basin of the Yser, the third biggest Belgian river, is almost entirely coastal. Small parts of Belgian territory form part of other hydrographic basins, namely the Rhine and the Seine basins. In the north-west, the North Sea borders the Belgian coast along more than 65 km.

Maritime Flanders is made up of a coastal region, composed of a narrow strip of beaches and dunes, behind which lie the polders. This strip of extremely fertile clayey soil some 15 km wide that follows the coastline extends along the lower Scheldt up to Antwerp and has been reclaimed from the sea and the estuaries through drainage. This zone is protected by dykes and is criss-crossed by drainage canals.

Ecosystems

In spite of the small size of the country and its slight topographical gradient, the climate and geological conditions have generated several types of ecosystems: Atlantic (dunes, heaths, marshes, peat bogs, prairies, deciduous forests), southern (calcareous prairies, groves, forests) and northern (peat bogs, pine forests). Belgian flora, which is typical of temperate zones, is characterised by forests of broad-leaved trees and conifers, and vegetation of prairies and heaths. At present, only 20% of the territory is still wooded. Forests remain in regions where the soil is the least suited to farming and grazing, primarily in the south of the country. The flora has undergone significant modification, with certain species growing scarce or disappearing. The main causes are the abandonment of traditional farming practices, the intensification of agriculture, the increase in built-up areas and roads, the fight against floods, the regulation and pollution of waterways, and atmospheric pollution.

Table 2.3. Land use – relative figures (% of total surface area, 2005) and evolution (1990-2005)

	%	Evolution 1990-2006
Total agricultural land[1]	57.1%	-4.7%
Forest and woodlands	19.9%	-0.6%
Built-up and related areas[2]	19.2%	17.8%
Miscellaneous[3]	3.0%	1.4%
Water[4]	0.8%	0.0%

1. including idle land
2. except for scattered farm buildings
3. fens, heaths, marshes, waste ground, rocks, beaches, dunes
4. OECD estimate

Sources: NIS and FPS Finance (land register). NIS calculations based on OECD/Eurostat definitions

Belgian fauna is typical of temperate Europe. The most common small species include weasel, ferret, hare, rabbit, hedgehog, fox and squirrel. The forests are home to wild boar, roe deer and deer. Wild birds, including falcons, finches, nightingales, owls, pigeons, sparrows and thrushes make up a large part of the animal population. Fish found off the Belgian coast include cod, mackerel, herring and flat fishes (skate and ray, sole, plaice and dab). They are very important commercially because they are caught at sea for their flesh.

Land use and communications

Agricultural land occupies the largest part of the national territory (Table 2.3). Its total area has declined since 1990 (-4.7%), while built-up areas grew nearly 18% during the same period. Forests occupy nearly 20% of the national territory, down slightly from 1990 (-0.6%). Belgian territory is also criss-crossed by a dense communications network (Table 2.4).

Belgium has the densest rail network in the European Union and the second densest road network. Per thousand km^2, it has three times as many motorways and more than twice as many rail lines as the European Union average. Between 1990 and 1999, the length of the motorway network increased 3.1%, while that of the rail network slipped 2%.

Table 2.4. The communications network (1999)

	Length (km)	Evolution 1999/1990	Density (km for 1 000 km^2)
Roads	146 482		4 798.3
of which motorways	1 682	3.10%	55.1
Railways	3 410	-2.00%	111.7
Navigable waterways	1 532		50.2

Sources: NIS & FPS Mobility and Transport

Economic profile

Generalities

Until the middle of the 19th century, the Belgian economy was dominated by agriculture, but the country was quickly influenced by the industrial revolution that began in England. The construction of the railway contributed largely to that process, as did the presence of coal, which facilitated the development of heavy industry (especially in the south of the country).

Today, the weight of the manufacturing industries in the Belgian economy has diminished: over the last 30 years, the industrial sector has been surpassed in large measure by services, which currently make up more than 60% of the added value of the different branches of economic activity. The employment market has followed the same trend. In 1970, the industry and services sectors offered approximately the same number of jobs. In 2003, services employed nearly three times as many persons as industry.

Belgium is a very open economy situated at the heart of a zone of intense economic activity. In addition, the port of Antwerp ranks second in Europe (after Rotterdam) and is one of the world's top 10. Exports of goods and services represented 81.5% of GDP in 2003 and imports nearly 78%. Although the share of services in trade is growing fast, around 70% of Belgian exports and imports are goods. This trade occurs in large measure with the European market. Half of Belgium's exports are sold to Germany, France and the Netherlands, and one fourth to other EU Member States. Imports follow more or less the same proportions. This situation reflects Belgium's role as the hub of the European Union.

Belgium also benefits from the presence of the European Commission in its capital, along with a high concentration of international agencies and service companies. Other international organisations, such as NATO, are also headquartered in Belgium.

Switch to the euro

On 1 January 2002, the euro replaced the Belgian franc. The switch to the euro involved a brief transitional period (two months) during which euro coins and notes were placed in circulation alongside the still circulating franc. The Belgian franc was then abolished as legal tender on 1 March 2002. It is still possible to exchange bank notes at the Belgian National Bank, with no time limitations. The switch to the euro, which was simultaneous in 12 European Union countries (Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland), marked a crucial and highly symbolic step forward in European integration and strengthened the trade dynamic. Monetary unification helped step up the mobility of labour and capital.

Recent developments

Under the impetus of the international economic situation, the Belgian economy registered relatively sustained growth (2.9%) in 2004 (Table 2.5). This followed three consecutive years of sluggish GDP growth (less than 1% in 2001 and 2002, and 1.3% in 2003) due to the international downturn, which considerably slowed Belgian exports [4]. The gradual upturn in industrial trade in Europe has nonetheless been beneficial to Belgium's main export markets. For the third consecutive year, Belgium has registered growth equal to (2002) or above (2003 and 2004) average euro zone growth. GDP at current prices in 2004 amounted to € 283.472 billion, or per capita GDP 18.5% above the EU average (25 countries).

This growth was driven by both internal demand and exports. The listless labour market put a damper on spending by households, which remained relatively low. During the period 2001-2004, the strongest growth occurred in commercial services (2.0% on an annual basis, cf. Table 2.6), which are becoming increasingly important in the Belgian economy (55% of GDP in 2003, cf. Figure 2.4), continuing a trend that began decades ago.

In the past decade, Belgium has registered average real economic growth of 2.22%. During the same period, prices have risen only moderately, with average inflation of 1.80%. Since 1985, the country has had a surplus current account. In 2003, the surplus amounted to 4.4% of GDP, one of the highest levels in the EU. Results are less positive, however, for public finances. The debt remains high in relation to GDP (95.6% in 2004) in spite of an ongoing decline since 1995 (when debt still amounted to 134% of GDP).

The structure of employment in Belgium has changed profoundly over the last 30 years (Table 2.7). The number of persons employed in agriculture dropped 42% between 1973 and 2004. Employment in industry also plummeted (- 42% likewise), while employment in services increased by 62%. Unemployment in Belgium stood at 7.8%[4] in 2004.

[4] Eurostat definition

Table 2.5. GDP growth at constant prices (1995) - Variation (%) from previous year

	2000	2001	2002	2003	2004
OECD[1]	3.9	1.1	1.6	2.1	3.4
European Union (25)[2]	3.7	1.8	1.1	1.1	2.4
Euro zone[2]	3.6	1.8	0.9	0.7	2.1
Belgium[2]	3.9	0.7	0.9	1.3	2.9

1. Source: OECD Economic Outlook 77 database [5]
2. Source: Eurostat

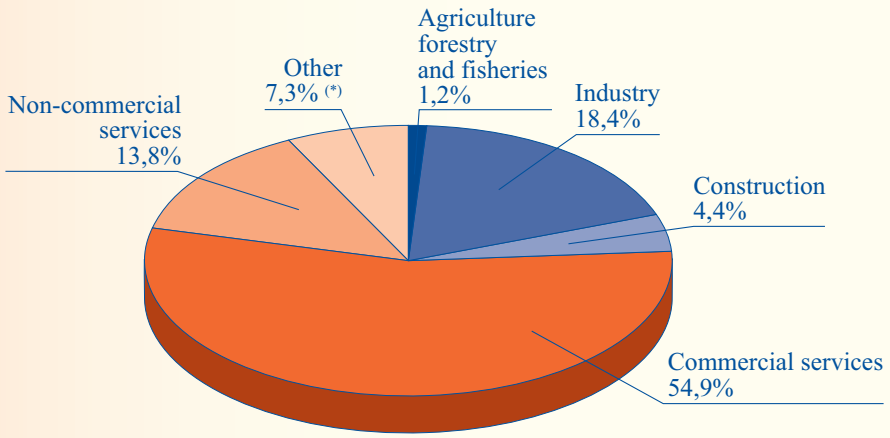
Table 2.6. GDP and gross added value by branch at 2000 prices (average % variations on an annual basis)

	1995-2000	2001-2004
Gross domestic product (total)	2.7	1.5
Agriculture, forestry and fisheries	2.4	1.0
Industry	3.2	0.4
Construction	2.2	1.1
Commercial services	2.6	2.0
Non-commercial services	1.3	1.2[a]

a. 2001-2003 average

Source: BNB (Belgian Central Bank)

Figure 2.4. Elements of GDP (2003)



* Financial intermediary services measured indirectly and net taxes on products

Source: BNB (National Bank of Belgium)

Table 2.7. Evolution of employment by sector (thousands of persons)

	1973	2000	2004
Agriculture	165.9	100.7	96.3
Industry	1488.0	916.3	856.6
Commercial services	1450.9	2241.3	2348.4
Non-commercial services	658.5	829.7	865.6

Source: NIS

Energy profile

Primary consumption

Belgium has limited energy resources and is consequently highly dependent on other countries for supply, particularly since the end of the coalmining era (the last mine was shut down in 1992). Belgian energy policy is therefore guided by the diversification of both sources of supply and suppliers. Along with petroleum imports, the country has considerably expanded the use of natural gas. The government has also programmed the withdrawal from nuclear energy and is working to step up the use of renewable energy sources.

Primary energy consumption rose an average of 0.2% a year during the period 1998-2003 (Table 2.8). There are nevertheless marked differences from one source to the next within this general increase: the most spectacular rises occurred in imports of electricity (increase of 24.7% a year in the electricity import balance) and renewable energy (+9.1% a year); the share of natural gas also expanded (+2.4% a year)

Table 2.8. Evolution of primary energy consumption

Gross apparent consumption in 2003, ktoe (NCV), and average annual growth rate in % calculated for the period 1998-2003

	2003	Evolution 1998-2003 (annual %)
Solid fuels	6 210	-5.2%
Petroleum, petroleum products	24 153	+0.1%
Natural gas	14 441	+2.4%
Renewable fuels	631	+9.1%
Nuclear energy	12 345	+0.4%
Other (primary electricity)	580	+24.7%
TOTAL	**58 361**	**+0.2%**

Source: FPS Economy, SMEs, Self-employed and Energy

due to higher demand by power plants and the residential and tertiary sectors. Coal declined sharply (-45.2% a year), representing only 10.6% of primary energy in 2003 (Figure 2.5), in particular due to declining demand by certain sectors (coking plants and power stations). Consumption of petroleum and of nuclear energy remained relative stable. The overall rate of dependence (ratio of net imports to gross internal consumption of primary energy) was 89.6% in 2003. The relative rate of dependence on petroleum and petroleum products, which had slipped below the 50% mark in 1999 and 2000, moved back over that level in 2003, to 53.8%. Primary energy intensity (the ratio of primary energy consumption to GDP) has been falling steadily since 1996, but rose slightly in 2003 compared to 2002, marking a break with the long-term trend. In spite of this relative drop in 2003, the trend is towards an uncoupling of economic growth and primary energy consumption.

Final consumption

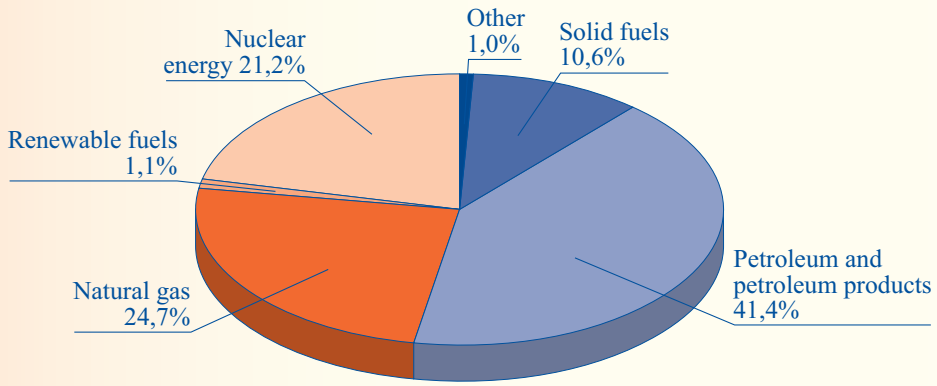
In Belgium, buildings (residential and tertiary) are the number one final consumer of primary energy (35%), followed by industry (30%, of which one third for iron and steel) and transport (24%). Non-energy uses, which are an activity indicator for the petrochemical industry (naphtha,

Table 2.9. Final energy consumption (2003, ktoe (ncv), and average annual growth rate in % calculated for the period 1998-2003)

Total final consumption by sector	2003	Evolution 1998-2003 (yearly %)
Iron and steel	4 116	-2.2%
Other industries	8 592	1.3%
Transport	10 194	1.2%
Residential and equivalent	15 047	0.7%
Non-energy uses	5 040	0.3%
TOTAL	**42 989**	**0.6%**

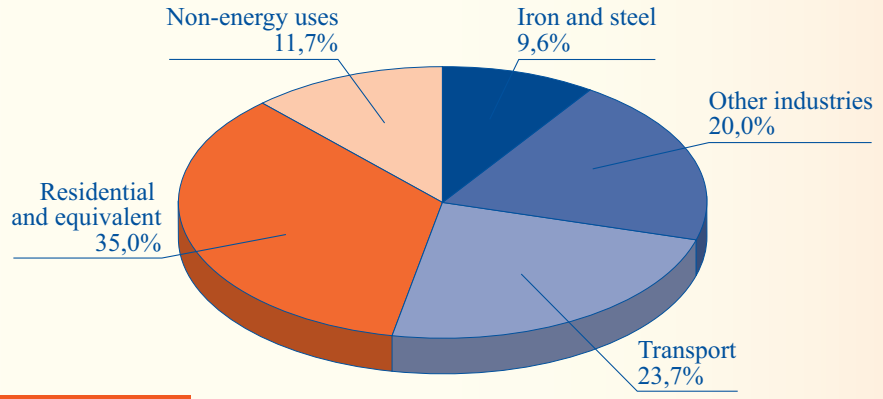
Source: FPS Economy, SMEs, Self-employed and Energy

Figure 2.5. Primary energy consumption – market share as % of total (2003)



Source: FPS Economy, SMEs, Self-employed and Energy

Figure 2.6. Total final consumption by sector (2003)



Source: FPS Economy, SMEs, Self-employed and Energy

natural gas), also register high consumption levels (Figure 2.6). On the whole, final consumption of energy rose at an annual rate of 0.6% (Table 2.9) between 1998 and 2003. The increase was particularly pronounced in transport and industries (other than iron and steel). Final consumption by the iron and steel industry continued to fall, in keeping with a trend that began in 1979 (-33%).

In terms of market share of total final consumption, petroleum remains the dominant energy (51% in 2003), followed by gas (26%), electricity (16%), solid fuels (6%) and heat (1.1%). In the industrial sector, petroleum (11.3%) is now well surpassed by natural gas (39.7%), electricity (27.0%), solid fuels (18.8%) and heat (3.2%). In the residential sector, petroleum had the highest market share in 2003 (41.5%), followed by natural gas (35.1%), electricity (21.8%), solid fuels (1.2%) and heat (0.4%). Petroleum, which still has a preponderant share of the country's total final consumption, primarily covers the needs of the transport and residential sectors, as well as non-energy uses (feedstocks). Electricity and natural gas, on the other hand, play a major role in industry and the residential sector, while the use of solid fuels is basically limited to the iron and steel industry.

Liberalisation of the electricity and gas markets

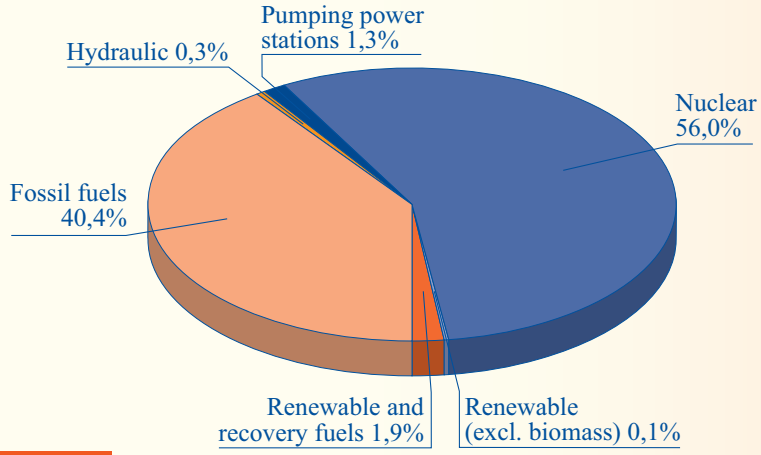
The opening up of European electricity and gas markets is regulated by Directives 2003/54/EC and 2003/55/EC. Implementation at federal level of these Directives, transposed into Belgian legislation, has necessitated the adoption of important regulatory provisions with a view to the organisation of the Belgian electricity and gas markets: authorisations for electricity generating installations and direct lines, provisions governing management of the electricity transmission grid, authorisations for the supply of natural gas, measures organising consumers' eligibility, definition of public service obligations, authorisation scheme applying to intermediaries operating in the electricity sector, authorisation system relating to gas transmission installations, etc.

Table 2.10. Electricity generation: structure (2003) and evolution
(average annual growth rate as % calculated for the period 1998-2003)

	2003 (GWh)	Evolution 1998-2003 (yearly %)
PRIMARY PRODUCTION	84 615	0.3%
Nuclear	47 379	0.5%
Hydraulic	246	-8.8%
Pumping power stations	1 068	-0.7%
Geothermal, solar, wind, etc.	89	51.9%
Renewable and recovery fuels	1 609	-
Fossil fuels	34 224	-0.8%
IMPORTS	14 664	13.4%
EXPORTS	8 254	5.1%

Source: FPS Economy, SMEs, Self-employed and Energy

Figure 2.7. Structure of gross electricity generation (2003).



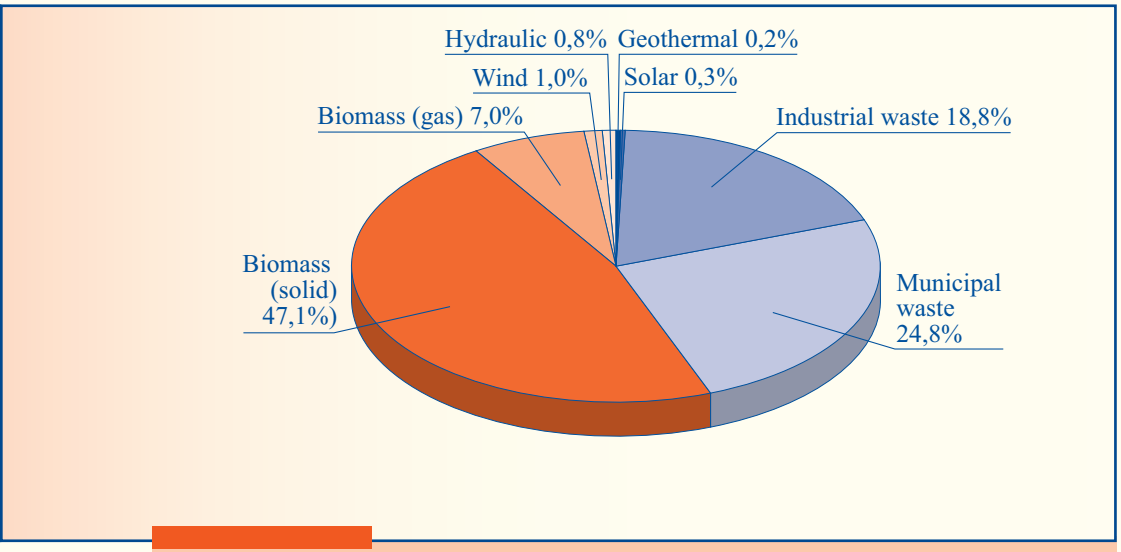
Source: FPS Economy, SMEs, Self-employed and Energy

Regional measures have also been adopted to ensure the full transposition into Belgian law of the above-mentioned Directives. In the context of the liberalisation of the European gas and electricity market, market opening is set to reach 59% in Belgium in 2003 and 90% in 2007.

Electricity market

In 2003, total primary electricity generation amounted to 84615 GW. It rose by an average of 0.3% a year during the period 1998-2003 (Table 2.10). In 2003, nuclear plants made up 56.0% of this total (Figure 2.7). Classic thermal plants generated 40.4% of electricity (solid fuels 11.4%, gaseous fuels 27.9%, of which natural gas 25.5%, liquid fuels 1.2%). The remaining 3.6% was generated by pumping power stations (1.3%), hydraulic energy (0.3%), wind (0.1%) and renewable/recovery fuels connected to the electricity system (1.9%). The share of liquid fuels in electricity generation has been dropping for a number of years. From 52.7% in 1971, it had slipped to a mere 1.2% in 2003. Final electricity consumption increased at an annual rate of 1.5% during this same period. Consumption by the industrial sector (50.2%) is roughly equal to that of the residential and tertiary sectors (48%). The remaining 1.9% is consumed by transport.

Figure 2.8. Contribution of different sources to primary generation of renewable energy (2003)



Source: IEA – Renewables Information (2005 Edition)

Renewable energy

The main renewable energy sources used in Belgium are biomass and renewable recovery fuels (Figure 2.8). Renewable energy still represents only a small share of primary energy generation in Belgium (less than 1% for the period 1990-2000, 1.5% in 2004) [6]. This situation is related to a number of factors, including the relatively low potential of this type of energy in Belgium. The small territory and the limited availability of hydraulic, geothermal and, to a lesser extent, solar resources, are obstacles to the development of renewable energy in Belgium.

The public authorities are nonetheless endeavouring to promote the development of renewable energy as a response to the issues of security of energy supplies and polluting emissions, and with a view to enhancing the value of local resources and creating jobs. In time, renewable energy is expected to constitute a substantial share of primary energy generation. Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources establishes an indicative target of 6% of electricity from renewable sources in gross electricity consumption, to be attained by 2010. Various wind energy projects in particular are being implemented.

In 2003, renewable energy (hydraulic, wind, biomass and recovery fuels) represented 2.3% of primary electricity generation (of which 77% biomass and 17% hydro-electricity) [7]. Electricity generation from renewable sources represents around 15% of total renewable energy output. In the Walloon Region, 2.6% of electricity generation is derived from renewable sources; the region's capacity reached 306 MW in 2004. These figures are continually evolving. Wind electricity generation is being developed to an ever larger extent. In the Flemish Region, electricity generation from renewable sources has grown exponentially since 1997 (reaching 2% of total output in 2004) [8].

Transport

General description

Belgium, densely populated and situated at the centre of Europe, is an important centre of transit. The country's economic activity, which is strongly export oriented, requires a dense road and rail network (one of the densest in the European Union). The expansion of the intra-European area has further increased transit traffic, resulting in constant growth of transport, a large consumer of petroleum products. This growth particularly concerns road and air transport, which have the highest growth rates. Road transport is the most energy-consuming means of transport in Belgium. It also consumes the most energy per unit transported per km on land. The number of passenger cars has skyrocketed and is not conditional upon the economic context (motorisation rate in Belgium: one car for every two inhabitants). Growth in the number of goods vehicles has been even more pronounced than that of passenger cars. The motorisation rate of the economy rose from 2.9 vehicles per million euro of GDP in 1994 to 3.2 in 2002. In the coming years, demand for fossil energy in this sector is expected to continue to grow (cf. Chapter 5 "Projections").

Recent trends also tend to demonstrate that new technologies serving to boost vehicle fuel efficiency are not being developed fast enough for the moment to offset the effects of increased road traffic. These elements argue for a global policy combining managed demand for transport, modal transfer and technological improvements to vehicles (cf. Chapter 4).

Passenger transport

If personal mobility is expressed in passenger kilometres travelled, cars (or motorcycles) are still the main means of transport in Belgium (81% of all motorised mobility in 2004). Public transport makes up only 7.8% of passenger transport (Table 2.11).

Passenger car use has continued to rise over the past five years, although to a lesser extent than public transport (bus, underground and railway). This continuing rise in the use of motor vehicles for passenger transport can be explained by the following factors:

- 'de-urbanisation' and the dispersion of housing;
- development of the services sector, combined with limited polarisation in the establishment of businesses and companies;
- the increase in households' available earnings and leisure time;
- taxation that has so far remained favourable to the acquisition of company cars and vehicle use;
- the development of Brussels as national capital and seat of the European institutions, which generates employment, but also commuters;
- the increasing complexity of mobility patterns, encouraging more frequent use of cars;
- mobility practices and households' choice of comfortable vehicles whose occupation rate is ever lower.

Table 2.11. Evolution of mobility: private and public modes of transport

	Billion passenger-km (2004)	Relative share	Evolution 2000-2004	Evolution 1990-2004
Private vehicle traffic	112.7	80.7%	5.0%	25.8%
Underground, tram, bus, approve	10.9	7.8%	20.3%	21.3%
Rail (SNCB)	8.7	6.2%	11.9%	32.7%
Private coach companies	7.3	5.2%	38.9%	112.0%

Sources: FPS Mobility and Transport and SNCB

Table 2.12. Evolution of the transport of goods

	Million tonnes km (2003)	Relative share	Evolution 2000-2003	Evolution 1990-2003
Inland waterways	8 302	13.9%	13.5%	52.4%
Rail	7 293	12.2%	-5.0%	-12.7%
Road	44 146	73.9%	5.0%	70.9%

Sources: FPS Mobility and Transport and SNCB

The combination of these factors, which all lead in the same direction, risks having consequences for ongoing growth of road traffic for passenger transport and the resulting emissions. The growing saturation of roads, moreover, is leading to an increase in fuel consumption (and emissions) that surpasses the increase in kilometres travelled. Finally, the growing use of diesel fuel in Belgian passenger cars is also having an impact on the evolution of emissions (lower for CO_2, but higher for NOX and particulates). The use of air conditioning is also rising sharply.

Transport of goods

The transport of goods is constantly on the rise in Belgium. This increase is expected to continue during the coming years (cf. Chapter 5 "Projections"). It includes the transport of goods by road, which has risen threefold over the last 30 years, in particular as a result of:

- the opening of borders in the European Union to the new Member States;
- the evolution of the organisation of work and production and the development of 'just-in-time' delivery (increase in the number of trucks).

Road transport is currently used for around 84% of goods (Table 2.12). Tonnage transported by road (+ 5% over 2000) and by inland waterway transport (+13.5%) is on the rise, while tonnage transported by rail is diminishing (-5%).

Industry

In the past, iron and steel, mechanical engineering, textiles and chemicals were the flagships of Belgian industry. Their output was exported to a large extent. Since 1960, however, in Belgium as in other parts of Europe, the profile of industry has changed significantly. Its importance in the economy has declined and its structures and spatial distribution have been transformed.

Metallurgy

This declining sector includes iron and steel and the processing of steel and non-ferrous metals. It is mainly made up of large firms situated at the heart of the former industrial regions of Wallonia, but also in Flanders, where sites are more dispersed. In the 1970s, the crisis in the sector resulted in major restructuring plans.

Agri-foods

The agri-foods industry is Belgium's third most important industrial sector in terms of added value. It is also the second largest employer and is characterised by a very high number of SMEs. Exports account for half its turnover. The most important sectors are breweries, slaughterhouses and meat, and bread and pastries.

Textiles

For several centuries, textiles were an important and renowned activity in both the north and south of Belgium. In recent decades, this industry has contracted and is now limited mostly to the Flemish Region, which accounts for 90% of national production. The sector has suffered from the lower wage costs practiced outside of Europe.

Chemicals

Chemicals represent more than one fifth of the turnover of Belgian industries and more than 20% of the country's total exports. Belgium ranks 10th globally in the chemical sector, accounting for around 4% of planetary trade. The Belgian chemical sector produces a wide range of products.

Mechanical engineering

The automotive industry in Belgium is limited to assembly, which takes place mostly in large assembly plants owned by multinationals. Railway construction has a strong presence in Belgium, as does the highly technological aviation sector.

Waste

Overall, the volume of waste generated in Belgium declined 7.8% between 1995 and 2000, owing to the decrease in industrial waste (-13%). At the same time, municipal waste rose by 10.3% (Table 2.13).

Table 2.13. Production of waste (2000) and evolution 1995-2000

	2000 (thousands of tonnes)	Evolution 1995-2000
Total	35 452	-7.8%
Industry	23 717	-13.0%
Municipal waste	4 953	10.3%
- of which households	3 875	6.3%
Other*	6 782	1.1%

* Including inert waste collected by municipalities

Sources: FPS Economy - NIS (estimates)

Remarkable progress has been made in the recycling of packaging, thanks to the cooperation agreement on prevention and management of packaging waste concluded by the three regions in 1996. This cooperation agreement (which gives effect to European Directive 94/62/EC on packaging and packaging waste) is meant to prevent and/or lessen the effects on the environment of packaging waste. It establishes a minimum recovery rate (recycling or incineration with energy recovery) of 80%. It also requires recycling of at least 50% of industrial packaging and a minimum recycling rate of at least 15% for each type of material (plastic, paperboard, metal, etc.). The cooperation agreement also provides for the creation of an Interregional Packaging Commission charged with certain administrative, control and advisory tasks. A body approved by that Commission (FOST Plus) is responsible for implementing the collection and recycling of used household packaging, which represents 94% of the Belgian household packaging market (2004) [9]. Collection is based on a mixed system: door-to-door collection from households and voluntary return by consumers via container parks and a network of bottle banks. Thanks to this system, Belgium is among the leaders in selective collection and recycling of household packaging waste in the European Union. In 2004, the recycling and recovery rate was 92.9% (89.5% recycling and 3.4% incineration with energy recovery) (Table 2.14). These high rates of recycling and recovery are also obtained at an annual cost of less than 10 euro per inhabitant.

Housing stock

In Belgium, three households out of four (75.3%) live in a single-family house and one out of four (24.1%) in a flat (2001) (Figure 2.9). The proportion of households occupying a single-family house has risen nearly 10% in 10 years (1991-2001). In the Brussels-Capital Region, the proportion of households occupying a single-family house is markedly lower (28.2%).

Belgian housing stock is characterised by a large proportion of old buildings. In 2001, only one person in five lived in housing built within the last 20 years. The big cities have the oldest housing stock, particularly Brussels, Charleroi and Liege. One housing unit in ten has undergone major renovation during the 10 years under consideration.

In 2001, 73% of housing units were equipped with central heating. In the space of 10 years, more than 600 000 additional

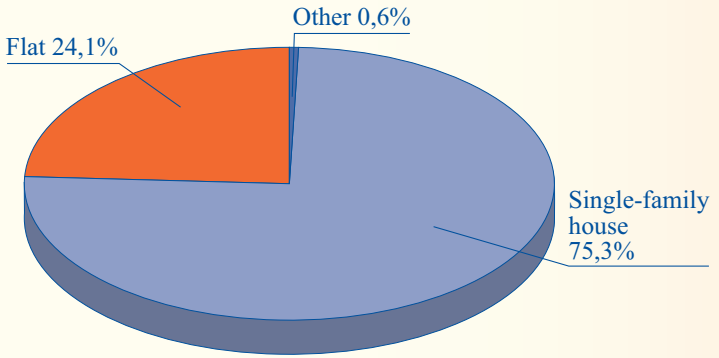
Table 2.14. Packaging waste: Quantities recycled (2004) and evolution 1995-2004

	Quantities recycled (2004) (tonnes/year)	Evolution 1995-2004
Glass	315 000	157%
Paper/paperboard*	183 188	699%
Metal packaging	94 507	307%
Bottles and flacons	79 600	2 282%
TOTAL	**679 295**	**291%**

* Including beverage cartons

Source: Fost plus

Figure 2.9. Breakdown of types of housing

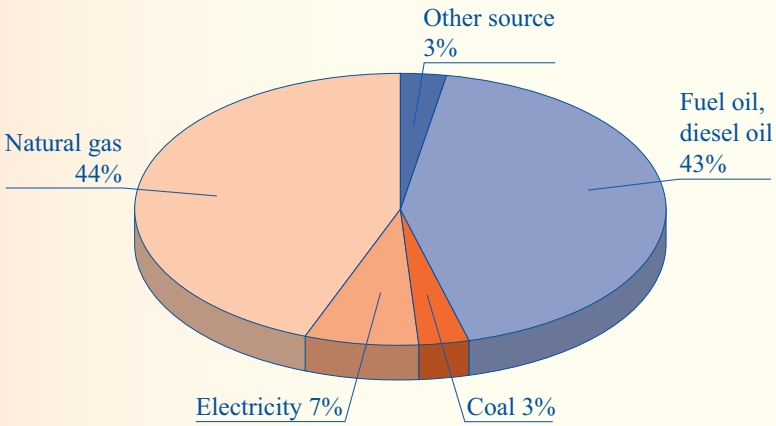


Source: general socio-economic survey 2001 - NIS

housing units were equipped with central heating, an increase of one fourth. In 1991, fuel oil was the most important fuel used for heating. This was no longer the case in 2001, by which time natural gas had surpassed fuel oil as the principal source of heat (Figure 2.10). Electric heating has also expanded, to an extent similar to that of natural gas. Inversely, coal has declined considerably: while one housing unit in 10 was still heated with coal in 1991, only 2.8% used coal in 2001. The use of natural gas as the principal source of energy for heating is markedly more important in the big cities than in the rest of the country (due to the penetration of the distribution system).

For insulation, more than seven housing units out of 10 have dual-glazed windows, around six out of 10 have an insulated roof, four out of 10 have insulated outer walls and six out of 10 have insulated heating pipes. In the big cities, these figures are lower, except for roof insulation (2001 data) [10].

Figure 2.10. Energy or fuel used primarily for heating



Source: general socio-economic survey 2001 - NIS

Agriculture and forestry

Agriculture in Belgium, favoured by fertile soil and a temperate climate, is specialised in market garden and horticultural crops, cereals, potatoes, sugar beets, stock farming and milk production. Due to the short coastline, fishing has relatively limited importance as an economic activity.

In 2005, Belgium counted 51 477 agricultural and horticultural businesses (Table 2.15) [11]. Wallonia has more agricultural land than Flanders (55% compared to 45%), but generates half the latter's added value (two thirds of intensive farming holdings are situated in Flanders). The active population employed in agriculture

Table 2.15. Agricultural and horticultural statistics (2005)

	2005	Evolution 2000-2005 (%)
Number of agricultural and horticultural businesses	51 540	-16,5%
Agricultural surface area in use (ha)	1 385 582	-0,6%
Total workfare (permanent & non-permanent)	95 009	-11,5%
Animals (x 1.000)		
Number of cattle	2 699	-11,3%
Pigs	6 318	-14,3%
Poultry	35 569	-10,5%
Crops (ha)		
Cereals (grain)	322 231	2,8%
Sugar beets	85 527	-5,9%
Maize (animal feed)	163 825	-1,5%
Potatoes	64 952	-1,4%

Sources: FPS Economy - NIS, Agricultural Statistics.

has been shrinking since the Second World War. Today, the active population in agriculture and fisheries represents barely 1% of the total population (compared to 21.5% in 1910). In recent years, the number of farms has continued to decrease significantly, while agricultural land in use has remained relatively stable. In spite of this decline, agriculture and fisheries are still important economic sectors. Over the last 15 years, land used for organic farming has multiplied twentyfold; at the same time, the number of organic farms has increased almost tenfold.

The distribution of forests in Belgium is shown in Table 2.16. Total forest area in Flanders amounted to 146 381 ha in 2000, based on the regional forest mapping (Van de Walle et al, 2005), while Walloon forests covered 544 800 ha (Perrin et al., 2000). Non-productive areas such as open spaces, roads, rivers, etc. in the Flemish and Walloon forests were excluded from the analysis. Considering the very small forest area in the Brussels region (0.3% of total forested areas), no emission inventory has been conducted so far.

Table 2.16. Forest cover in Belgium

	Total area (km^2)	Forest area (km^2)	Forest cover (%)	% of total forest area
Wallonia	16 845	5 448	32.3	78.6
Flanders	13 521	1 447	10.8	21.1
Brussels-Capital	162	20	12.3	0.3
Belgium	30 528	6 931	22.7	100.0

Sources: National Institute of Statistics and regional forest inventories, 2000

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3. Greenhouse gas inventory information

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Procedures and methodology

In the Belgian federal system, the regions have major responsibilities for environmental matters. The preparation of greenhouse gas emission inventories is one such responsibility. Each region implements the means required to establish its own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined into one national greenhouse gas emission inventory. Since 1980, the three regions have been developing their own methodologies for compiling atmospheric emission inventories. In Flanders, the greenhouse gas inventory is prepared by the *Monitoring and Research Department* of the *Flemish Environmental Agency* (VMM). The emission inventories of the Walloon region are compiled by the *Directorate General for Natural Resources and the Environment* (DGRNE). The emission inventories of the Brussels region are compiled by the *Brussels Institute for Management of the Environment* (IBGE-BIM)

A considerable effort has been made in recent years to harmonise these methodologies at the national level, especially for the key sources. Co-ordination is required to ensure consistent data and to draw up the national inventory. This co-ordination is one of the permanent duties of the Emissions Working Group of the *Co-ordination Committee for International Environmental Policy* (CCIEP), where the different actors from the regional and federal level coordinate preparation of the national inventory, taking into account the specific characteristics and interests of each region as well as the available means. This working group also draws up the National Inventory Report. The *Interregional Environment Unit* (CELINE - IRCEL) is responsible for integrating the emission data and compiling the inventory data from the three regions into a single national inventory. The inventory data (in the 'common reporting format') together with the National Inventory Report are formally submitted to the National Climate Commission for approval before being submitted to the Secretariat of the United Nations Framework Convention on Climate Change and to the EC, under Council Decision 280/2004/EC[5].

Further details on the methodology can be found in the National Inventory Report which can be downloaded from the UNFCCC website. The National Inventory System is being prepared at the regional and national level, with the aim of completing it by the end of 2005 in compliance with Art. 4.4 of Council Decision 280/2004/EC.

[5] Council Decision 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

Overview

National inventory

The inventory data presented in this chapter are extracted from the 2005 submission, following the recommendations of the Dublin workshop on the preparation of Fourth National Communications by Annex I Parties (FCCC/SBI/2004/INF.14, paragraph 13). This inventory includes emissions data for the years 1990 to 2002, and provisional estimates for the year 2003. The summary tables 10s1 to 10s4 (Common Reporting Format) from the national GHG inventory are reproduced in Annex A of this report.

Total greenhouse gas emissions (without LUCF) in Belgium amounted to 147.7 Mt CO_2 eq. in 2003, which is 1.4% above 1990 emissions. Compared to the base year level[6], however, emissions increased by 0.6% in 2003 (Figure 3.1).

Under the Kyoto Protocol and the EU 'burden sharing' agreement, Belgium has made an undertaking to reduce its GHG emissions by 7.5%. Assuming a linear target path from 1990 to 2010, total GHG emissions in 2003 were 5.5 index points above this target path.

The major greenhouse gas in Belgium is carbon dioxide (CO_2), which accounted for 85.5% of total emissions in 2003 (Figure 3.2). Emissions of CO_2 increased by 6% from 1990 to 2003, while N_2O, CH_4 and fluorinated gas emissions dropped by 8%, 21% and 67%[7] respectively during the same period. The share of the main sectors is given in Figure 3.3.

Figure 3.4 summarises the impact of the main sectors on the national trend. It clearly shows that the increase in Belgian emissions is due to the sharp increase in road transport on the one hand, but also to emissions from buildings in the residential and commercial sectors on the other. Since 1990, those two sectors have been responsible for a 7.1% increase in total emissions.

This trend is counterbalanced by the 6.5% decrease in emissions in the other sectors, particularly industry, giving an overall increase of 0.6% compared to 1990.

The drivers of these trends are analysed and commented upon in the following pages, sector by sector.

[6] The base year under the Kyoto protocol is 1990 for CO_2, CH_4 and N_2O, but 1995 for fluorinated gases

[7] Compared to 1995 emissions

Table 3.1. Overview of GHG emissions and removals from 1990 to 2003 (Gg CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO_2 emissions/removals	115 906	119 246	117 111	116 048	119 430	120 700	124 736	119 172	124 505	119 165	120 679	118 944	119 004	122 971
CO_2 emissions (without LUCF)	119 010	122 064	120 242	119 109	122 519	123 618	127 707	122 165	127 382	121 985	123 815	123 355	122 984	126 331
CH_4	10 788	10 799	10 758	10 608	10 729	10 777	10 587	10 526	10 397	10 078	9 798	9 231	8 792	8 530
N_2O	12 192	12 221	11 821	12 152	13 173	13 114	13 521	13 102	13 291	13 096	12 853	12 729	12 223	11 253
HFCs	255	255	255	255	255	255	386	526	669	691	759	920	1 148	1 322
PFCs	1 753	1 678	1 830	1 759	2 113	2 335	2 217	1 211	669	348	361	228	108	209
SF_6	1 663	1 576	1 744	1 677	2 035	2 205	2 120	525	270	120	109	105	94	75
Total (with net CO_2 emissions/removals)	142 557	145 775	143 518	142 498	147 736	149 386	153 568	145 062	149 801	143 498	144 558	142 157	141 368	144 360
Total (without CO_2 from LUCF)	145 660	148 593	146 649	145 559	150 825	152 305	156 539	148 056	152 678	146 318	147 695	146 569	145 349	147 719

Regional trends

The regional trends in GHG emissions are shown in Figure 3.5.

Flanders

In Flanders, the main changes in emissions have occurred in the residential (CO_2 emissions increased by 17%) and commercial (85% increase in CO_2 emissions) sectors. The growing number of houses and wide use of liquid fuels explain rising emissions in the residential sector. In the commercial sector, an increase in fuel consumption is observed in 2003 compared to 1990.

The second most important sector is transport. Emissions of CO_2 in this sector rose by 25% because of the higher number of cars, the increase in average distance travelled and higher capacity linked to the switch from petrol to diesel engines.

A third important sector responsible for the increase in greenhouse gas emissions in the Flemish Region is the energy industry. Higher electricity production as well as fluctuations on the petroleum refining market are responsible for the emission trends.

Brussels-Capital Region

The Brussels-Capital Region is a city of one million inhabitants. The few companies present in the region are mostly medium-sized and are responsible for only a small share (about 2.5%) of regional GHG emissions. GHG emissions are mostly due to heating in the residential sector and service industry (~70%) and to road traffic (~20%). Heating is logically driven by climatic conditions. Global variations shown in Figure 3.5 follow climatic variations.

Large variations can be observed in small emitter sectors, for example, a reduction (-51%) of fugitive emissions, linked to the improvement of the gas distribution network (reduction of leakage) and an in-

Table 3.2. Overview of GHG emissions and removals in the main CRF sectors from 1990 to 2003 (Gg CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Energy	**113 130**	**117 162**	**115 586**	**114 633**	**116 797**	**116 886**	**121 659**	**115 866**	**120 995**	**115 702**	**116 987**	**117 135**	**116 207**	**119 562**
Energy Industries	30 195	29 959	28 775	28 491	30 526	29 489	29 239	28 126	30 433	27 160	28 339	26 606	28 128	29 510
Manufacturing Industries and Construction	33 601	34 372	32 640	31 653	32 459	32 955	32 165	31 561	33 410	32 000	33 103	32 529	31 189	30 938
Transport	20 180	20 848	22 359	22 531	22 130	22 250	22 697	22 986	23 708	24 144	24 614	25 261	25 599	26 134
Residential, commercial and agriculture	28 144	30 986	30 832	30 988	30 717	31 301	36 687	32 328	32 600	31 551	30 071	31 913	30 481	32 180
Other combustion	168	168	168	166	168	108	92	100	94	97	91	99	98	98
Fugitive Emissions from Fuels	842	829	812	805	797	782	781	765	750	749	771	727	712	702
Industrial processes	**16 089**	**15 146**	**14 799**	**14 765**	**17 756**	**19 026**	**18 883**	**16 241**	**15 784**	**15 001**	**15 413**	**14 670**	**14 902**	**14 342**
Solvent and other product use	**253**	**249**	**249**	**247**	**241**	**242**	**238**	**238**	**238**	**238**	**256**	**256**	**253**	**253**
Agriculture	**12 779**	**12 760**	**12 691**	**12 816**	**12 797**	**12 994**	**12 702**	**12 577**	**12 665**	**12 615**	**12 358**	**12 294**	**11 913**	**11 557**
Land-use Change and forestry	**-3 103**	**-2 817**	**-3 132**	**-3 061**	**-3 088**	**-2 918**	**-2 971**	**-2 993**	**-2 877**	**-2 820**	**-3 137**	**-4 412**	**-3 980**	**-3 359**
Waste	**3 409**	**3 276**	**3 324**	**3 098**	**3 234**	**3 157**	**3 057**	**3 134**	**2 996**	**2 762**	**2 681**	**2 214**	**2 074**	**2 005**

crease in fluorinated gas emission from refrigeration activities (including transport) by a factor of more than 10 (mainly due to the replacement of gases covered by the Montreal Protocol by gases covered by the Kyoto Protocol). As a result of this increase, these emissions of fluorinated gases are now close to 3% of regional emissions.

Wallonia

In Wallonia, emissions have largely decreased since 1990. The shutdown of iron and steel furnaces and coke refineries in energy industries, together with a switch to natural gas, explain the greater part of the decrease. The development of biogas recovery in the waste sector and the growing use of biomass fuels in cement kilns have also contributed to this trend in recent years.

Figure 3.1. Belgian GHG emissions 1990-2003 (excluding LULUCF) compared with Kyoto target. For fluorinated gases, the assumed base year is 1995, so the index value 100 on the Y-axis is: CO_2, CH_4 and N_2O emissions in 1990 + HFC, PFC and SF_6 emissions in 1995.

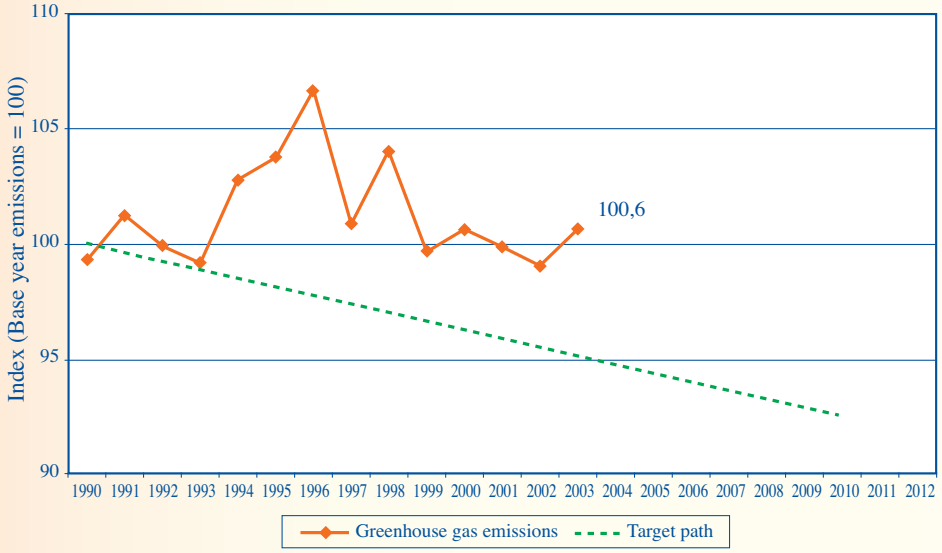


Figure 3.2. Share of greenhouse gases in Belgium (2003)

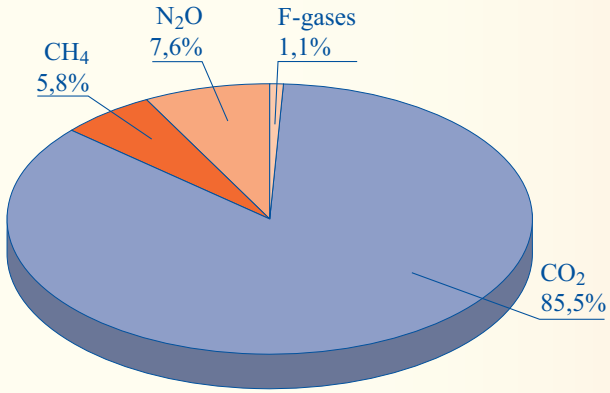
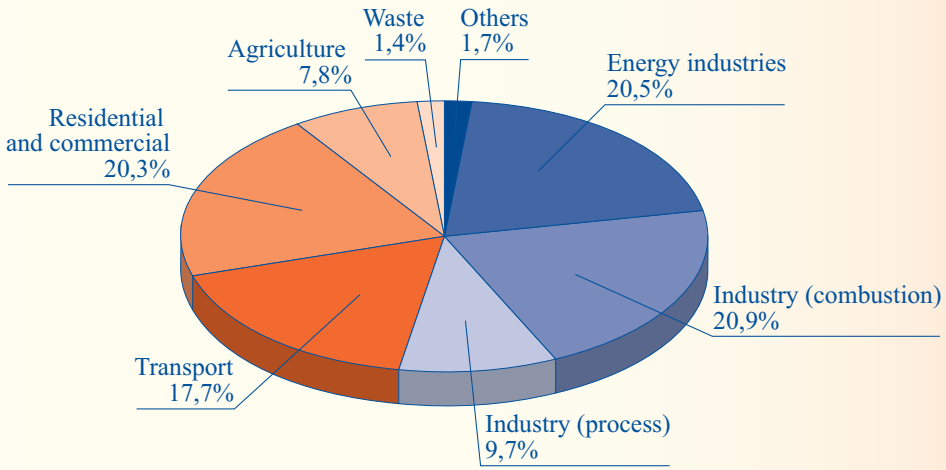


Figure 3.3. Share of the main sectors in 2003



However, as in other regions, emissions from road transport and heating in the commercial sector have continued to rise.

Energy industries

The main source for this sector is public electricity and heat generation, which accounted for 80% of sectoral emissions in 2003. Petroleum refining and manufacture of solid fuels accounted for 19% and 1% respectively.

Emissions from the manufacture of solid fuels have decreased by 80% since 1990 (-1700 Gg CO_2 equivalent) due to the closure of four coke plants in 1993, 1994, 1997 and 2002. In the meantime, emissions from petroleum refining have increased by 20%, owing to higher production and the general economic context.

As mentioned above, however, the main driver in this sector is public electricity and heat generation. While electricity production has risen by 30% since 1990 [1], emissions have remained stable due to technological improvements and the switch from solid fuels to gaseous fuels. This is illustrated in Figure 3.6. It is estimated that some 7000 Gg CO_2 equivalent have thus been avoided.

Manufacturing industries

In the manufacturing industries, added value [1] has increased by more than 25% since 1990. One fifth of this growth stems from the chemistry sector, where added value rose 65% between 1990 and 2003. Significant growth was also seen in sectors such as food, paper, lime and cement.

Figure 3.4. Impact of the main sectors on the global trend 1990-2003

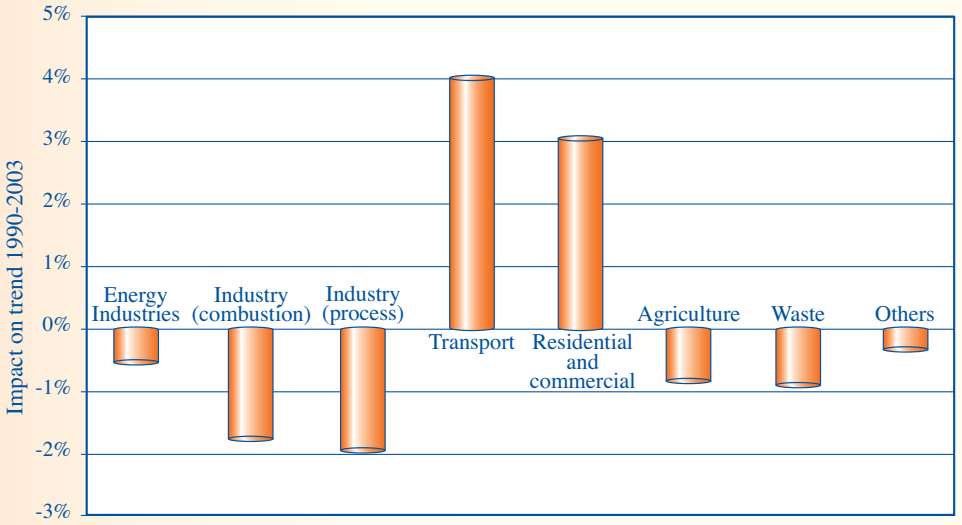
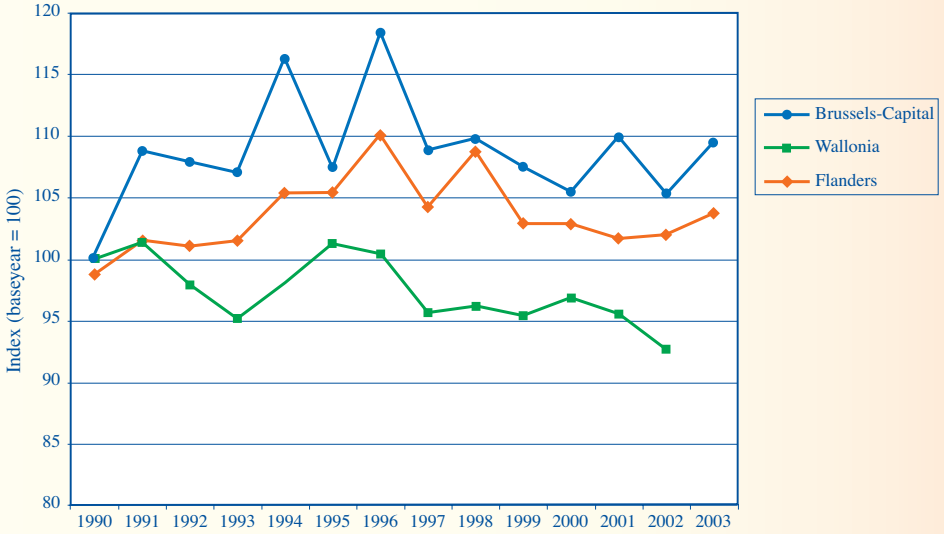


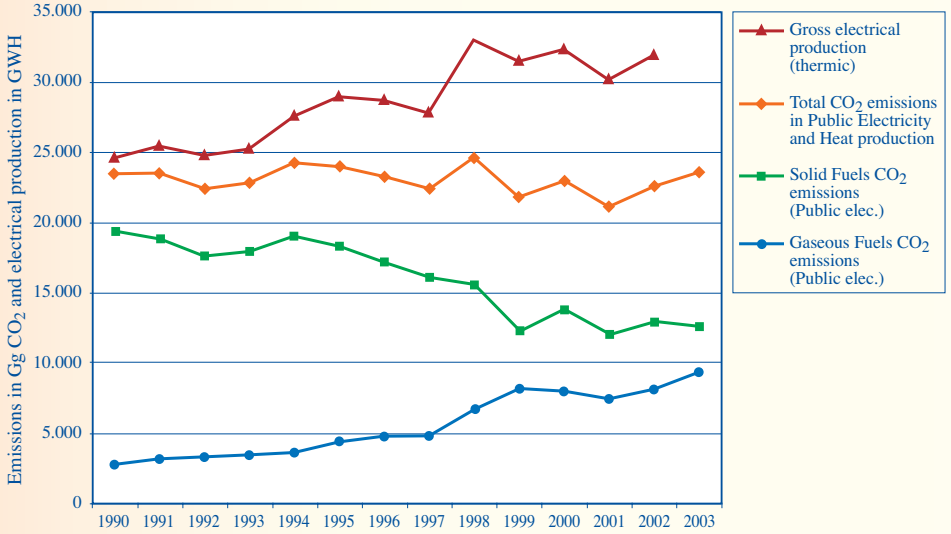
Figure 3.5. Regional GHG emissions



As seen in Figure 3.7., primary energy consumption increased by only 4% between 1990 and 2003. This apparent **decoupling of added value and energy consumption** can be attributed to various drivers according to sectors:

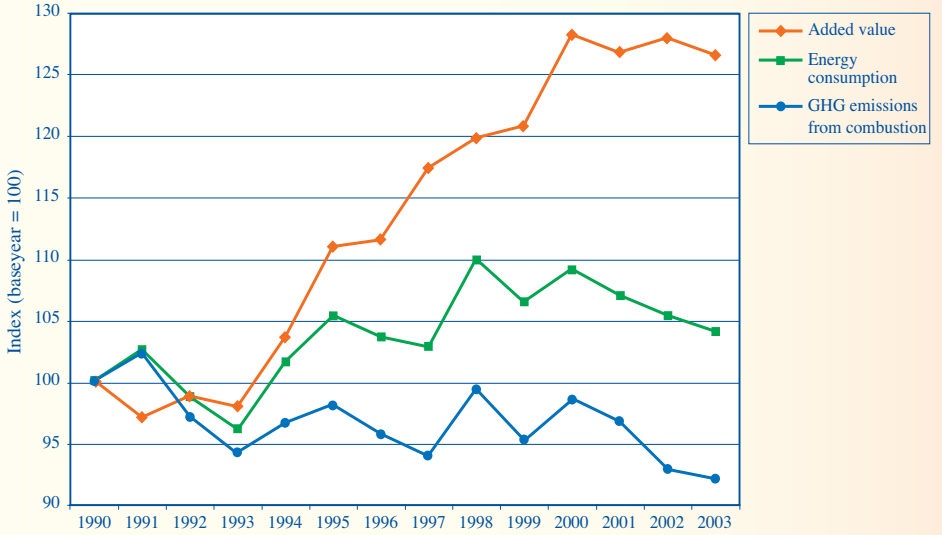
- In the iron and steel industry, many plants have switched to electric furnaces since 1990. In Belgium, electricity consumption by the sector increased by 27.5% from 1990 to 2002 [1]. This is the main cause of the apparent decreasing energy consumption, while stable added value is observed in this sector. This sector represents between 35% and 42% of energy consumption by the manufacturing industries and consequently has a significant impact on the global trend.
- In the chemistry sector, energy consumption has increased by 50% since 1990, compared to 65% growth in added value [1] [2]. This relative decoupling is linked to both rational energy use and high added-value products. This sector represents nearly 30% of energy consumption in the manufacturing industries.
- Food processing and beverages represent 7 to 9% of energy consumption in the manufacturing industries, but 13 to 14% of added value [1] [2]. This sector shows the steepest increase in added value compared to energy consumption. The diversity of the plants in this sector does not allow a detailed analysis of the trend; only certain types of plants are commented upon here. In sugar plants, for example, some products with high added value, such as inulin and fructose, have been developed recently, but the main driver is still the sugar beet yield (quantity and sugar content), which is highly climate–dependent.
- Cement and lime plants also represent 8 to 9% of energy consumption in this category. Since 1990, total production (cement and lime) has risen by 4%,

Figure 3.6. GHG emissions from public electricity and heat generation, in relation to gross electricity generation [1].



Note: Data from 2003 are not available for the latter.

Figure 3.7. Manufacturing industries: index of GHG emissions, energy consumption and added value [1] [2].

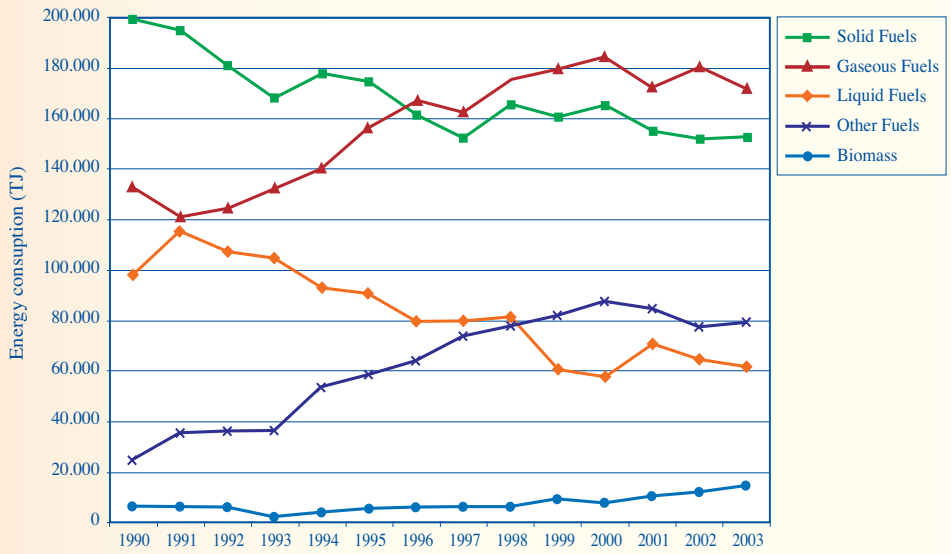


while energy consumption has declined by 7% [1] [2]. This is linked to the production process: the dry process, which is considerably less energy-demanding, is gradually replacing the wet process and is now used for 73% of production compared to 61% in 1990.

Figure 3.7. also shows a **decrease in greenhouse gas emissions for an equal level of energy consumption**. One reason is the increasing use of gaseous fuels, coupled with a decrease in liquid and solid fuels observed across all sectors. This is illustrated in Figure 3.8.

The increasing use of 'other fuels' (see Figure 3.8) reflects on the one hand the growing numbers of naphtha crackers and the enlargement of existing plants. On the other hand, cement plants have been using more and more substitute fuels since 1990, such as impregnated sawmills, animal waste, tyres, etc. Those fuels now represent 34% of energy consumption, compared to 7% in 1990. The non-biomass fraction of these fuels is included in the "other fuels" category. The biomass fraction of these fuels is included in biomass fuels and not accounted for in the national emissions. Cement plants have caused a doubling of the use of biomass fuels since 1990, with a particularly steep increase since 2001, when the 'dioxin crisis' in Belgium resulted in the elimination of high levels of poultry and animal meal in cement kilns. The other half of the biomass fuels used in Belgium comes from the pulp and paper sector, where part of the woody raw material has always been used as fuel in pulp paper plants. Finally, although its effect on the national total is not yet significant, a recent trend in the food processing sector is the use of the biogas recovered from wastewater treatment plants.

Figure 3.8. Type of fuels used in the manufacturing industries.



Industrial processes

The 'industrial processes and F-gases' sector covers emissions from industrial activity, but not resulting from fossil fuel combustion. In 2003, these emissions of greenhouse gases were mainly caused by mineral products (cement and lime production, 38% of emissions) and the chemical industry (nitric acid and ammonia production, 36% of emissions). Metal production and fluorinated gases accounted for 14% and 11% respectively of total emissions in this sector.

Mineral products

These emissions occur during the production of clinkers and are closely linked to production levels, which are stable on the whole.

Chemical industry

Despite the closure of two nitric acid plants (one in 1995 and another in 2000), the production of nitric acid in the two remaining plants was multiplied by a factor 4.6 in 2003 compared with 1990. In parallel, these plants have taken measures to reduce emissions from their processes and one of the plants is still testing catalysts to further decrease its emissions. Consequently, the emissions remained rather stable although production rose substantially.

Metal production

In the iron and steel sector, CO_2 emissions increased by only 3% in 2003 compared to 1990. This is more or less in line with the production of pig iron which remained stable during the same period.

Fluorinated gases

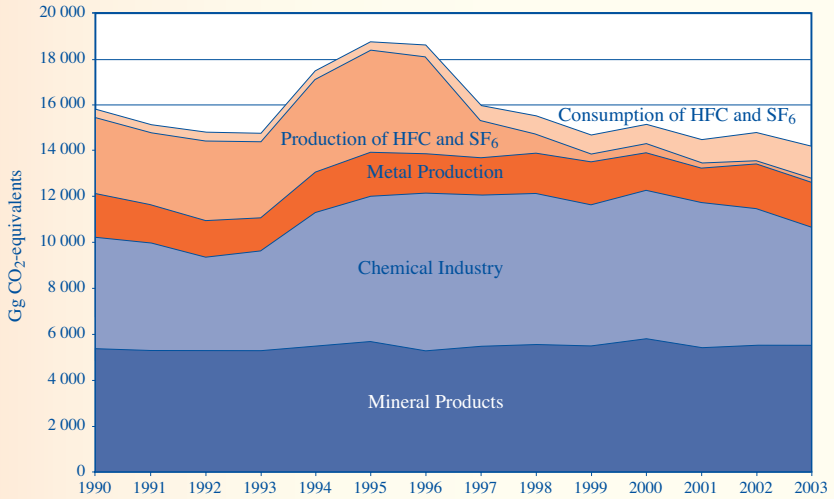
Emissions of fluorinated gases accounted for 1.1% of total greenhouse gas emissions in 2003. A distinction is made between 'production emissions', which are fugitive emissions during the production process, and 'consumption emissions',

which are those occurring during the use or dismantling of existing equipment and products.

The sharp decrease in emissions from the production of HFC between 1996 and 1999 (Figure 3.9) is due to the installation of a gas incinerator with an HF recovery unit (Fluoride Recuperation Unit) in the most important source identified, which is an electrochemical synthesis unit.

The growing consumption of HFC (Figure 3.9) is directly linked to the implementation of the Montreal Protocol and EU Regulation 2037/2000, which bans the use of ozone-depleting substances such as CFCs. The CFCs which were formerly used are now replaced by HFCs in most sectors like refrigerating and air conditioning installations, production of isolating foams and some aerosols. The quantities of HFCs are nonetheless lower than those of CFCs, because in many cases CFCs have been replaced by non-fluorinated gases, like ammonia in refrigeration, pentane and CO_2 for isolating foams, etc.

Figure 3.9. Greenhouse gas emissions in the industrial processes sector



SF_6 emissions originating from the production of acoustic double-glazing have been cut through the use of alternate products, however, SF_6 consumption emissions are likely to increase in the coming years due to the dismantling of existing equipment.

Residential and commercial

In the residential sector, fuel consumption has increased by 12% since 1990. This is mainly linked to the growing number of houses. Annual fluctuations are of course climate-related: this is particularly clear for 1996, a cold year with a marked peak of emissions from heating [3]. Since 1990, gaseous fuels consumption has increased from 34 to 44% of total energy consumption, together with a decrease in solid fuels and liquid fuels. Liquid fuels still account for 52%, however. One explanation could be that the gas distribution network does not cover sparsely populated areas, thus hampering the switch from liquid to gaseous fuels, which is observed in other sectors.

In the commercial sector, fuel consumption has increased by 48% since 1990. One reason is the rising number of employees, which has risen by 21% since 1990 and now represents up to 77% of total salaried employment [4]. A clear switch from liquid fuels to gaseous fuels has been observed since 1995 and gaseous fuels represent nearly 60% of the sector's energy consumption. In the meantime, electricity consumption has also grown by 53%, mainly due to the development of Information Technologies and the increased use of refrigerated areas and air conditioning.

For both sectors, other fuels and biomass remain negligible for the time being. In the commercial sector, a slow increase has been observed since 1999, but biomass represents only 1.1% of the sector's energy consumption .

Transport

Transport emissions accounted for 14% of total GHG emissions in 1990 and 18% in 2003. This increasing level is due to road transport, which represents 98% of total emissions by the sector.

Emissions from domestic navigation are fairly stable and represent 1.5% of total emissions. Emissions from railways seem to have decreased since 1990, but in fact this reflects the switch from diesel to electrical engines.

In the road transport sector, most indicators are increasing: the number of cars

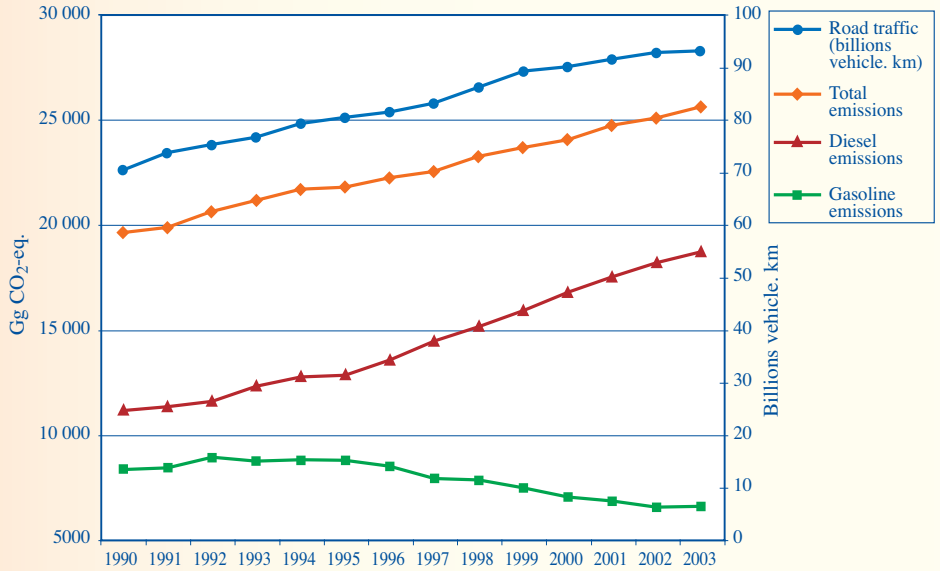
has increased by 30% since 1990, together with traffic (vehicle km) which has risen in the meantime by 32% [4].

There is a marked switch from petrol engines to diesel. The number of petrol engines has dropped slightly since 1990 (-2%), while the number of diesel engines has almost doubled (+ 98%) for the same period. This is reflected in their respective emissions (Figure 3.10).

The average engine capacity has also increased since 1995, reflecting the switch to diesel on the one hand and the growing success of SUV vehicles on the other [6]. The average age of the cars has increased (improved rust protection and overall resistance), as has the average distance travelled.

The number of cars using LPG has almost doubled since 1990 and represents 1.4% of private cars compared to 0.8% in 1990 [5]. This relative progress is rather limited, however, in regard to the price of this fuel and available subsidies.

Figure 3.10. Road transport emissions and traffic figures.



N_2O emissions from transport more than doubled between 1990 and 2003. This is partly due to the introduction of catalytic converters (the use of catalytic converters on all petrol-engine cars was made compulsory in Belgium in 1993), but also to the ageing of the first converters, which leads to an increase in their N_2O emissions. Finally, although there is considerable uncertainty, N_2O emissions represent only 3% of total GHG emissions from road transport.

Road transport is the leading source of greenhouse gas emissions in Belgium, in terms of level and trend analysis. It constitutes one of the main drivers of emissions trends. The absolute increase in CO_2 emissions from road transport between 1990 and 2003 is the highest among the key sources (+5 543 Gg Co_2 eq.).

International air and maritime transport

In accordance with the UNFCCC guidelines, emissions from international air and maritime transport are not included in national emissions. In 2003, these emissions accounted for 18% of national emissions, with maritime transport representing the most important source (87% of this category). Emissions from international aviation have increased by 13% since 1990, while emissions from maritime transport have risen by 71%.

Agriculture

GHG emissions from agriculture accounted in 2003 for 7.8% of total emissions in Belgium. Overall, they decreased by 9.6% between 1990 and 2003 (figure 3.11).

One third of these emissions are CH_4 emissions from enteric fermentation, with cattle representing 95% of these emissions. These emissions have dropped by 11% since 1990, mainly due to a general reduction in livestock [5], but also to the shift from dairy cattle to brood cattle (a general EU trend linked to the Common Agriculture Policy), the latter causing a lower level of emissions.

Almost one third (29%) of emissions are CH_4 from manure management, with swine accounting for 56%, cattle 40% and poultry 4%. These emissions are driven by livestock levels: swine livestock rose from 1990 until 1999 and then decreased, its impact on emissions being diminished by the cattle livestock evolution explained above.

The last third of emissions from agriculture are N2O emissions from soil. These have decreased by 12%, due to the smaller quantities of nitrogen from mineral fertiliser applied on the one hand and to livestock reduction (nitrogen excreted on pasture) on the other. Both reductions have also had an impact on indirect emissions.

Land use change and forestry

The methodology used to estimate carbon emissions and removals by LULUCF activities is explained in the NIR.

Figure 3.12 gives the evolution of biomass carbon stock in trees. For the 1990-2000 simulation, a working hypothesis of a linear trend in forest areas and overall biomass increase was used. A distinction was made between main deciduous and coniferous species for estimating annual wood growth.

The annual wood harvest is estimated through a comparison of the estimated annual increase in carbon stock (based on annual wood growth) with the effective annual carbon stock variation observed in the inventories (fig. 3.12).

For the 2000-2003 period, a dynamic model simulating the evolution of the forest biomass was used [7]. The complete description is given in [8].

The difference between biomass growth and harvest gives the net removal of CO_2, presented in fig. 3.13.

The change in activity data sources and methodology mentioned above explains the gap between 2000 and 2001. The trend for the year 2000 also reflects a practice of conservation of the mature stands observed recently in private forests (half of the total forest area). Due to the model, this trend appears more abrupt than it actually was. The other annual fluctuations reflect changes in C stocks due to external factors such as commercial wood demand, pests, etc.

For the time being, Belgium provides CO_2 emissions/removals only for category 5A1. Net CO_2 removal in 2003 represented 2.3% of total CO_2 emissions. Due to the accounting rules of the Kyoto Protocol, however, the net sink which could potentially be accounted for during the commitment period 2008-2012 is much smaller.

Figure 3.11. Emissions in the agricultural sector.

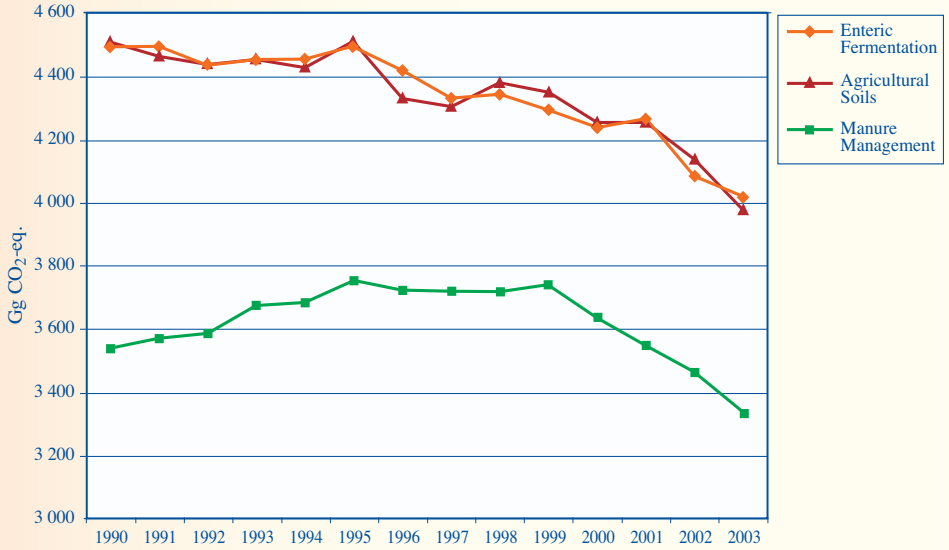
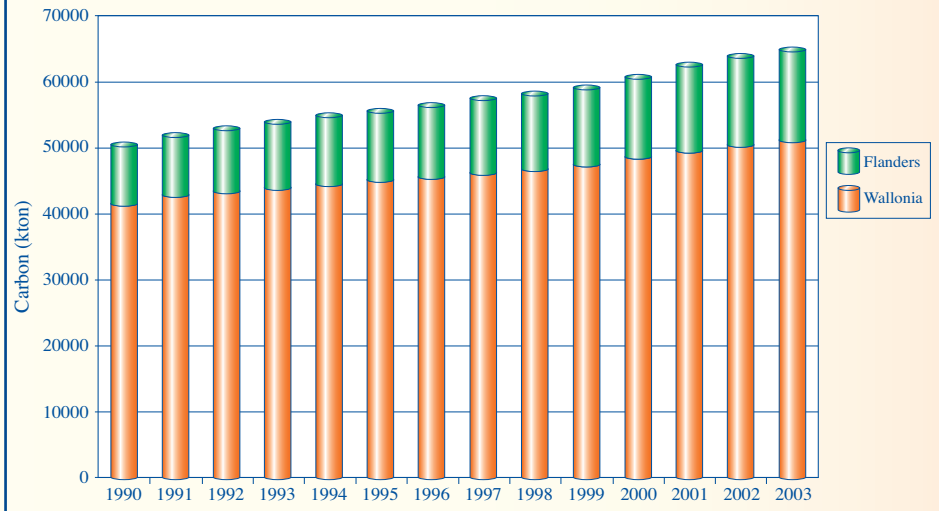


Figure 3.12. Evolution of biomass carbon stock in Belgian forests, expressed in Gg (ktonne) carbon.



Studies are under way to estimate carbon stocks in agricultural and forest soils and the impact of forest and grassland conversion. These figures will be reported in the 2006 submission and may have an important impact on the trend in this sector.

Waste

GHG emissions from waste accounted for 1.4% of national emissions in 2003, compared to 2.3% in 1990. This decrease is due to CH_4 emissions from solid waste disposal on land, which represented 45% of total emissions for the sector. Biogas recovery in landfills by flaring or for energy purposes according to its richness has been developed on a wide scale since 1990 and is the main driver of the trend in this sector. Emissions in this sector have dropped by 41.2% since 1990.

The remaining 55% of GHG emissions stems in similar quantities from three sources: waste incineration, wastewater handling and composting. CH_4 emission from composting is a key source in Belgium, reflecting in fact the increasing use of sorting and recovery practices. This source is probable overestimated, however, due to the lack of studies in the sector. This sector will be revised in the next submission in 2006. Emissions from waste incineration and wastewater handling are gradually increasing, together with the implementation of waste and water policies.

Figure 3.13. Net CO_2 removals from LULUCF in Belgium (Gg CO_2)

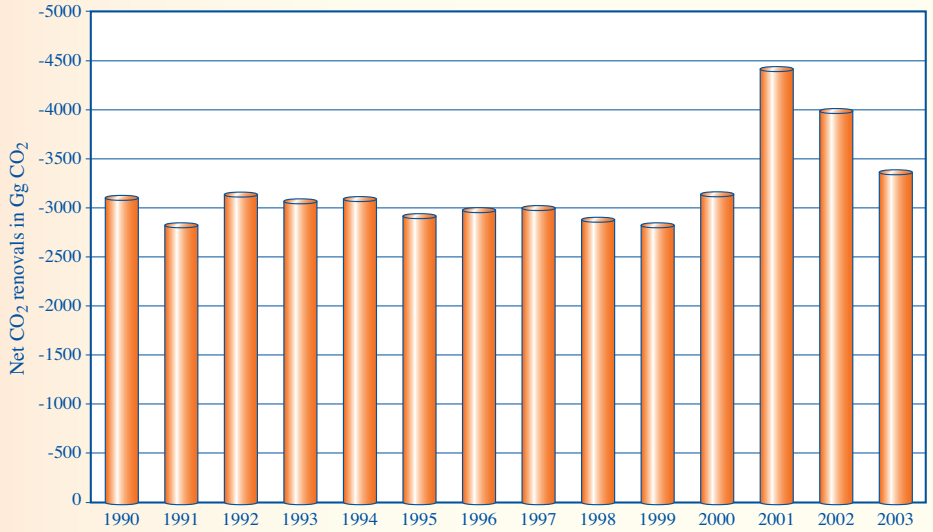
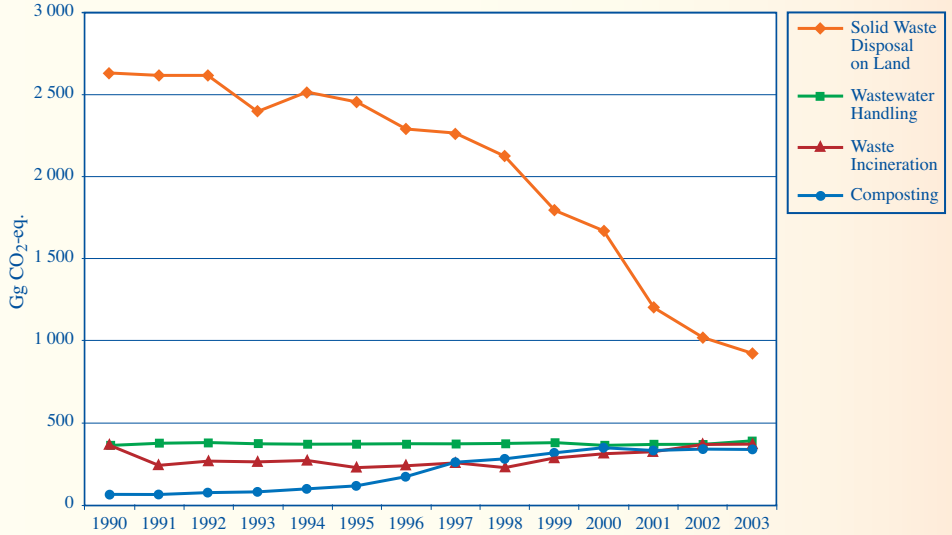


Figure 3.14. Emissions in the waste sector.



Changes compared to the Third National Communication

Many recalculations and improvements have been made to the inventory preparation process since the Third NC was published in 2001. In 2002, Belgium submitted its first National Inventory Report, including key source analysis, and provided a complete time series since 1990. In 2003 and 2004, the sectoral background tables were filled in, allowing detailed analysis and further harmonisation of methodologies between the regions. In 2005, a Tier 1 uncertainty analysis was reported.

In the meantime, emissions have been recalculated for the whole time series since 1990, for various reasons such as revision of emission factors, harmonisation of methodologies between regions and time series consistency. The recent recalculations in the 2004 submission were the following: harmonisation of the allocation of utilities between 1990 and present (major impact on KS analysis) and the discovery and addition of an important new source of emissions of F-gases since 1990. In the 2005 submission, the main recalculations were: accounting for biomass fuels in cement kilns (availability of the relevant data), revision of the emission factors in power plants based on fuel analysis, revision of CO_2 emissions from non-energy use in the chemical industry and complete coverage for C-sinks (Flanders).

Conclusion

In Belgium, greenhouse gas emissions increased by less than 1% in 2003 compared to the base year emissions. This apparent stability actually masks contrasting developments in the sectors.

On the one hand, emissions due to road transport have risen continuously since 1990 due to the growing number of cars, and increased traffic. Emissions from the residential and commercial sectors are also increasing due to various factors such as the rising number of residential houses, the rising number of employees in the commercial /institutional sector, the limited switch to gas in sparsely populated areas and so on.

On the other hand, the switch from solid fuel to gaseous fuels is observed in all sectors of fuel combustion. Together with the development of biomass fuels, it has allowed a reduction in emissions of about 7% compared to 1990, by cutting the CO_2 emissions factor for an equal level of energy consumption. The more rational use of energy is also developing but it often goes hand-in-hand with increased electricity use, so its impact on actual emissions is generally more difficult to quantify.

In agriculture, CH_4 and N_2O emissions are decreasing, reflecting the evolution of the livestock population and certain changes in agricultural practices. In solid waste disposal, biogas recovery and use has led to a net reduction in CH_4 emissions.

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4. Policies and measures

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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 take 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, i.e. encouraging the target groups to modify their behaviour through legal, regulatory or administrative constraints
R&D	Research and development	All instruments promoting 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 to raise awareness in the target groups by information campaigns and training
VOL	Voluntary / negotiated agreements	All initiatives by the political authorities 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 is adopted	Measure for which a government has taken an official decision and is expressly engaged in proceeding with the implementation
PLA	Measure is planned	Arrangements are currently being examined for which a favourable policy consensus exists for its future implementation
Greenhouse gas involved		
CO_2	Carbon dioxide	
CH_4	Methane	
N_2O	Nitrous oxide	
FLG	Fluorinated gases	
ALL	All gases	

Foreword

The policies and measures introduced by the federal government and the regions in the context of climate change policy are described in this section. The framework of the policy making process for these actions is presented, followed by the policies and measures for the different sectors. For each sector, policies and measures are grouped into categories based on the intended objective or type of instrument and the political authority concerned. Where appropriate, connections between the policies and measures implemented by the different authorities are mentioned, plus their link with the different regional plans. A serial number, preceded by a letter indicating the sector concerned (E: energy; T: transport; I: industry; A: agriculture and forestry; W: waste; M: flexible mechanism), identifies each action. and makes clear the relationship between the actions listed in the tables and their description in the text. The following information (in this order) is also presented for each action: the type of instrument, 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 chapitre 5 (projections of GHG emissions). The codes used to indicate the type of instrument implemented and the stage of implementation is explained in Table 4-1.

Policy-making process

In the Belgian federal system, policies and measures to reduce greenhouse gas emissions are mapped out at different levels of government, in keeping with the division of power between the federal state and the regions. Each of these levels of power establishes its own priorities for environmental and climate policy. Co-ordination bodies have been established, in order to harmonise and create synergy between the policies conducted by the federal government and those of the three regions, the National Climate Commission being the most important. The general context for the preparation of policies and measures regarding climate change is consequently established by a number of guiding plans drawn up by the federal and regional authorities, which determine policy objectives and strategies. These plans are presented below.

National climate policy

In its decision of 6 March 2002, the Interministerial Conference for the Environment approved the National Climate Plan 2002-2012. This plan was developed jointly by the federal government and the regions. It is meant to enable Belgium to fulfil its commitments under the UNFCCC and the Kyoto Protocol. The plan is based on the integration of the policies and measures implemented by the different authorities, in relation with their respective competencies, within the federal framework of Belgium.

The 'Cooperation Agreement for the implementation of a National Climate Plan and reporting in the context of the UNFCCC and the Kyoto protocol', adopted on 14 November 2002, concerns implementation and follow-up of the National Climate Plan and the establishment of reports in the context of the UNFCCC, the KP and the decision for a Monitoring Mechanism (Decision 280/2004/EC), with the ultimate goal being to reduce emissions of CO_2 and other greenhouse gases. A first evaluation of the National Climate Plan, based on environmental, social and economic criteria, will take place in 2005 and will be followed by an update of the Plan.

To implement this Cooperation Agreement, the 'National Climate Commission' (NCC, the executive body of the Cooperation Agreement) was formally put into place on 5 December 2003. This Commission is an essential instrument for implementation of the Kyoto Protocol in Belgium. It has a key role in assessing and monitoring the national climate policy and the institutional setting-up of the flexible mechanisms. The NCC is composed of representatives of the federal and regional governments.

Within the framework of the Cooperation Agreement, an internal burden sharing arrangement was agreed on 8 March 2004 between the federal government and the three regions, under the auspices of the National Climate Commission. This agreement clarifies the respective responsibilities of the different authorities as regards compliance with international commitments. It defines differentiated targets for the three regions, and determines the extent to which the federal government will contribute to the national effort, through both the implementation of domestic measures and the acquisition of emission allowances on the international market (see below).

Moreover, in application of European Directive 2003/87/EC (EU GHG emission trading scheme), Belgium has developed its National Allocation Plan (NAP) 2005-2007, adopted by the European Commission on 20 October 2004. The regional authorities are competent for allocations to almost all installations under the ETS Directive. Only the backup installations of nuclear power plants fall under federal jurisdiction.

A cooperation agreement relating to the organisation and administrative management of the national register, negotiated within the National Climate Commission, was adopted in September 2005.

Finally, a cooperation agreement providing for implementation of the flexible mechanisms is currently being negotiated and is expected to be adopted in the near future.

Federal government (FED)

In the context of the Act on coordination of federal policy for sustainable development (5 May 1997), a new version of the Federal Plan for Sustainable Development (2004-2008) was adopted by the federal government (14 September 2004). This Plan defines the measures to be taken at the federal level to achieve SD objectives. One of the six themes of the Federal Plan for Sustainable Development (FPSD 2004-2008) is 'limitation of climate changes and more intensive use of clean energy'. A number of specific actions under the Plan are related to this theme. They aim notably at: strengthening federal coordination, implementing a green tax system, developing a fair pricing strategy, developing solidarity through the 'flexible mechanisms', promoting alternative energies and 'clean buildings', improving the public transport supply, developing clean car technologies, etc. This plan is characterised by both prescriptive and indicative planning. The FPSD also provides for the promotion of mobility that is compatible with sustainable development, based on managing the growing need for mobility and increasing the security of travel, technological innovation and modal transfer.

Although it has been established by Royal Decree, the Plan does not have regulatory authority. The measures that it contains have to be worked out and implemented under ordinary decision-making procedures and, if need be, are submitted to Parliament for approval. The federal government is required to report yearly on the progress made on achieving the Plan's objectives. A new Federal Plan for Sustainable Development has to be drawn up every four years.

The Council of Ministers of 19-20 March 2004 approved a set of measures to reduce greenhouse gas emissions. These measures make up the core of the federal climate policy. As a whole, this set of measures should guarantee a reduction in national greenhouse gas emissions of 4.8 Mt CO_2 eq. per year for the period 2008-2012. These measures are currently being assessed and will be adapted if necessary.

The federal government also intends to make use of the flexible mechanisms (about 2.5 Mt CO_2-eq./year for 2008-2012) of the Kyoto Fund (financed by € 25 million/year, operational since 2003). A first invitation to tender for JI and CDM projects was launched in spring 2005. The federal government has also agreed with the regions to take up the task of establishing a national registry of emission rights, in the framework of the Cooperation Agreement of September 2005. The national registry has been approved by the European Commission in June 2005 to connect with the Community independent Transaction Log. The national registry will be fully operational before the end of 2005.

Flemish region (FR)

The Flemish Climate Plan (FCP) was approved by the Flemish government on 28 February 2003 and is intended to give an overview of all climate related policies and measures in the Flemish Region. The plan was the first result of the policy-integrating work of the Flemish Taskforce on Climate, established by the government in 2001. The central part consists of 33 projects, divided into three categories: projects with a certain emission reduction potential, research and policy-oriented studies and communication campaigns. The third Environmental Policy Plan (MINA-plan 3) 2003-2007, approved on 30 September 2003, takes the same approach as the Climate Plan by promoting three strategic elements for an integrated Flemish climate policy: optimisation of the foundations on coordination and reporting (task force, emission inventories, projections and monitoring), a sectoral approach with actions for each key source sector and a clear strategy on the use of flexible mechanisms, including implementation of the EU emission trading scheme.

Designed as a 'learning by doing' plan, the FCP is subject to a yearly evaluation. The Climate Task Force submitted an initial progress report (VORA03) to the government on 5 September 2003. A second, VORA04 was approved on 11 June 2004. Each progress report gives the status of implementation of all projects, updated emission trends and new projects (six in each report), and calculates the effort still to be made to achieve the Flemish Kyoto objective. The advice of different councils and the Parliament is incorporated.

The first climate plan focused on the Flemish stabilisation objective for 2005, conditional on federal actions. On 1 October 2004, the Flemish government gave the Climate Task Force the task of preparing a new plan for the period 2006-2012. The new plan will be based on an evaluation of the first FCP and intermediary reports and accompanied by a broad consultation process with the stakeholders, the Flemish Climate Conference. This conference started in June 2005 and held its first evaluation on 18 October; many recommendations from stakeholders were submitted to the Flemish Minister of Environment and Energy.

Since 2001, several working groups under the Task Force have been set up to prepare or implement more technical issues such as the Flemish allocation plan, implementation of the EU Linking Directive, optimisation of the GHG inventory and a Flemish strategy for beyond 2012.

Walloon region (WR)

On 19 July 2001, the Walloon government adopted the Walloon Region Action Plan for Climate Change. 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 on adoption of the Kyoto protocol objectives). Among the many corollaries to this plan, some recent policies and measures should be emphasised.

First, the scheme for GHG emission allowance trading was adopted by the Regional Decree of 10 November 2004, in application of Directive 2003/87/EC. Pursuant to this law, a Regional Allocation Plan was adopted by the Walloon government on 27 January 2005. 128 industries received a maximum greenhouse gas emission quota based on energy audits performed at each site. The incentives to reduce industrial GHG emissions were reinforced by voluntary branch agreements under which the main industry sectors made an undertaking to improve their energy efficiency.

Second, the Walloon Plan for Sustainable Management of Energy (18 December 2003) proposed several approaches to stepping up the policy of rational use of energy (RUE) and developing renewable energy sources (RES). RUE is promoted by various grants (energy audits, etc.) or tax deductions on investments (house insulation, replacement of old boilers, etc.). The plan's target is to ensure that 8% of electricity and 12% of heat are produced from RES by 2010. To attain that objective, 'green' electricity is promoted through the allocation of a minimum quota of RES certificates to each energy supplier ('green certificates') defined in the regional Decree of 4 July 2002, and through a system of support for production (Regional Decree of 6 November 2004).

Third, recent measures taken in the transport sector are essentially structural in nature, e.g. improvement of public transport or multimodal transport of goods. During the last year, several Mobility Plans were established for 52 municipalities, aiming to improve the rational use of different types of transport.

Finally, two legislative instruments have come into force in the agriculture and forestry sectors: the decrees implementing the decree on environmental permits (11 March 1999) and the decree relating to the Walloon Sustainable Management Programme for nitrogen in agriculture (10 October 2002). Concrete application of the Decree (6 December 2001) on the preservation of Natura 2000 sites (protection of endangered flora and fauna) is resulting in the protection of 148 000 hectares of forest (27% of the total Walloon forest) and thus helping to preserve carbon stocks in these ecosystems. In the waste sector, implementation of the waste plan has reduced the total amount of waste being put in landfills and its biogenic content. Biogas recovery is also encouraged by the plan and has been considerably developed since 1993, leading to a substantial decrease in net methane emissions from landfills.

Brussels-capital region (BCR)

The Brussels-Capital Region adopted on 13 November 2002 (Decision G-31.55.0) an eight-year Air and Climate Plan, the Plan for Structural Improvement in Air Quality and the Fight against Climate Change, 2002-2010. The legal basis of the Plan is the decree on the evaluation and improvement of ambient air quality (25 March 1999), which is the transposition of European Directive 1996/62/EC.

Since the region is a city, the main sources of most atmospheric pollutants are the same as the sources of greenhouse gases: the heating of buildings (residential and tertiary) and transport. That is why the Air Plan has been merged with the Climate Plan. The Air and Climate Plan is being managed by the Brussels Institute for Environmental Management (IBGE/BIM) in collaboration with other regional administrations such as the Administration for Infrastructure and Mobility (AED) and the Administration for Land Management and Housing (AATL).

The Plan comprises 81 provisions designed to reduce the main sources of pollutants and greenhouse gases. These include:

- For road transport: traffic and parking management actions, compulsory mobility plans for businesses, promotion of public transport and introduction of clean vehicles in all public fleets;
- For energy consumption by heating systems in buildings: thermal regulation actions, systematic control of boilers, energy certification and eco-construction; and
- For the business sector: regulation and control of refrigeration installations.

The plan also establishes that the region will give preference in the implementation of flexible mechanisms to clean development mechanisms.

Since the EU emission trading scheme covers only 2% of regional GHG emission, the Brussels allocation plan adopted in October 2004 is unfortunately not an efficient tool for emission reduction.

Energy

Context of the energy policy

Main policy objectives

In Belgium, energy policy encompasses both federal and regional competences. The federal government is responsible for 'matters which, owing to their technical and economic indivisibility, require equal treatment at national level', including electricity and gas tariffs, market regulation for large infrastructure for storage, transmission and production of energy, the nuclear fuel cycle, and R&D in both nuclear fusion and fission.

The regional governments of Flanders, Wallonia and Brussels-Capital are mainly responsible for formulating and implementing policies for energy efficiency, renewable energy, non-nuclear energy research and development (R&D) and market regulation for the distribution and supply of electricity and gas through distribution networks.

FED: From the early 1970s, Belgium's overall energy policy objectives have concentrated on security of supply based on diversification of geographical sources and fuels, liberalisation of the electricity and gas market, energy efficiency, transparent and competitive energy pricing, and environmental protection.

More recently, the Federal Plan for Sustainable Development (2004–2008) defined the key strategies in the field of energy policy related to climate change mitigation and more intensive use of clean energy:

- Strengthened federal coordination, including the development of a green tax system for buildings, companies and the transport and electricity sectors.
- Fair prices, including the progressive limitation of existing advantages on certain products or activities and reform of the taxation system (shifting from taxation of work towards taxation of consumption of resources).
- Flexible mechanisms, including proactive dialogue with developing countries, strengthened financial and technical assistance and capacity building.
- Promotion of alternative energies, including fiscal incentives and research focused at the regional level, plus promotion of bio-fuels.
- Clean buildings, including streamlining investments in energy efficiency, most notably through third-party financing.

FR: Flanders aims to implement a sustainable energy policy in which the economic and social importance of energy is reconciled with the finite nature of fossil fuels and the need to safeguard the environment. On the one hand, the Flemish energy policy wants to ensure the best possible energy services for a correct and socially acceptable price for all social groups. On the other hand, it promotes the rational use of energy and aims to achieve the Kyoto objective. The Rational Use of Energy Decree, approved on 2 April 2004, forms the basis for the Flemish policy on rational use of energy and renewable energy sources and the Flemish deployment of flexibility mechanisms. The Flemish government wants to reduce energy use in the residential sector by 7.5% in 2010 compared to 1999 and to increase energy efficiency in industry and the service sector in 2010 compared to 2004. In 2010, 25% of electricity supplies in the Flemish Region should be generated in CHP installations and installations using renewable sources (Flemish government Agreement 2004-2009).The Flemish Region has set an objective of a 6% minimum contribution of renewable energy sources to the total supply of electricity by the end of 2010.

WR: 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[8] is based on five 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 constitute a specific policy area treated separately). The Walloon Region wants to reduce the final energy consumption by 8% in 2010 compared to 2000 (-11% in industry, -5% in residential, -11% in tertiary and –6% in transport).

By 2010, the objectives of the Walloon Region for green energy are to:

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

BCR: The Brussels Government Agreement mentions the need for a coherent energy policy to improve air quality in Brussels, stimulate the rational use of energy[9] and promote the use of solar energy. The new energy measures will stress the rational use of energy by proposing actions in the area of the energy performance of buildings, transport, etc. In 2006, energy actions under the Air and Climate Plan will be reinforced.

Legal context of liberalisation of the electricity market

FED: The Federal Law on the operation of the electricity market of 29 April 1999 establishes the basis for the transposition of a European Directive[10] at the federal level. It concerns electricity generation and distribution, the tariff structure, long-term planning and competition. To support 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, the market for 'green certificates' for electricity produced from renewable energy (Article 7), and the construction of off-shore wind farms along the Belgian coast (Article 6). The Indicative Plan of Infrastructure for Electricity Generation[11] sets out the broad lines of the choice of primary energy sources. Particular attention will be paid to renewable sources when implementing this plan. The law establishes, among other things, conditions for third party access to the transmission system and regulatory aspects. Consequently, a Federal Regulatory Commission was set up in 2000

[8] Plan pour la maîtrise durable de l'énergie

[9] In view of the limited opportunities in terms of electricity generation in the Brussels-Capital Region, no numeric objective has been set for the proportion of renewable energy in electricity generation (with the exception of the use of solar heating applications)

[10] Directive 96/92/EC of the European Parliament and the Council of 19 December 1996 concerning common rules for the internal market in electricity

[11] Article 3 of the law of 29 April 1999

to monitor the electricity and gas market. It is charged with advising the authorities on the organisation and operation of the liberalised electricity and gas markets. It also supervises and monitors the application of relevant laws and regulations.

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

These regional responsibilities are:
- low voltage distribution of electricity (i.e. < 70 kV);
- public service obligations related to RUE;
- public service obligations related to the promotion of renewable energy;
- social aspects.

In Flanders, the electricity and natural gas markets were fully liberalised on 1 July 2003. The Flemish Parliament Act of 17 July 2000 and 6 July 2001 transposes the European Directive concerning the liberalisation of the electricity and natural gas market. In the Walloon and Brussels-Capital Regions, the liberalisation process is under way and is expected to be completed by the end of 2006.

Administrations and bodies in charge of energy

FED: At the federal level, the Directorate-General Energy of the Federal Public Service (FPS) Economy, SMEs, Self-employed and Energy is in charge of energy matters. Under the current legislature, responsibility for energy falls on the Ministry of Economy, Energy, Foreign Trade and Scientific Policy.

The Commission for the Regulation of Electricity and Gas (CREG), which monitors the liberalised segment of the gas and electricity markets, has two essential missions:

- advising the public authorities ;
- providing surveillance and control of the application of laws and regulations.

FR: In the Flemish Region, energy matters are regulated by the Division of Natural Resources and Energy (ANRE), the future Flemish Energy agency. The Flemish Regulatory Authority for the Electricity and Natural Gas Market (VREG) ensures the efficient organisation and operation of the Flemish electricity and natural gas markets.

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 research and development related to energy technology.

WR: In the Walloon Region, the Directorate-General Technology, Research and Energy (DGTRE) is in charge of energy policy, including research. The Walloon Energy Commission (CWAPE) is the official regulatory body for electricity and gas matters that are the remit of the Walloon Region.

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

Federal-Regional Cooperation

CONCERE/ENOVER (Concertation Etat-Régions pour l'Energie/Energie-overleg) is a formal forum for discussion of all energy matters. It became operational in 1992. Its main tasks are to:

- Gather information and promote information exchange between the regions and the federal government on national and international issues.
- Support all policy measures, including those involving both federal and regional authorities, in a spirit of internal cohesion and respect for mutual responsibilities.
- Contribute to the definition of common positions by the federal government and the regions on international and/or European energy issues which concern all the parties.
- Select representatives for Belgian delegations participating in international meetings.

This unit provides advice and makes recommendations, although these are not binding. Plenary sessions are held monthly. Several working groups on thematic subjects have been created. The DG En-

Table 4-2. Division of Responsibilities for Energy Policy between the federal and regional governments

Federal government	Regional governments
- Indicative programme for the electricity sector - Nuclear fuel cycle and related R&D programmes and nuclear fusion research - Large storage infrastructure, - Transmission and production of energy - Tariffs - Offshore energy	- Distribution and transmission of electricity through networks with maximum voltage of 70 kV - Public distribution of gas - Use of methane and blast furnace gas - District-heating equipment and networks - Use of waste products from coal tips - New and renewable sources of energy - Recovery of waste energy from industry or other uses - Rational use of energy

ergy of the Federal Public Service (FPS) Economy, SMEs, Self-employed and Energy provides secretarial assistance to the unit, which does not have an independent budget or permanent staff.

Energy production

E01 – Green certificates

FIN/REG IMP CO_2-CH_4

A new market mechanism has been set up, consisting in a system of 'green' certificates (GC). These are delivered to the 'green' producer. In addition, procedures guaranteeing priority access to the network are implemented for renewable electricity or electricity from high quality CHP. Electricity suppliers are obliged to buy a minimum volume of 'green' electricity (i.e. made from renewable energy sources: wind, hydro, solar, biomass, cogeneration). There are some differences between the non-cumulative GC systems implemented by the different entities. These are summarised in the table 4.3:

FED: At the Federal level[13], a GC mechanism has been introduced for electricity generated by RES installations. These GC will be issued by the Commission for the Regulation of Electricity and Gas (CREG) to the producers that are entitled to a concession and dispose of a warranty of origin.

With a view to ensuring the placing on the market of a minimum volume of green electricity, a system of minimum repurchase prices for GCs was established by the Royal Decree of 16 July 2002. The grid manager is under an obligation to buy green certificates from producers of green electricity, generated by installations located on Belgian territory (maritime or continental), at a minimum fixed price.

The grid manager commercialises these certificates to recover the costs involved. The net balance resulting from the difference between the GC purchase price paid by the grid manager and the sale price of the certificate on the market is financed by a surcharge on electricity transmission tariffs.

FR: Since 1 January 2002, producers in the Flemish Region are awarded a certificate for every 1 000 kWh generated from a renewable energy source.

An administrative fine of 125 euro is imposed on suppliers from 2004 if they are unable to present a sufficient number of GCs. These fines are paid to the Renew-

Table 4.3. Differences between the Green Certificate systems implemented by the different entities

Criteria	Federal	Flanders	Wallonia	Brussels
Minimum quota		2% in 2004, increasing to 6% in 2010	2% in 2004, 5% in 2005, 6% in 2006 and 7% in 2007	2% in 2004, 2.25% in 2005 and 2.5% in 2006
Calculation basis		2% of delivered electricity	Comparison with best classic conversion process	Comparison with best classic conversion processes
Minimum purchase price:				
Off-shore wind	€ 90/MWh or € 107/MWh[12]	€ 80/MWh	€ 65/GC	
On-shore wind	€ 50/MWh	€ 80/MWh	€ 65/GC	
Hydraulic	€ 50/MWh	€ 95/MWh	€ 65/GC	
Solar	€ 150/MWh	€ 450/MWh	€ 65/GC	
Biomass	€ 20/MWh	€ 80/MWh	€ 65/GC	
Non- compliance price			€ 100/GC	€ 75 until 2006 and € 100 from 2007

[12] The grid operator is obliged to purchase green certificates originating from the first 216 MW of off-shore installations.

[13] Royal Decree of 16 July 2002

able Energy Sources Fund, which is used to broaden the social support for renewable energy, to take sectoral flanking measures, to launch demonstration and market entry projects and to encourage the production of green heat.

On 5 March 2004, the Flemish government gave final approval to a new Decree on the promotion of electricity generation from renewable energy sources, as a result of which there is now a possibility to grant certificates for the production of electricity generated from the organic-biological part of residual waste.

The Flemish Parliament Act of 7 May 2004 amending the Flemish Parliament Act on the organisation of the electricity market of 17 July 2002 introduced a progressive exemption for large users from the system of green electricity certificates to avoid putting pressure on their competitive position. For every point of delivery, there is a 25% exemption for levels of use between 20 and 100 GWh. The exemption amounts to 50% for a level of use above 100 GWh.

WR: Electricity suppliers have to buy a certain quota of green certificates, otherwise the supplier has to pay a penalty[14]. The CWAPE supervises the green certificates market.

In 2003, the CWAPE issued 612 180 GCs (52% hydro, 12% biomass, 23% CHP+biomass, 11% CHP and 2% wind). The average price for a GC was € 85.24.

The CWAPE has estimated that 1 100 000 GCs will be issued in 2005 (40% biomass, 24% hydro, 19% CHP+biomass, 12% wind, 5% CHP).

For installations that became operational after 1 July 2003, the green producer may choose not to sell green certificates to suppliers, but rather to exchange them for production aid financed by the Energy Fund.

Another mechanism based on eligibility is introduced by the decree to stimulate green electricity. A customer who is not eligible based on consumption volume becomes eligible if supplied by a green supplier. Green suppliers buy half of the electricity supplied in the Walloon region from green producers.

BCR: In the Brussels-Capital Region, as in the two others, a system of green certificates (GC) has been put in place. Two obligations are imposed on electricity suppliers: the annual submission of green certificates (whose number is determined by the regional government), and the purchase of surplus electricity derived from CHP generated by independent producers. The GCs are compatible and exchangeable with the Walloon Region.

E02 – Financial support for electricity generation from RES

FIN | IMP | CO_2-CH_4

In addition to the Green Certificates scheme, the Belgian authorities have implemented several measures to promote generation from RES. RES and CHP producers enjoy priority access to the grid in all regions.

FED: The Federal Minister for Energy can deliver concessions for the construction and exploitation of installations generating electricity from water, currents or winds in Belgium's territorial seas and exclusive economic zone[15]. The zones where installations may be set up have been defined. The Decree also specifies the criteria and procedure for the grant of concessions.

The Energy Chapter of the law of 20 July 2005, which contains various provisions, provides that the grid operator must contribute one third, with a maximum of € 25 million, of the cabling costs for projects of 216 MW or more. This contribution is reduced proportionally if the project is inferior to 216 MW. The Royal Decree of 5 October 2005 amending the Royal Decree of 16 July 2002 makes provision for:

- the increase from € 90 to € 107/MWh for green certificates originating from the first 216 MW of off-shore installations;
- a 20-year purchase obligation for green certificates originating from off-shore installations, rather than 10 years.

FR: The most important financial support measures for electricity generation from RES are:

- support for ecological investments ("Framework Decree on the economic support policy approved and the implementing decree on renewed ecological aid"): the investment subsidy amounts to 10-14% for CHP or electricity generation from biomass or bio-oil, 17.5-24.5% for hydro-electric or solar power plants and 2.5-10.5% for wind plants, depending on the size of the company and the installation;
- a tax abatement of 13.5% of RES investments can be deducted from companies' taxable income.

These support schemes can be cumulated.

- To promote renewable energy sources, some legal barriers are also dismantled, such as the adaptation of the establishment rules for wind turbines and for fermentation plants in agricultural areas.

WR: Subsidies are available for RES investments under a decree that establishes a new legal basis[16] for financial incentives for sustainable energy (investments in energy efficiency in the production process, renewable energy and CHP). This new legislation has been adopted following Community guidelines on state aids for environmental protection.

[14] Decree of 4 February 2002 on the promotion of green electricity, amended by Walloon Government Decree of 4 March 2004.

[15] Royal Decree of 20 December 2000, amended by a Decree of 17 May 2004

BCR: In the Brussels-Capital Region, a financing scheme has been set up for the public sector and non-commercial organisations. It covers 20% of investments in CHP or 30% of investments in other renewable sources provided certain performance requirements are met, as well as 50% of feasability studies.

E03 – Support for electricity generation from CHP

MIX | IMP | CO_2

These measures come on top of the Green Certificates (see E01).

FED: The generation of electricity from CHP is encouraged particularly by the tax deduction (see E05 and E08). Chapter XVIII of the general law of 27 December 2004 establishes an exemption from the energy tax for fuels supplying a CHP installation.

FR: Pursuant to European Directive 2004/8/EC on the promotion of cogeneration based on useful heat demand in the internal energy market, the Flemish Region aims to realise the economic potential of high-efficiency CHPs amounting to 1,198 MW in 2005 and 1,832 MW in 2012. At end-2004, the cogeneration capacity deployed came to 1,091 MW. At present, cogeneration plants with a capacity of over 500 MW are under construction.

On 2 July 2003, the introduction of a cogeneration certificate scheme was approved by the Flemish Parliament. For each 1,000 kWh saving through cogeneration in a high-efficiency CHP, a certificate is awarded to the producer. At the same time, the suppliers of electricity are required to present cogeneration certificates.

According to the accompanying implementing decree of 5 March 2004, electricity suppliers must present cogeneration certificates in 2006 for 1.19% of the electricity supplied in the previous year. This proportion increases each year to 5.23% in 2013 and is then maintained. The acceptance of the certificates under the requirement is degressive according to the age of the plant (full acceptance during the first 4 years and subsequently gradually phased out after about 10 years). The scheme started on 1 January 2005.

To supplement this scheme, the cogeneration promotion and information activities were stepped up.

WR: In August 2004, there were 19 CHP installations with a total capacity of 132.242 kWe and 10 CHP from biomass installations with a total capacity of 35.225 kWe.

The objective is to produce 15% of electricity from CHP in 2010.

This objective is based, for the industrial and tertiary sectors, on studies assessing the potential, company by company, that still exists in Wallonia. For the residential sector, the objective counts on, among other things, the development of micro-cogeneration and combustible batteries after 2005.

In addition to Green Certificates, different tools have been set up by the Walloon Region to promote CHP:

- Seminars and meetings to demonstrate the efficiency and relevance of this technology;
- Public allocation scheme to finance this technology: CHP installations may receive financial aid for feasibility study or investment.
- Technical and administrative information through a free CD-Rom and the services of a facilitator.

BCR: The Brussels-Capital Region set up a new financing scheme in 2005, which includes financial support for CHP for various public institutions and non-commercial organisations (up to 20% of the investment). Additionally, Sibelga (the electricity and gas distribution system operator) provides financial support for various techniques, including CHP, and feasibility studies in the context of its public missions for the Rational Use of Energy.

E04 – Demonstration projects, information actions and "facilitators" to promote RES and CHP

EDU | IMP | CO_2-CH_4

FR: To promote the use and know-how of RES and CHP, facilitators have been appointed. Target groups include industry, project developers, local authorities, education institutions and so on.

RES demonstration projects are supported financially by the Ministry of the Flemish Community. Each project is eligible for a subsidy covering up to 35% of total costs. To be eligible, the demonstration projects must be innovative and present economic opportunities for the region.

WR: Several "facilitators" have been appointed. These are private operators subsidised by the Walloon Region. They provide information and advice for potential investors, but do not develop projects themselves. The facilitators also inform the Walloon Region on obstacles to the development of their particular renewable field.

There are several facilitators for:
- wind
- hydro-electricity
- biomethanisation
- wood (public and private sector)
- biofuels
- CHP

BCR: In 2005, the Brussels Region introduced a similar system of facilitators. Two facilitators have been appointed, focusing respectively on renewable and CHP. Additionally, Sibelga provides technical support for CHP, in the context of its public missions to promote the rational use of

[16] Decree of 11 March 2004 on incentives to promote protection of the environment and the sustainable use of energy

energy. Several demonstration projects using solar thermal panels were financed in 2003-2004 in Brussels.

Energy consumption

Industrial sector

Preliminary remark:

Policies and measures for improving energy efficiency by benchmarking or voluntary agreements in the industrial sector are presented in 4.4 ('Industry'). Actions that relate to training or raising awareness of the issues are described in Section 9 'Education, training and public awareness'. Only actions in the industrial sector whose main objective is not a voluntary agreement and which make use of instruments other than training are presented here.

E05 – Financial incentives for investments in energy efficiency

FIN | IMP | CO_2

FED: Since 1992, a tax deduction has been granted for 13.5% of the cost of investments aiming to increase energy efficiency in the industrial sector (including the use of renewable energy resources).

The legislation provides that investments eligible for tax deductions must concern real property falling into one of the categories of Annex II of the Royal Decree/CIR92[17]. The investments must concern more rational use of energy, improvement of industrial processes with regard to energy or the recovery of energy in industry.

FR: In pursuance to the Community guidelines on State aid for environmental protection (OJ C 37 of 03.02.2001), the Decree on the economic support policy was approved on 31January 2003. The provisions of this Decree are put into practice through the Decree of the Flemish Government on the award of aid to undertakings for ecological investments in the Flemish Region of 1 October 2004 and the Ministerial Decree of 29 October 2004 regulating its implementation. The new scheme started on 29 October 2004. The ecology premium is a financial subsidy for undertakings carrying out ecological investments in the Flemish Region. Ecological investments refer to environmental investments, investments in the energy sector and investments for relocation for environmental reasons. The ecology premium has 3 important characteristics:

1) To boost the investment climate focusing on sustainable development and the manufacture of sustainable products;
2) Low threshold for the benefit of SMEs;
3) Duty to achieve a given result for investments in the energy sector.

For energy-intensive heavy industry, the award of the ecology premium is conditional on signing the benchmarking covenant on energy efficiency in industry.

WR: A grant is allocated to federations of companies for improving energy efficiency in their sector as a whole (up to 100% of operational costs)[18].

Twenty-one subsidies are available to legal entities and self-employed persons.

BCR: A subsidy of 20% is granted to companies making investments in energy efficiency. Additionally, Sibelga (the electricity and gas distribution system operator) provides financial support for specific techniques, e.g. frequency regulators for pumps, fans and compressors, in the context of its public missions to promote the Rational Use of Energy.

E06 – Energy audits

MIX | IMP | CO_2

FR: - The Flemish government employs energy consultants who conduct pre-audits for users, free of charge. In 2006, the Flemish government will also grant subsidies to sector federations for the employment of energy consultants. The idea is to provide direct delivery of information and advice to a large group of small companies with energy use under 0.1 PJ.

- With the Decree of 29 March 2002 (amended on 26 September 2003), the Flemish government imposed RUE public service obligations on the electricity distribution grid operators (see E 07). Grants for energy audits are part of the RUE action plans.

WR: A free consultation service for small and medium-sized companies, the 'RUE broker', has been set up to promote RUE. This service analyses the company's energy balance, identifies the main problems, suggests solutions and provides advice on financing, including the use of subsidies and other incentives available in the Region. In addition, grants (up to 50 or 75%) are available to companies for external and internal energy audit costs.

BCR: Energy audits are subsidised at the rate of up to 50% of cost (75% for companies under the European emission trading scheme). Specific audits in the field of HVAC and lighting are also financed up to 50% by Sibelga (the electricity and gas distribution system operator), in the context of its public missions to promote the Rational Use of Energy.

E07 – Public service obligation

REG | IMP | CO_2

FR: To ensure that energy companies continue RUE actions in the liberalised market, the government of Flanders approved a Decree on 29 March 2002 (amended on 26 September 2003), imposing RUE public service obligations on the electricity distribution grid operators. They are obliged to achieve primary energy savings for end us-

[17] Royal decree of 27 August 1993, version 1992

[18] 30/05/2002: Walloon Government decree on the grant of subsidies for the improvement of energy efficiency and the promotion of more rational use of energy in the private sector

ers every year. The primary energy savings target for high voltage clients is 1%.

Every distribution grid operator must submit yearly, no later than 1 June, a plan outlining its RUE actions for the following year. The actions providing financial support for RUE technologies for the operator's customers must be accompanied by awareness-raising and information campaigns. The grid operator must also draw up an evaluation report every year on the actions implemented during the previous year. Fines must be paid if the targets are not achieved. The fine amounts to 10 euro cents for every kWh of primary energy below the target level that is not saved. An evaluation of the RUE public service obligation is planned in 2005.

WR: A public service obligation is imposed on electricity and gas suppliers. An annual bill provides detailed information on consumption and primary energy. This includes the annual consumption and the evolution of consumption for the last three years, as well as the average consumption of a typical customer. Together with the annual bill, suppliers must transmit any RUE documents issued by the ministry. They also grant subsidies, specified by the government, for RES or RUE.

Grants are refunded through the Energy Fund.[19]

RUE and RES in buildings

a) Residential

E08 – Financial incentives for the rational use of energy (RUE) and RES

FIN | IMP | CO_2

FED: The Federal law of 10 August 2001 on the reform of personal income tax stipulates that investments to improve the rational use of energy give entitlement to tax deductions for income for the year 2003 and following.

The rate is 15% for the replacement of old boilers (more than 20 years) by new condensation boilers and for solar and geothermal energy; 40% for the installation of double glazing, roof insulation, the installation of a central heating regulator, plus energy audits. The tax deduction may not exceed 500 euro (base amount, before "indexation"; 610 euro for 2004 income) per year. These incentives were made effective by the Royal Decree of 1 January 2003.

As provided for by the law of 10 August 2001, an extension of the tax deduction for energy savings investments by households will be in application from 2006 (for 2005 income):

1. 40% of the investment are deductible up to 620 euro for new houses and 750 euro for renovation (for all 8 types of investment);
2. tenants may also apply for the tax deduction.

The Belgian government recently implemented various measures to limit the impact of high oil prices. These include the doubling of the ceiling for the yearly tax deduction granted for investments to improve the rational use of energy in dwellings. In addition, the creation of a fund to provide 0% interest loans for RUE investments by private citizens is planned.

FR: The Flemish authorities provide a subsidy of 50% for the installation of photovoltaic panels. In 2006, the subsidy will be replaced by the minimal support in the framework of the Green Certificate system (450 euro/MWh, see E02).

Solar boilers are provided by the electricity grid operators as part of their RUE public service obligations. The Flemish government, the grid operators and the solar sector have signed an agreement on awareness-raising, the implementation of a quality system and guaranteed subsidies by the grid operators (625 euro).

WR: The SOLTHERM[20] programme aims to have 200 000 m^2 of solar panels installed for 2010, by means of information campaigns and incentives. For households, the subsidy is 1 500 euro for 4m^2 plus 100 euro per additional m^2. Financial incentives from local authorities (provinces and municipalities) can be added to this amount. Subsidies from the provincial authorities range between 500 and 750 euro; municipalities offer between 124 and 750 euro.

BCR: A subsidy is granted for investments in solar water heaters for domestic hot water (35% of the cost; maximum of 991.57 euro per household). Sibelga (the electricity and gas distribution system operator) also provides an extra subsidy (up to 625 euro for 8m^2, and 75 euro per extra m^2, up to 9 625 euro), in the context of its public missions to promote the Rational Use of Energy.

In addition to regional renovation subsidies and federal tax deductions for investments in energy efficiency, households can obtain subsidies for using energy efficient appliances: electrical (refrigerator, washing machine, etc.) and heating (low temperature gas boiler, thermal regulation system, etc.) equipment.

E09 – Energy performance and certification of buildings

MIX | IMP | CO_2

FED: The federal government and the regions have co-financed and are co-financing several projects related to RUE in buildings and renewable energy. A software tool to assess the energy performance of existing buildings is in a test phase. Other projects (relating to the energy certification

[19] 10 April 2003: Walloon Government Decree on public service obligations in the electricity market, amended by the Decrees of 4 December 2003 and 9 December 2004

[20] SOLTHERM: Walloon Government Decree of 27November 2003 establishing premiums for the installation of solar powered water heaters (amended by Decree of 13 May 2004)

of buildings) are also being co-financed in the framework of CONCERE/ENOVER.

Cooperation between the regions for inspecting building insulation and ventilation is being conducted under the auspices of the Belgian Building Research Institute (BBRI). Various actions are being undertaken with the goal of defining, harmonising and improving the application of energy performance standards:

- an information Web site on legislation relating to ventilation and insulation in the three regions is being created
- a manual on a uniform inspection procedure throughout the country is being produced
- more appropriate legislation is being prepared
- different standards are being harmonised
- enforcement of regulations is being stepped up (more inspections).

FR: The Flemish Parliament Act on energy performance and internal climate requirements and enforcement in buildings was approved on 7 May 2004. It provides the basis for the introduction of energy performance requirements in buildings and a strict enforcement framework (based on the as-built declaration and administrative fines that correspond to approximately three times the costs not invested). The Flemish government Decree of 11 March 2005 determines the requirements (and calculation method) from 1 January 2006 for new buildings and the conversion of existing buildings, for which an urban development application must be submitted. The Decree sets the following requirements :

- for new dwellings, offices and schools: thermal insulation, primary energy use ('E-level') and ventilation;
- for new industrial and other buildings: thermal insulation and ventilation;
- for conversion of existing buildings: thermal insulation and ventilation of new parts.

The Decree on energy performance standards also provides for the introduction of a system of energy certificates containing information on the energy performance of the building (energy label) and also includes a list of energy-saving measures on which costs are recovered in the short term. They must be available when buildings are constructed, sold and rented out. They will therefore have an impact on the rent and the value of the building, as a result of which owners have an interest in investing in energy-saving measures.

The European Directive on the energy performance of buildings provides that from 2006 the energy performance certificate is to be drawn up by a qualified or accredited energy expert. Since it is not feasible for Flanders to have sufficient accredited experts available by 2006, Flanders will avail itself of the additional period of three years provided for in the Directive to introduce the certificate gradually. For new buildings, the certificate will be imposed at the same time as the introduction of the energy performance requirements (from 1 January 2006). The additional requirements for new buildings are reduced to a minimum. Introduction of a certificate before sale and renting of existing buildings is provided for from 2008. In the meantime, a calculation method for the energy performance of existing buildings and a certification procedure are being worked out.

In connection with EU Directive 2002/91/EC on the energy performance of buildings, the regulations on maintenance and checking of heating appliances for buildings and hot water are being updated to include an annual check for heating appliances, stricter technical requirements and stricter emission requirements. A modernised system of inspection, including accreditation of technical experts, is also being established.

WR: The transposition of European Directive 2002/91/EC is in progress in the Walloon Region.

This Directive sets requirements for the adoption of a calculation method for the energy performance of buildings. This method is adapted to the evolution of thermal regulations.

The fixing of new requirements for energy performance of new and renovated buildings is also mentioned in the Directive.

As far as energy certificates are concerned, the Walloon Region is currently working on introducing tools and methodologies.

Concerning new dwellings, the 'Building with Energy' action is a transitional stage. It gives architects and building contractors the opportunity to anticipate the transposition of Directive 2002/91/EC on the energy performance of buildings and encourages future owners to opt for new dwellings with high energy performance. A charter sets out the technical conditions required to reduce energy consumption. When the conditions are fulfilled, a certificate is issued for the building. This certificate describes the building's different energy features and can be considered its 'identity card'.

With regard to existing dwellings, an energy consulting procedure provides an audit, on a voluntary basis, with a view to energy performance certification.

For new tertiary sector buildings (and other types of buildings), the energy performance certification will be issued on the basis of an energy performance statement at the latest two months after the building becomes operational. Standard schedules of conditions and different tools ('Energie+ CD-ROM) are available to help project managers and building contractors.

For existing tertiary sector buildings, the Walloon Region has developed a simplified auditing procedure that is disseminated through the 'Energie+' CD-ROM (cf.

Information actions). Following a few adjustments to procedures, a certificate will be introduced soon. Our network of approved consultants will be able to take on this responsibility with adequate training.

Legislation in force (the Royal Decree of 1978) on the installation of heating equipment (boiler or heated air generator fired with solid or liquid fuel) is currently being reviewed.

The scope has been widened to take account of other requirements from the Directive on energy performance of buildings.

The objective is to adopt a decree establishing the approval and training procedures for heating specialists by the end of 2005.Training courses will be organised from 2006.

BCR: With regard to existing dwellings, an energy consulting procedure provides an audit, on a voluntary basis, with a view to energy performance certification. The Brussels Energy Agency (ABEA) has been trained and is now offering free audits.

The Brussels Region is preparing a new regulation on the energy performance of buildings, set to come into force in 2006. It will replace the existing regulation on the insulation performance of the building shell.

b) Public buildings

E10 – RUE in Public buildings

MIX | IMP | CO_2

FED: The Belgian federal government has established the Belgian Energy Service Company (ESCO) to promote energy efficiency, mainly in public buildings. ESCO has been set up with € 1.5 million in government financing from the Kyoto Fund and will seek € 5 million in private funding. ESCO will invest in projects for which energy reduction would be profitable, but the investment cost for the owner or building administrator is too high. The savings on the energy bill will first be used to reimburse ESCO and will then benefit the client.

An environmental management system will become compulsory for all federal agencies by the end of 2005. 'Sustainable development units' will be created in each federal agency to that effect.

FR: On 23 May 2001, the Flemish Parliament adopted a Resolution on the role of the government to set an example with regard to energy saving. A policy plan will be drawn up for the existing administrative buildings of the Flemish government and investments made with the aim of reducing the electricity and fuel consumption per m^2 in existing buildings and installations by 10% for the 100 largest administrative buildings by 2004. Energy accounting was started in 255 buildings and various energy audits were conducted. In implementation of the Resolution, a number of pilot projects were also carried out to demonstrate the feasibility and the energy saving of the investments in the rational use of energy. At the same time, the internal environmental performance system raises awareness about energy (see chapter 8).

To gain experience and knowledge in the field of 'sustainable building' – in which the rational use of energy is one of the key items – and in the perspective of setting an example, a budget is earmarked from the social housing sector to carry out demonstration projects involving various aspects of sustainable building. This refers to both energy-saving measures (K45 standard, insulation requirements, ventilation standards) and investments in solar heaters and mini-CHPs. A publication will be drawn up on these projects and the results attained and experience gained will be evaluated and published. It will be possible to visit the projects. At the same time, awareness-raising campaigns are under way (see chapter 8).

Ecological criteria for subsidy applications for investments in the welfare and care sector in the context of the VIPA regulations (VIPA = Flemish Infrastructure Fund for Personal Affairs) have been in force since 1 July 2003. The accompanying energy requirements consist inter alia in maximum permissible U-values for individual walls of the shell of the building, criteria for heating installations and lighting, cooling, ventilation, etc. and apply for all new buildings, extensions, and fundamental renovations of more than 1,000 m^2.

The internal energy supply action plan will be approved by the Flemish government in spring 2006. The plan describes various measures, from technical measures by building managers to awareness campaigns for all staff members to tackle the rising energy consumption in Flemish government buildings.

WR: The Walloon Region has developed voluntary actions on energy management and improvement of the energy performance of the region's buildings.

These concern, for example, the installation of energy accountancy, the designation of a person in charge of energy, audits or particular energy investments, the introduction of specific energy clauses in schedules of conditions for construction/renovation, and information for occupants.

BCR: The Energy Facilitators for the tertiary sector, collective accommodation, cogeneration and 'renewable energy-large systems'[21] provide advice for all legal persons or institutions taking steps to improve the energy performance of their property or activities.

[21] Measure 64 of the Walloon Region Action Plan for Climate Change: « Energy management of buildings in the Walloon Region», adopted in July 2001.

E11 – Promotion of RUE with the local authorities

MIX | IMP | CO_2

FR: The Flemish government has concluded a voluntary agreement with the local authorities, the 2002-2007 Cooperation Agreement, to promote a sustainable local environment policy. Through the energy section of this agreement, the municipalities and provinces have freedom of choice to encourage rational use of energy with ambitions at various levels. One of the main targets of the energy section is the emphasis on the exemplary role of the local level of administration. The most important components of this section are the start-up of energy accounting and of an energy supply system for urban, municipal or provincial buildings, infrastructures and domains.

The Flemish Government Decree of 29 March 2002 (amended on 26 September 2003) on RUE public service obligations on electricity distribution grid operators requires that special attention be given to actions involving the local authorities. The grid operators are also obliged to carry out an energy audit for public lighting every five years.

WR: With EP-URE[22], the Walloon Region grants subsidies to municipalities for the replacement of public lighting (up to 70% of the cost of the investment).

Another Walloon subsidy programme promotes energy efficiency for municipal, provincial and regional buildings and also for schools and hospitals. This UREBA programme allows a subsidy rate of:

- 50% for energy accountancy
- 30% for energy audit
- 30% for investments up to a certain level of energy performance
- 30% for CHP and renewable energy investments.

The PALME programme (Programme of Local Action for Energy Management) finances voluntary municipal initiatives in the field of RUE and RES. The Walloon Region offers a a three-year grant covering 50% of the personnel and operating expenses of PALME initiatives proposed by municipalities. Twenty-three municipalities are involved.

BCR: From 1 January 2005, subsidies to encourage investments to reduce energy consumption in the services sector are available from SIBELGA. The investments can concern improvements to lighting and electric installations, HVAC and heating efficiency.

A regional subsidy known as BRUREBA has also been put in place. BRUREBA is a set of RUE subsidies to improve building energy efficiency via energy audits, feasibility studies, implementation of energy accountability, use of renewable energy sources, quality CHP installations and other RUE investments.

The PLAGE programme (Local Action Plan for Energy Management) was launched in 2005. It provides financial support for voluntary municipal initiatives in the field of RUE and RES. The Region offers three-year grants covering up to 50% of personnel and operating expenses.

Energy efficiency of appliances

E12 – Labelling of appliances

REG | IMP | CO_2

FED: 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 efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels.

To comply with Directive 92/75/EEC on the energy labelling of household appliances, the Belgian federal government has adopted a number of Decrees concerning:

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

The existing labelling system for electric appliances will be extended (label A will be divided into three categories) through:

- the transposition of Directive 2003/66/EC
- an information campaign.

Other actions

E13 – 'Energy 2030' Committee

EDU | IMP | CO_2-CH_4

In 2005, the federal Minister of Energy assigned the Federal Planning Bureau with the task of carrying out an in-depth analysis of Belgian Energy Policy for the next 25 years. The Federal Planning Bureau will be assisted by the 'Energy 2030 Committee', composed of Belgian and foreign experts in the field of energy.

The conclusions of this scientific study on long-term energy policy for Belgium are expected in 2006. The provisional results, conclusions and recommendations will be debated, especially with representatives of industry, the social partners, regulators and environmental experts. The regions will also be actively involved in this consultation.

[22] Walloon Government Decree of 1 April 1999 on the grant of subsidies to municipalities and provinces for carrying out works designed to achieve energy savings in the public lighting system , amended by the Decree of 25 April 2002 with a view to the introduction of the euro

Transport

Main objectives of transport policies

FED: The federal government's priority for mobility is to encourage intermodal transport through the promotion of rail, maritime and inland waterway transport, as well as public transport. The government agreement of August 2003 provides for the development of a mobility plan based on priority use of the least polluting means of transport. A preliminary draft National Plan for Sustainable Mobility, which supplements and strictly respects existing regional mobility plans, is currently being discussed.

On road transport, the government plans to initiate a transition from fixed to variable costs. In case of a decrease in vehicle fuel prices, the effect will be partially neutralised by an adjustment of excise duties. The proceeds from this operation will in time make it possible to abolish the registration tax (by the end of the legislature). In that spirit, the federal government intends to conclude a cooperation agreement with the regions with a view to modulating the fixed taxes they they collect – namely the road fund tax and the tax on entry into service – in terms of the environmental qualities of vehicles. The federal government has also made a commitment to promote the development and use of clean vehicles. Several measures in this respect have been taken as part of the Federal Plan to combat acidification and tropospheric ozone. In accordance with the Second Federal Plan for Sustainable Development (2004-2008), the FPS Mobility and Transport has initiated an action plan to implement the following priority measures:

- Managing demand for mobility (action 26)
- Promoting alternative mobility (action 27)
- Improving the supply of public transport for passengers and goods (action 28)
- Improving expertise and data on mobility (action 29)
- Making vehicles less polluting (action 30)

The federal government has also adopted the Directive on the promotion of the use of biofuels and other renewable fuels for transport. Implementation of this Directive should ensure the placing on the market of a minimum proportion of biofuels and other renewable fuels (2% in 2005; 5.75% in 2010).

Finally, a cooperation agreement between the federal government and the regions, currently being discussed within the Interministerial Conference for Infrastructure and Transport, will seek to ensure better follow-up of the use of infrastructure and to encourage and promote the multimodal transport of goods among clients and hauliers.

Belgium also wishes to respect its obligations to limit or reduce emissions from greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO). Accordingly, it supported the position of the ECAC and the EU and its Member States during debate at the 35th ICAO Assembly on the need to update the consolidated statement of continuing ICAO policies and practices related to environmental protection. As for the work of IMO, Belgium subscribes to the relevant positions and actions undertaken by the EU and its Member States during meetings of the MEPC on the subject of climate change and the role of maritime transport in the reduction of greenhouse gas emissions from ships.

FR: On 17 October 2003, the Flemish government gave its agreement in principle to the Flanders Mobility Plan – envisaged policies. The document covers the short term (up to 2007) and the medium term (up to 2012) and deals primarily with mobility on land. Five packages of measures are put forward on the basis of the concept of "sustainability":

- The development of more and better alternatives to transport by car and lorry;
- The provision of a good, safe road infrastructure, adjusted as well as possible to the urban environment and open areas;
- The encouragement of efficient use of means of transport and infrastructure;
- The prompting of a change in mentality towards safe and ecologically sound driving;
- Conversion of the fleet of vehicles to become more energy-efficient, ecologically sound and safe.

In accordance with the policy recommendations, the emphasis must be placed mainly on developing alternative forms of transport, providing control systems for the main infrastructure, eliminating bottlenecks on the main road network, increasing the use of alternative forms of transport through transport management, improving vehicle occupancy by encouraging car pools, ironing out the rush hour peaks by telework and better spread of working hours. Via enforcement (increased chance of being caught) and targeted communication and awareness-raising, it is important to arrive at ecologically sound and safe driving. Finally, initiatives must be taken leading to an ecologically sound and safe car fleet.

One of the goals of the Mobility Plan is to stabilise CO_2 emissions from the transport sector in 2010 at the 1990 level. The Mobility Plan is directly connected with the actions of the Third Environmental Policy Plan (MINA 3). The Third MINA Plan (2003-2007) contains a range of actions intended to reduce transport emis-

sions, especially via technological measures that favour clean vehicles and fuels.

The Flemish government decided on 25 March 2005 to implement the Directive on the promotion of the use of biofuels and other renewable fuels for transport.

WR: In the Walloon Region, transport issues are addressed 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 structural, but also include organisational and management measures, as well as 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 be working to ensure an equitable distribution of the public space between users. It will encourage the use of 'alternative' mobility (bicycles, walking) by eliminating 'black spots' and the physical barriers found on some roads. For the transport of goods, the Walloon Region also wants to promote a shift away from road transport. Currently, however, the conditions and connections needed for the coordinated development of networks and freight terminals are not yet in place. In recent years, improvement of the navigability of the main waterways in the Walloon Region, combined with the regional government's recent decision to abolish navigation dues, have led to an appreciable increase in the quantities of goods transported by boat. The introduction of instruments for managing and planning the flow of goods traffic is currently being studied.

BCR: In the Brussels-Capital Region, mobility policy is set out in the Transport Plan or 'Iris Plan'. The objective of this plan is to stabilise car traffic during the morning rush hour at the 1991 level by 2005. It implements a number of actions on urban structures, public transport, car traffic, parking management, pedestrians, bicycles and motorcycles and the transport of goods. The Iris Plan was approved by the government of the Brussels-Capital Region on 1 October 1998. The Iris Plan II is currently being prepared and will integrate the mobility chapter of the Regional Development Plan (PRD), whose main target is to reduce pollution from transport. It gives priority to reducing automobile traffic (the target 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 and Climate Plan are also designed to contribute to a reduction in the volume of road traffic and its emissions.

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 introduced in the near future, for other actions to promote more sustainable mobility. On car parking, for example, the Brussels-Capital Region will create an infrastructure for transfers from motor vehicles to public transport. The Brussels Region will also improve the complementarity of different modes of goods transport by developing road-rail connections, improving access to the airport and setting up distribution centres. 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 are based on three approaches:

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

Promotion of different forms of transport

Passenger transport

T01 – Improvement of the quality of public transport

MIX | IMP | CO_2-N_2O

FED: An ambitious railway investment plan (€ 17 billion) was approved by the federal government on 13 July 2001. This multi-annual plan (2001-2012) is aimed at improving the quality of the service offered by the national railway company (SNCB/NMBS) in terms of capacity, safety and speed, for both for passengers and goods. The investments will be targeted at improved maintenance and capacity, improved rolling stock, high-speed train (TGV) infrastructure and improved mobility in Brussels. The plan will be also the subject of a cooperation agreement with the regions. A Regional Express Network (REN) will be developed in the Brussels area to offer higher capacities and frequencies on the lines to/from Brussels. A specific agreement was approved on 4 April 2003 by the Consultation Committee that brings together representatives of the federal government and the governments of the regions and communities, with a view to development of the REN.

The agreement lays down the structure of consultation and the bodies to be set in place. It also makes provision for the study of specific transitional measures to strengthen the current capacities and frequencies of certain radial lines. A steering committee is analysing mobility needs in terms of frequency, amplitude and stops and developing supporting measures (e.g. integrated tariffs and tickets, parking policy, improvement of the conditions of intermodality and complementarity). The agreement sets a general target of placing the REN in service by 2010-2012 and focuses on a scenario of operating two initial radial lines by December 2006. Two REN trains per hour will serve the 54 train stations on these lines.

All regions:

At regional level, different measures are being implemented to promote the use of public transport:

- maintenance of the existing supply;
- basic mobility: guaranteed minimum supply of regular transport within the residential areas of the city, town, conurbation, small town and outside areas;
- network management: investigate for each connection what frequency and capacity must be deployed;
- expansion of suburban networks;
- increase in travelling speed of trams and buses;
- improvement of vehicle comfort;
- improved equipment of stops;
- development of dispatching centres for each province;
- supply of integrated mobility services;
- free access for children and senior citizens granted by the public transport companies De Lijn, STIB and TEC (bus, underground and tramways);
- 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 targeted users (e.g.: easy access vehicles, facilities for people with reduced mobility, etc.);
- coordination of timetables between railways and other public transport;
- 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 informing users in real time);
- progressive renewal of the stock of public transport vehicles (less polluting vehicles);
- introduction of bus service on demand in rural regions or areas with low traffic density (Telbus, Belbus), and express bus service from rural areas to urban centres (e.g. Namur–Couvin; Bastogne-Namur);
- in Flanders, the public transport company acts as an example in the implementation of the Biofuels Directive (from 2006, generalised use of significant percentage of biodiesel in vehicle fuel mix);
- in the Walloon Region, accessibility information is provided to the population and visitors. This includes a detailed map, timetables of trains and buses, access possibilities for mobility-reduced persons and bicycle parking locations.

T02 – Promotion of public transport for daily mobility

MIX | IMP | CO_2-N_2O

FED: Since the 2001 tax year (2000 income), contributions by employers to the cost of a season ticket to the public transport system for travel between home and work can be deducted in full (up to a limit of EUR 125 per year). Previously the tax exemption was limited to the employer's compulsory contribution. This measure applies to both the private and public sectors. The limit of 125 euro was recently cancelled (as of 1 March 2004). The employer's contribution for car-pooling is also tax deductible. The amount exempted is in this case limited to the price of a first class season railway ticket for a distance equal to the distance the worker has to travel by public transport.

The federal policy to promote modal shift encompasses a series of measures:

- Free train service for commuters: free train service for travel between home and the workplace was introduced on 1 March 2004 for federal civil servants and the staff of autonomous undertakings. From 1 January 2005, this possibility was offered to private companies provided they bear at least 80% of the cost of the train pass for their employees. The federal government compensates the railway for the loss of earnings.
- Extension of the tax deduction for expenses incurred for home-work travel when using alternative transport: the deductible expenses relating to daily travel between home and work, previously limited to travel by motor vehicle, have been extended to all modes of transport (walking, cycling, public transport, car-sharing, etc.). The tax deduction is set at € 0.15/km, even if the real cost is lower (Art. 9 of the Law of 10 August 2001 on the reform of personal income tax). For the 2002 tax year (income from 2001), the maximum distance allowed was fixed at 50 km for the round trip. It has since been raised to 100 km (2003 tax year), 150 km (2006 tax year) and 200 km (2007 tax year).
- Tax deduction for collective transport organised by private companies: employers may deduct 100% of expenses for the operation of collective transport of staff members (Art. 62 of the law of 10 August 2001). Previously, this deduction was limited in certain cases to 75%. Expenses taken into consideration include investments and maintenance of the vehicles used for collective transport, road tax, insurance, fuel, etc. This measure has been in force since the 2002 tax year (2001 income). From the 2003 tax year onwards (2002 income), the deductible amount rose to 120% (Art. 63).
- Analysis of travel between home and the workplace: a national survey on travel between home and the workplace will be conducted at all companies with more than 100 employees based on the situation existing on 30 June 2005. After a consultation of workers or their representatives, the analysis will be transmitted, no later than 30 April 2006, to the FPS Mobility and Transport. An evaluation will subsequently be conducted to determine whether this data base is used by employers as a basis for establishing enterprise transport plans, by the public authorities as support for their mobility policy and by institutions involved in research on mobility issues.

WR: In addition to these measures targeting workers, business mobility plans are also developed to encourage the use by employees of alternatives to cars (public transport, transport service organised by the company, car sharing, etc.), as well as school mobility plans designed to improve the conditions in which pupils travel between home and school and to reduce the share of car travel.

BCR: A complement to the federal measure for free travel between home and the workplace: from 1 January 2005, private companies may provide for their employees to be entitled to free travel between home and the workplace on public transport with the use of combined train passes.

- To contribute to achieving the goal of reducing road traffic by 20% from its 1990 level by the year 2010, the government approved in July 2005 the plan for the restructuring of the public transport network. The new network will in the short term be extended by several kilometres of rail lines and availability will increase 20 to 30%, depending on the mode of transport, through the acquisition of 15 new underground railway cars, 68 new high-capacity trams and 140 new buses. The new plan will be implemented in full by 2008.
- Company transport plans are being developed to encourage the use by employees of alternatives to cars (public transport, transport service organised by the company, car sharing, etc.).

T03 – Promotion of bicycle use

MIX | IMP | CO_2-N_2O

FED: The STOP principle and the Bike Plan:

The STOP principle consists in giving priority to the use of the least polluting and most appropriate means of transport. To implement the principle, the federal government will take various measures to improve the safety and comfort of walking, cycling and public transport. In 2004, a Bike Plan meant to define a coherent policy integrating cycling into the overall system of traffic and transport, was developed and submitted to the Council of Ministers. Its implementation is set to begin shortly.

FR: By order of the Flemish Region, five Flemish provinces devised a supra-local functional cycle track network. The total length of this network comes to some 11,000 km, of which about 3,500 km along regional roads. The Flemish government aims within a period of 10 years to equip each regional road which forms part of the supra-local cycle track network with a cycle track which meets the criteria set out in the manual.

WR: Among the most outstanding actions to promote the use of bicycles as a means of transport are the following:

- the investment programme for the building of cycling tracks along regional roads;
- the construction of the greenways non-motorised network (RAVeL): a network of itineraries reserved to pedestrians, cyclists, persons with reduced mobility and horseback riders. The network is built along abandoned rail lines and on towpaths along rivers and canals. It is used for both daily mobility and recreation.

BCR: For cyclists, Brussels has made one-way streets open in both directions for cyclists, installed appropriate facilities (bicycle stands, bicycle hire and minor maintenance) at the main public transport stops and stations, and created a regional cycling itinerary integrated into the European greenways network (REVER). For pedestrians, shortcuts have been put in place and pedestrian signs and markings improved.

These measures are reinforced locally by discouraging the use of private cars through the creation of different types of zones such as red zones (pay parking) and blue zones (long-term parking prohibited except for residents), and the limitation of the number of parking places that can be built.

The Brussels public transport company, STIB, has developed a partnership with cycling associations to put in place facilities to encourage intermodality between bicycles and public transport (cycle parking close to underground stations, special 'bike' pass, etc.)

T04 – Promotion of car sharing

MIX | IMP | CO_2-N_2O

FED: Reservation of a lane of traffic: to make car sharing more attractive (commuters travelling by car represent 20 to 30% of road traffic), the highway code was modified in 2003 to allow the road system manager to reserve a lane of traffic not only to public transport vehicles, but also to private vehicles occupied by more than one passenger. The measure will be evaluated for the first time in September 2005.

FR: To implement the mobility plan, more promotion will be carried out on professionally supported car-sharing in Flanders. In cooperation with the towns, the development of car-sharing facilities must be continued in the regional urban areas. It is assumed that 1 car-sharer causes 40% less CO_2 emission than a private motorist.

WR: A car-sharing service has been put in place in several Walloon cities (Liege, Namur, Ottignies and Louvain-la-Neuve). It is the result of a partnership between the company Cambio, the cities and the public transport company TEC.

BCR: A similar car-sharing service was put in place in the region two and a half years ago. In 2005, it counted 14 leasing points near underground stations or bus stops and around 40 cars. Cambio Brussels already has 1,000 users. The Brussels public transport company, STIB, is both a partner and shareholder in the project. The supply of this service, which is supported by the region, is continuing to expand.

Transport of goods

T05 – Improvement of multimodal systems MIX IMP CO_2-N_2O

FED: The main actions being taken by the federal government to step up intermodal transport of goods are the following :

- Marco Polo programme: As part of the European Marco Polo[23] programme of financial support for modal shift, launched in February 2002, the FPS Mobility and Transport has the role of developing projects involving Belgian stakeholders in transport, logistics and production. The federal department launched a second call for projects in September 2004. The programme's objective is to shift the expected increase in international road transport of freight to short-distance maritime freight services, rail and inland waterways.
- Diabolo Plan: A new rail infrastructure will be built to make the Brussels-National Airport directly accessible from the north and east of the country. The airport is expected in time to be connected to the REN and TGV rail systems. An investment of € 387 million is planned for the project.
- Subsidies for freight transport by rail: from 1 January 2005, a subsidy is available for freight transport by rail for distances over 50 km (€ 22 per unit + € 0.40 per kilometre). This support for combined transport aims to consolidate and reorganise shuttles between interior terminals, notably due to the transhipment costs specific to this type of transport. The measure is meant to prevent short-distance combined transport from disappearing from rail traffic (this currently concerns nearly 300 000 shipments). The initial budget (€ 15 million for 2005) will rise to 30 million a year in 2006 and 2007.
- Improvement of transport infrastructure around the Port of Antwerp: the federal government will finance major infrastructure works to promote rail transport and service to the Port of Antwerp by train; the works are expected to be concluded by 2009.

FR: The Flanders mobility plan, through changes in modes of transport, aims to limit the increase in the number of tonnes/kilometre over the road network to 33% in 2010/2012 (compared to 1998). The increase in the number of vehicle kilometres remains limited to 17% as a result of the improved transport efficiency. This includes the following measures:

- boosting internal navigation and railway transport;
- transport prevention and optimisation at company level;
- analysis of introduction of variable kilometre levy scheme;
- promotion of water transport quality including allowing shipping to run smoothly by developing the main waterway network, sound maintenance of the main waterway network, guaranteed shipping times for internal navigation and reliable access to ports and port infrastructure.

WR: A trimodal (waterway/road/railway) transhipment platform has been created at the Clabecq site to facilitate the development of integrated transport on the Charleroi-Brussels[24] canal.

The Walloon government has also adopted an assistance plan for combined transport (25 August 2005) which will provide subsidies in the amount of 21% on the following investments:

- acquisition of land for the transhipment of goods
- construction of infrastructure and installations needed for transhipment
- equipping of transhipment systems (cranes, lifting machinery, etc.)
- completion of the upgrading of the Walloon waterway network to the European size (1 350 T).

In recent years, notable progress has been made on the waterway network to make it more attractive and reliable:

- completion of the Strepy-Thieu lift, making the network fully operational for class IV (1 350 T) and above[25];
- creation of an operational plan to remove and manage large amounts of sediments and guarantee gauges[26];
- construction of a new class VIb (9 000 T) lock has been launched in Lanaye (set to open in 2011);
- upgrading of the upper and lower Meuse (new dams, etc.);
- preparatory studies for construction of a new class VIb lock in Ivoz-Ramet have begun;
- launch of a proposal, under the 'priority measures for the development of Wallonia', to abolish navigation fees;
- carrying out of the first studies to improve traffic management to meet RIS requirements.

As part of its Plan for the Economic Redevelopment of the Walloon Region, the Walloon government has decided to abolish navigation dues.

BCR: An intermodal platform integrating rail, waterway and road transport systems has been placed into service. The availability of land will enable the port to develop logistics activities.

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[23] The Programme's objective is to reduce road congestion and to improve the environmental performance of the freight transport system within the Community and to enhance intermodality, thereby contributing to an efficient and sustainable transport system. To achieve this objective, the Programme supports actions in the freight transport, logistics and other relevant markets.

[24] http://routes.wallonie.be

[25] http://services-techniques.met.wallonie.be/en/the_counterweighted_lift_/

[26] http://voies-hydrauliques.wallonie.be

Other measures

T06 – Reduction of vehicle emissions

MIX | IMP | ALL

FED: Various federal measures aim to promote clean vehicles:

- modulation of the road tax: a law[27] introduces a differentiated road tax in accordance with 'EURO' standards, in such a way as to encourage vehicles to meet the most recent standards for polluting emissions;
- CO_2 guide: in application of Directive 99/94/EC, the federal government publishes yearly a guide to CO_2 emissions of all cars placed on the market in Belgium and distributes it to all showrooms; a database of car emissions is also available on a web site[28];
- tax cut for the purchase of clean vehicles; since 1 January 2005, the federal government has offered tax reduction to natural persons for the purchase of a new 'clean' vehicle. In September 2005, the tax break amounted to: up to 15% of the vehicle price (max. € 4 100) for cars with CO_2 emissions of less than 105 g/km; up to 3% of the vehicle price (max. € 765) for cars with CO_2 emissions of between 105 and 115 g/km;
- Taxation of company cars: The programme law of 27 December 2004 imposes, from 1 January 2005, a lump-sum minimum monthly contribution of € 20.83 on company cars (passenger cars, minibuses, tractors, light trucks); this contribution varies in terms of the rate of CO_2 emissions in grammes per kilometre;
- clean vehicles for the public services: the federal government is planning a progressive shift in the public service fleet to clean vehicles. This is planned through: renewal of the fleet of the federal administrations; voluntary agreements between the federal state and public companies (post office, railway, police, etc.);
- promotion of LPG vehicles: the purchase of new LPG vehicles is promoted through a reduction (€ 298) of the car registration tax for cars fitted from the outset with LPG (in practice, this makes car registration tax-free for the smallest vehicles); a working group is studying regulatory measures to authorise access for LPG vehicles to underground car parks;
- promotion of renewal of the car fleet: from 1 May, 2002, the car registration tax for second-hand vehicles is reduced by only 5% a year dating from the fifth year after initial placing into operation, instead of 10%;
- gentlemen's agreements with car manufacturers: the federal government supports the European Commission initiative to lower average CO_2 emissions by cars up to 120 g CO_2/km by 2012.

FR: The Flemish Region includes CO_2 and other greenhouse gasses in an overall emission label called 'Ecoscore'. The methodology is explained on the website www.milieuvriendelijkvoertuig.be, which presents the Ecoscore for both new and older cars, heavy duty vehicles and two-wheelers, as well as information on CO_2 emissions, the Euro standard and clean vehicles and fuels.

The action plan for the promotion of ecologically sound vehicles focuses on:

- the definition of an ecologically sound vehicle (ecoscore study) as starting point for the further development of the policy;
- the development of an ecologically sound vehicle fleet through the conversion of the existing vehicles (De Lijn bus fleet);
- the expansion of the vehicle fleet of the Flemish government with ecologically sound vehicles;
- the support of new technologies (all vehicle categories);
- information and awareness-raising of the population and other operators;
- the creation of incentives for use to encourage citizens, such as tax incentives, or low emission zones. Encouraging the use of ecologically sound vehicles is also a stimulus for the manufacturers to make vehicles even cleaner and quieter.

This also includes actions directed at the general public (e.g. greening of taxation and education), actions in relation to government such as the support of municipalities in developing an ecologically sound fleet (and greening of the government's own vehicle fleet) and action in relation to private fleets (e.g. integration of measures relating to vehicles with low CO_2 emissions in measures targeting mobility-friendly businesses).

BCR: Communication tools have been developed, including the 'Ecoscore' software tool available on the website www.ibgedim.be, which calculates the environmental score of any vehicle (air and noise).

[27] Law of 13 March 2001 approving the Protocol modifying the Agreement of 9 February 1994 on the charging of heavy goods vehicles for the use of certain roads, 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 on 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 on 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 (Moniteur belge of 30 March 2001).

[28] http://www.health.fgov.be/pls/portal/co2

The Brussels Air and Climate Plan (March 1999) provides for a shift in the public service fleet to clean vehicles: the regional administrations must own a minimum of 20% clean vehicles in their fleet by 2008. A model call for bids for the purchase of clean vehicles has been developed for public administrations.

The STIB will add environmental criteria for procurement of new buses and a study will evaluate the investment needed to make the fleet fully 'clean' by 2010.

Its bus fleet already includes 20 buses operating on natural gas, 12 hybrid buses, 269 buses fitted with particulate filters (end 2005) and around 130 buses that comply with the Euro 4 standard.

The STIB has launched a sustainable development process and will continue to invest in the most effective technologies from the environmental standpoint for transporting its passengers. This choice will be made in terms of the best value for money for each investment.

Information on the STIB's clean buses is available on its site: www.stib.be.

T07 – Mobility plans at local level

PLA/VOL | IMP | CO_2-N_2O

FR: In 2002, transport was included in the environment contracts concluded between the Flemish Region and local governments. Local authorities can subscribe to one of three stages. Stage 1 entails support for the purchase of clean vehicles, campaigns on transport and the environment, and implementation of transport plans for municipalities. To comply with stage 1, the local authorities also have to report on cooperation between their transport and environment services. Stage 2 is linked with the mobility contracts. To comply with stage 2, the local authorities have to evaluate their local transport plan on environmental issues. This evaluation will then be integrated into an overall evaluation of the local transport plan. Measures are also linked, for example, a project submitted under the mobility contract with an environmental link will also be subsidised through the environment contract. To be eligible for subsidy, local authorities must submit their mobility policy to an environmental check and take concrete actions to reduce the effect of traffic on the environment.

The actions come under the following themes:

- ecologically sound vehicles: drawing up an inventory of vehicle fleet + environmental check + drawing up of action plan to arrive at a more ecologically sound vehicle fleet + taking concrete measures;
- ecologically sound transport of own staff: analysis of working at home and shifting of services + drawing up action plan to arrive at ecologically sound travel + carrying out of concrete measures;
- targeted awareness campaigns on the environment and mobility.

WR: The Walloon Region has implemented mobility plans at town and municipality level, with the assistance of external consultants.

The studies are being carried out in partnership with the towns and municipalities concerned, the public transport companies (TEC, SNCB) and the Directorate-General Roads of the Ministry for Equipment and Transport (MET)[29]. They define the actions to be taken to ensure sustainable mobility, which include renovating road systems to give priority to public transport and alternative means (lanes reserved for buses, regulation of intersections giving priority to public transport, cycling tracks and pedestrian lanes, etc.) and increasing the public transport supply. Currently, 52 mobility plans have been completed, 20 are in progress and five are in the preparatory phase. Specific funds are earmarked in the regional budget for the plans.

BCR: Each of the 19 municipalities of the Brussels-Capital Region is strongly encouraged to implement a Local Mobility Plan: if the local and regional administrations sign a cooperation agreement, the Region finances a large part of the Plan's development. Some municipalities are already putting the Plan into operation.

T08 – Implementation of transport/mobility plans (schools and businesses)

PLA | IMP | CO_2-N_2O

FR: (MIX/ADO/CO_2): The Flanders mobility plan indicates that an incentive, support and coordination policy should be developed for companies. In addition, the possibilities and limitations will be examined of commitments between the government and companies, with each party implementing the available instruments to good effect.

As regards school transport, the Flemish government has decided to transfer the transport of schoolchildren from the Education department to the Flemish transport company De Lijn. In the future, this must develop towards cross-network collection services for the transport of schoolchildren.

In the short term, it is wished to start up one cross-network pilot project per entity and on the basis of this to continue to develop school transport efficiently.

Attention is also being paid to transport to events. The Flemish government is trying to conclude a cooperation protocol with the organisers of large-scale events and event bureaus to maximise the accessibility of the venues by means of public transport.

WR: an agreement between the Walloon Region and the Walloon Business Federation[30] on a campaign to raise public awareness of mobility issues for Walloon companies;

[29] http://routes.wallonie.be
[30] Union wallonne des entreprises (UWE)

- the production, in collaboration with the 'UWE Mobility unit' and based on existing experiences, of a methodological guide to help companies draw up a Company Transport Plan (PTE);
- training courses for company mobility advisors;
- agreements between the Walloon Region and companies (public or private) on pilot transport plan projects.

A mobility observatory has been created. Its responsibilities, which concern the transport of both passengers and goods, include the following:

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

BCR: A decree approved by the Brussels Government on 4 February 2004 makes staff mobility plans compulsory for all companies with more than 200 employees. To facilitate the preparation of mobility plans, technical information and a manual are available on the IBGE's website and specific training sessions are organised. Once fully implemented, the business mobility plans will concern the mobility of about 200 000 workers.

The regional and local authorities, in collaboration with the STIB, will build 10 pilot areas with specific mobility plans.

The STIB will develop specific strategies for any event bringing together more than 3 000 people.

Municipalities have authority to create '30 zones' (speed limit of 30 km/h) on their roads. The regional objective for '30 zones' is 77% of local roads by 2010.

T09 – Improvement of traffic flow on main roads

MIX | IMP | CO_2-N_2O

FR: Not only very high speeds and abrupt changes of speed but also heavily congested traffic results in higher consumption and higher emissions. Increasing the capacity of the main road network, in view of the expected growth in road transport, is one of the solutions. The elimination of capacity restrictions at bottlenecks on the main road network, dynamic traffic management and facilitation in the case of capacity-reducing incidents are measures to be taken.

T10 – Eco driving

EDU | IMP | CO_2-N_2O

FED: "Eco driving" campaign

Since vehicle fuel consumption is determined in part by driving habits, a campaign will be organised shortly to inform drivers about different ways of driving more fuel-efficiently.

FR: In implementation of Directive 2003/59/EC, this measure aims for a change in behaviour as regards the driving style of both private and professional drivers. The principles of eco driving (speed, time of changing gear, use of accessoires, tyre pressure, etc.) must become automatic reactions and be applied as such in everyday driving. To this end, mesures for the general public (e.g. adaptation of the driving instruction with eco driving module), specific target groups (sales representatives, etc.) and governments (e.g. training of municipal staff) are provided for.

BCR: Promotion of less polluting driving habits and specific actions for driving schools.

The STIB launched an experiment in 2005 to reduce electricity consumption by adapting tram driving habits. The experiment is being conducted in connection with the acquisition of the new T3000 and T4000 trams.

T11 – Trafic regulation

MIX | IMP | CO_2-N_2O

FR: Consumption and emissions rise sharply from 90 to 100 km/hour. Avoiding speeding offences and abrupt changes of speed offer potential. These measures are also important to meet the air quality standards:

- tightening up of control on compliance with the imposed speed limits;
- introduction of intelligent speed adaptors;
- unmanned cameras.

WR: From the mid-1990s, a large-scale project was launched for the coordination of traffic management actions on the system of motorways and trunk roads: WHIST (Walloon Highway Information System for Traffic)[31]. It is based on the use of road telematics tools, also known as 'intelligent transport systems', and on an operations centre, PEREX. Traffic optimisation and monitoring are meant to limit bottlenecks and to keep speed under control, leading to a decrease in GHG emissions.

T12 – Green procurement rules for public service vehicle fleets

ORG | IMP | CO_2-N_2O

FED: The federal government is planning a gradual shift in the public service fleet to clean vehicles. This is planned through:

- renewal of the fleet of the federal administrations;
- voluntary agreements with public companies (post office, railway, police, etc.).

FR: The Flemish government is putting together a fleet of ecologically sound vehicles in which account is taken of other

[31] http://routes.wallonie.be/

emissions, in addition to greenhouse gas emissions. The Flemish government uses the eco score of the vehicle as a basis for this (www.milieuvriendelijkvoertuig.be).

BCR: The Air Decree requires regional public bodies with a fleet of more than 50 vehicles to own at least 20% clean vehicles by 2008. The administrations concerned by this measure are clearly identified by the implementing decree of 3 July 2003, referred to as the Clean Vehicle Decree. To help public bodies acquire clean vehicles, IBGE has developed a second tool, in addition to ecoscore: a model for special tender specifications the administrations can use to issue an invitation to tender.

Industry

Preliminary remark

This section only presents measures based on regulations (environmental permits) or voluntary/negotiated agreements. This type of measure is implemented at the regional level. Actions in the field of energy efficiency that are based on financial/economic instruments are described in section 4.3 (Energy). Actions related to training or awareness are enumerated in Chapter 9, Education, training and public awareness.

Policy context of actions in the industrial sector

In the Flemish Region, the context for introducing measures to reduce greenhouse gas emissions in the industrial sector is created by regulations on environmental permits[32] and benchmarking agreements on energy-efficiency. 180 companies (in the following industries, among others: iron and steel, chemicals, paper, refineries, brick, food, metal, textiles) have signed a benchmarking agreement with the Flemish government. The benchmarking agreement was fine-tuned with the European emission trading scheme for these sectors.

The strategy of the Walloon Region to encourage industry to reduce greenhouse gas emissions per unit produced is based on negotiated voluntary agreements. Agreements covering an entire sector constitute a 'contract' between the public authorities and associations of companies in the industry, with the two parties agreeing on a quantitative improvement in pollutant emissions. In addition to improving energy efficiency, these agreements aim to enhance the management of industrial waste, implementation of 'best available technologies' (changes in structural processes) and product policies. They will provide for penalties in case of infringement. These voluntary agreements are subscribed to under general legislation on environmental conventions, established by the Walloon Government Decree of 20 December 2001.

In the Brussels-Capital Region, there is currently no integrated policy as such for reducing greenhouse gas emissions in the industrial sector. Specific measures have nonetheless been taken, notably through environmental permits.

Policies and measures in the industrial sector

I01 – Agreements with industrial sectors VOL IMP ALL

'Branch agreements' here refer to agreements for the reduction of emissions of greenhouse gases covered by the Kyoto Protocol (CO_2, N_2O, CH_4, HFC, PFC, SF_6) or for improved energy efficiency.

FR: The **benchmarking covenant** was definitively approved by the Flemish government on 29 November 2002 and applies to large energy-intensive companies (with an annual consumption of at least 0.5 PJ) and companies which fall under the European Emissions Trading Directive. By signing the benchmarking covenant, companies undertake to be among the most energy-efficient in the world by 2012 at the latest. The Flemish Government undertakes not to impose any additional specific Flemish measures focusing on further energy savings or CO_2 reduction on the participating companies. Furthermore, everything possible will be done by the Flemish Government to ensure that these branches will be exempt from additional Belgian or European energy or CO_2 taxes or other additional CO_2 or energy-saving obligations. Another commitment by the Flemish government is that a company will be allocated all the necessary initial emission rights in accordance with the energy plan adopted. In addition, the Flemish Government intends to focus additional Flemish support to promote energy efficiency in the first instance on the companies which have joined the benchmarking covenant.

The Benchmarking Committee supervises the implementation of the benchmarking covenant. To put everything on the right lines technically, an independent Verification Bureau has been set up which monitors the benchmark processes.

On 25 March 2005, the Flemish Government in principle approved the implementation of the **audit covenant** for medium-sized, energy-intensive establishments with energy consumption of between 0.1 PJ and 0.5 PJ per year which are not covered by the European Emissions Trading Directive. Undertakings signing this covenant undertake to allow an energy audit to be conducted and to implement the energy-saving measures: in the first round, investments must be carried out for which the pay-back period is approximately five years or less (internal rate of interest of at least 15%) and during the second round this concerns investments with an internal

[32] See implementation decrees of the Flemish regulations concerning Environmental permits Vlarem I (February 1991), Vlarem II (July 1995) and their subsequent adaptations.

rate of interest of at least 13%. The counter-measures of the Flemish Government are the same as in the benchmarking covenant, except for the allocation of emission allowances.

WR: Since 2000, the Walloon Region has negotiated voluntary branch agreements meant to enhance the energy efficiency of the main industrial sectors based in Wallonia, known as Sector Agreements (SAs). These also set out the efforts made by the industrial sectors to reduce their CO_2 emissions.

SAs are normally implemented in four successive stages:

1. Declaration of intent: signature of a declaration of intent to conclude an SA between a federation representing an industrial sector and the Walloon Region;
2. Energy audits: conducting of energy audits to identify potential energy savings and draw up implementation plans;
3. Signature of the SA: negotiation of the agreement, including the quantitative targets accepted by the sector, and the formal signature of the SA;
4. Implementation: this includes an annual declaration of the results achieved, certified by an auditor, and an annual sectoral report.

The SAs cover virtually all installations targeted by the EU emission trading Directive. The energy audits carried out when preparing the SAs identify and quantify the measures that can enable participating industries to reduce their energy consumption and CO_2 emissions. Consequently, the Walloon Region has decided to use this facility to estimate the allocation of emission quotas to plants in Wallonia covered by the ET Directive.

Information obtained when developing SAs must be reprocessed to be usable directly in the context of preparing the allocation plan:

- SAs that call for energy-efficiency improvements for both direct and indirect emissions need to make a distinction between the two in order to identify direct emissions;
- when preparing a plan that requires an emission estimate in absolute terms, it is necessary to convert energy efficiency improvements into changes in direct emissions in absolute terms;
- lastly, there is a need to deal with the rare cases of plants covered by the ET Directive but not taken into account in the context of SAs, namely the electricity and tertiary sectors.

The Walloon Region has negotiated voluntary branch agreements with the 13 main industrial sectors. The 13 sectors represent more than 100 companies that intend to reduce their energy consumption by 13.5%. The voluntary agreements cover 90% of industrial energy consumption, which represents 47% of final energy consumption in the Walloon Region.

I02 – Energy efficiency criteria in environmental permits

REG | IMP | ALL

FR: In the context of the IPPC Directive (96/61/EC), provisions on energy efficiency have been included in the Flemish environmental legislation (Flemish government approval on 14 May 2004). For each new plant requiring a permit or major alteration to an existing plant – with annual energy consumption in excess of 0.1 PJ – an energy audit must be conducted on energy efficiency. The study must demonstrate that the plant concerned is as energy-efficient as is economically feasible.

For existing plants with annual primary energy consumption in excess of 0.5 PJ, an energy plan must be drawn up. Companies which have signed the benchmarking covenant meet these requirements de facto. At the same time, the plants with annual primary energy consumption in excess of 0.1 PJ will be required to report their energy consumption.

I03 – Covenant to reduce N_2O emissions from nitric acid production

VOL | IMP | N_2O

FR: Industrial nitric acid production constitutes the main source of nitrous oxide emissions in Flanders. There is one manufacturer in the Flemish Region. On 18 November 2005, a covenant was concluded between the Flemish government and this firm. The aim is to reduce N_2O emissions per tonne nitrous acid produced to the lowest possible level by applying state-of-the-art technology for the reduction of N_2O emissions to each individual plant.

I04 – Regulations limiting the use of fluorinated greenhouse gases

MIX | IMP | FLG

In application of Regulation (EC) 2037/2000 on substances that deplete the ozone layer, the Member States have to adopt national regulations to reduce emissions of ozone-depleting refrigerant gases (HCFCs and CFCs). They must take all precautionary measures practicable to prevent and minimise leakages of these gases and must define the minimum qualification requirements for the personnel involved.

The three regions recently adopted or will soon adopt regulations related to stationary applications containing refrigerant gases (refrigeration, air conditioning and heat pump equipment):

- a regulation concerning the operators of such equipment (already adopted in the Flemish and Brussels-Capital Regions);
- a regulation laying down rules for the certification of personnel (in preparation in the three regions; a proposal has already been adopted at first reading by the governments of the Flemish and Brussels-Capital Regions).

The three regions are also preparing regulations setting out the qualification re-

quirements for workers involved in the installation and maintenance of fire protection systems containing fluorinated gases (ozone depleting substances or greenhouse gases). These systems are also concerned by the European regulations already mentioned.

The aim of all these regional regulations is to reduce emissions of fluorinated gases and, wherever possible, to promote clean equipment (not-in-kind technologies).

In the field of waste policy too, specific provisions have been devised to reduce the emissions of fluorinated greenhouse gases when certain equipment is scrapped. For instance, scrapped household refrigerators are collected and dismantled and the coolant is recovered. The obligation to accept scrapped vehicles provides that the coolant from the air-conditioning system of the vehicle still present must be recovered. In addition, HFCs and all scrapped equipment containing HFCs are considered as hazardous waste for which specific rules apply for recovery, collection and processing.

Agriculture and forestry

Context of policy in agriculture and forestry

Agricultural policy is determined mainly by the European Commission. The EU Member States reached an agreement in June 2003 on a fundamental reform of the Common Agricultural Policy (CAP), also known as the mid-term reform (MTR). The basis of this agreement is the principle of decoupling the present income support from production. The farmer will in future receive aid on the basis of what he received during a historical reference period and irrespective of what he produces. This aid is known as the single farm payment. The purpose of the decoupling is to align production more effectively with market demand. As such, the new CAP will be more attuned to what the consumer and society want. With a view to meeting social concerns, the 'decoupled single farm payment' will be subject to additional conditions. These preconditions relate to the environment, animal welfare and health and food safety. The policy is therefore directed at sustainable, multi-functional agriculture which at the same time is far less disruptive to trade. The production-linked aid, which in the late 1980s still amounted to 90% of the European agriculture budget, is therefore reduced to no more than 20% by 2006.

In Belgium, agriculture and forestry policies are primarily the responsibility of the regions. The role of the federal government mainly consists in determining the Belgian position on agricultural policies at the level of the European Union and international organisations, and ensuring the implementation of European directives and regulations.

FR: The objective of the Rural Development Programme is is to establish a context for the 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 set out in ten strategic objectives of integrated rural policy, which include:

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

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

The manure-spreading policy in Flanders is mainly determined by the Manure-spreading Decree (Decree on the protection of the environment against pollution by fertilizers) and the provisions in the VLAREM (Flemish Regulation on the Environmental Permit). At the beginning of 2000, the third phase was embarked upon, based on a three-prong policy. The manure surpluses must be eliminated via source-oriented measures, judicious fertilisation and above all via processing of manure. Source-oriented measures consist on the one hand of reduced nutrient content of animal feed, adapted feeding techniques and rational feeding and on the other hand of instruments for livestock reduction. Manure processing techniques converting manure into exportable products and harmless emissions must be used to process at least half the manure surplus in Flanders. Furthermore, via judicious manuring (code of good farming practice), the application of fertilizers on the land is better geared to the needs of the plants.

At the beginning of 2006, provision is made for the start of a modernised manure policy with accountability coming to lie still more with the sector. The aim is to implement the Nitrate Directive.

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 land. The principal measures target changes of practice in the storing, handling and spreading of liquid manure. The plan is based on a gradual approach in which the most effective measures (from the standpoint of costs) will be applied first.

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

- the decrees implementing the decree on environmental permits (11/03/1999);
- the decree on the sustainable management of nitrogen in agriculture.

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

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

Policies and measures in agriculture

A01 – Limitation/reduction of CO_2 emissions in agriculture and horticulture

MIX | IMP | CO_2

FR: The financial incentives for energy-saving measures and the encouragement of the use of natural gas in glasshouse horticulture are the principal measures to reduce CO_2.

Incentives for energy-saving measures in glasshouse horticulture take the form of subsidies from the Flemish Investment Fund and demonstration projects on the rational use of energy in the cultivation of ornamental plants and vegetables, inter alia.

The installation of CHP motors offers possibilities in horticulture. In recent years, it has mainly been a matter of projects in cooperation with energy producers, in which larger natural gas engines are installed, equipped with catalytic flue gas cleaning system for CO_2 – fertilisation.

The action plan 'for sustainable glasshouse horticulture in Flanders' (14 March 2003) aims via the clustering of glasshouse horticulture holdings to optimise energy supply benefits, including the improvement of access to natural gas supplies. The plan provides for a number of measures to be able to connect 75% of glasshouse horticulture holdings to the natural gas network within a period of 10 years.

Finally, farmers and horticulturalists are eligible for tax benefits if they invest in energy saving. Certain investments give entitlement to a tax deduction of 13.5% of the value of the investment.

A02 – Limitation/reduction of methane and N_2O emissions

REG | IMP | CH_4-N_2O

FR: The digestion of ruminants and manure are major sources of methane and nitrous oxide in agriculture. The emissions from manure occur from storage, application and processing.

The agriculture sector achieves considerable reductions mainly by reducing the livestock (both financial incentives to halt production (2001-2003) and natural decline in cattle-breeding and by reduced use of artificial fertilizer. The reduction in livestock is supported by decoupling for animals. The reduction in the number of animals and the tightening up of the manure policy also contribute to reduced use of manure, which in turn reduces the direct and indirect emission of nitrous oxide from the soil. Technical measures with regard to feed have only a limited impact on the emission of methane for the well-fed cattle in Flanders.

In the context of the manure processing obligation, manure processors will be asked to draw up a nutrient balance in which, if there are large differences between incoming and outgoing nitrogen content, it must be demonstrated in which form the nitrogen has disappeared. A procedure has been devised to have the measurements of nitrous oxide and ammonia emissions in manure processing made according to a standard procedure.

WR: The Walloon Region will introduce by 2010 a set of measures to reduce the quantity of mineral nitrogen used in agriculture. These measures will concern the management of organic matter, storage infrastructures for farmyard manure, the physico-chemical characterisation of manure, the timing of application, the assessment of fertilising value in the context of manure plans and a scientific approach to complementing organic fertilisers with mineral fertilisers.

A set of measures concerning the storage, handling and spreading of farmyard manure is being phased in by 2010. The measures are particularly intended to optimise storage, spreading and composting techniques and practices, as well as the production of bio-methane, via environmental agreements and with the financial support of the public authorities.

A03 – Agri-environmental measures

REG | IMP | CO_2-CH_4-N_2O

WR: Among the agri-environmental measures passed by the Walloon Government on 11 March 1999[33], the following

[33] Moniteur Belge/Staatsblad of 31 March 1999

will have a significant impact on the emission of greenhouse gases from the agricultural sector:

- the introduction of extensive strips of meadow or grassland on the edge of crop fields along waterways to avoid seepage of nitrogen and pesticides into surface water;
- the introduction of seeded crops 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.

Policies and measures in the forestry industry

A04 – Measures for encouraging reforestation and prohibition of deforestation

REG | IMP | CO_2

FR: The authorities of the Flemish Region have set up, under the town and country planning act (Flanders Structural Town and Country Plan), measures to extend forested areas. The Flemish Region policy of reforestation is based on two strategies: first, the authorities are implementing a purchasing policy designed to create new forested areas; second, they are offering financial support to initiate afforestation and reforestation initiatives by local authorities or individuals, with special emphasis on the afforestation of agricultural lands as part of the regional rural development programme in accordance with relevant EU policies. These policies were reviewed and adjusted in 2003.

New regulations on deforestation came into force in February 2001. Their objective is to preserve wooded areas in the Flemish Region; the deforestation of land outside residential and industrial areas is no longer allowed unless a special exemption is obtained. When deforestation is permitted, moreover, compensation is required; this may be made in kind (by planting trees elsewhere in Flanders), or by a financial payment, to be used by the Flemish Region for afforestation. A compensation factor multiplies the area of deforestation by 1.5 or 2 depending on the ecological value of the wood concerned. The basic figure is € 1.98/m², multiplied by the compensation factor.

A05- preservation of the ecological stability of forests

REG | IMP | CO_2

WR: The Rural Development Plan 2000-2006 provides compensation for the lack of income for owners who practice forest conservation, through a policy of awarding allowances to private owners for setting up, managing and conserving private forest reserves.

Two important European Directives on nature protection – the Habitat and Birds Directive and the Natura 2000 Directive – have been transposed into law in Wallonia. The Natura 2000 network (European sites for the preservation of the natural habitats of flora and fauna) now comprises 231 sites covering 217 000 hectares or 13% of Walloon territory. The implementation of these policies results in the preservation of land, limiting changes in land use and consequently the loss of soil carbon. A number of information initiatives on Natura 2000 have been launched.

FR: Preservation of ecological stability is an integral part of the concept of sustainable forest management (SFM) as defined in Flemish forest legislation. This principle was reiterated by the adaptation of criteria for sustainable forest management by the Flemish government.

Biodiversity concerns are addressed by the following means:

- clear interpretation of the standstill principle for forest management in internal instructions;
- biodiversity as an important principle of criteria for sustainable forest management;
- more detailed interpretation of the concept of 'forest reserve' as foreseen in the Flemish Forest Decree, where nature conservation is a key objective in forest reserves (e.g. amendment of Forest Decree in 1999).

Some of the concrete technical details for forest management are continous development or close canopy management and the promotion of spontaneous processes and continuous regeneration cycles. The 'regular system' of subsidies for SFM also includes financial compensation if certain general objectives and targets are met.

A06- The Wood Energy Plan

MIX | IMP | CO_2

WR: A Wood Energy Plan was set up in March 2001. It is targeted at initiating and implementing a dozen projects for automatic wood heating, gas generation or other wood-use technologies designed to secure energy from wood in Wallonia. This plan essentially concerns municipalities and communities, whether or not connected to district heating systems. Actions will include information and awareness measure, feasibility pre-studies (evaluation of available resources, evaluation of energy needs, evaluation of RUE potential) and assistance with setting up projects.

A07 – Harmonisation of forest and climate policies

PLA/REG | IMP | CO_2

FR: The Flemish forestry policy recently developed informative and incentive instruments to orient forestry more towards sustainable forest management (Decrees of the Flemish government of 27 June 2003 on sustainable forest management criteria + subsidies, management outlook for public forests). Although these concepts are based on general principles of multifunctionality and orientation towards nature, specific concerns can be

considered, including specific measures or directives based on the climate policy. Exploratory studies indicate that these developments based on forestry policy are much in tune with the concern to maintain and boost the storage capacity of greenhouse gases by forests. An extra task can consist in suitably translating "favourable climate measures" into forest management and forestry practice.

A08 – Promotion of energy crops

R&D | IMP | CO_2

FR: In spring 2003, the demonstration project "Application of ligneous biomass crops for sustainable energy production within farms in Flanders" was started up for the purpose inter alia of investigating the sales market and acceptability of energy crops in Flanders. In addition, a study was started up to investigate the legal, economic, social, ecological and technical aspects of short-rotation forestry in Flanders. The implementation of Directive 2003/30/EC can act as a significant stimulus to energy crops in Flanders.

Waste

Context of policy in the waste industry

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

FR: The Flemish waste policy is stipulated by OVAM and follows the principles of the ladder of Lansink and the relevant European Directives. The implementation plan for domestic waste 2003-2007 and the industrial waste plan indicate how the aim is to be achieved for the minimum quantity of waste to be dumped and maximum harnessing of the energy content of waste. Since 1 July 2000, the moratorium on dumping organic waste has also come into force. Methane emissions from landfill sites (old or in use) are being regulated under the VLAREM II regulations.

WR: 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.

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

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

BCR: In the Brussels-Capital Region, the waste management strategy is defined in the Third Waste Prevention and Management Plan (2003-2007). This plan emphasises waste prevention at the source and recovery methods. The Plan contains recovery actions but gives priority to waste prevention with dematerialization and recycling. These include more selective 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.

In its Waste Prevention and Management Plans, the Region establishes the following hierachy for waste management: prevention, re-use, material recycling and energy recovery, with specific targets for each type of waste flow. The idea is to reduce the incineration of non-sortable and non-recyclable waste and to reduce waste to be dumped in the other regions.

Policies and measures in the waste industry

W01 – Maintenance of elimination obligations and reinforcement of regulations on the use of gas from landfills

REG | IMP | CO_2-CH_4

FR: The VLAREM amendment on the recovery of gases from landfill sites was definitively adopted by the Flemish government on 14 March 2002 (BS/MB 13/02/2004). It requires the operators of landfill sites which do not have a system for putting gases from landfill sites to good use to submit a study by 1 July 2004 demonstrating that this is not technically and economically feasible. If it is possible to put these gases to good use, the system must be installed by 30 June 2005.

WR: The programme to treat former landfill sites will be continued and intensified; this programme is intended to make sure that all emissions are recovered and treated correctly. Biogas recovery is also being encouraged and has developed considerably since 1993. According to the annual survey of solid waste disposal sites and estimated total emissions, more than

70% of methane is now being recovered, which is directly reflected in net emissions. Depending on methane content, the biogas is flared or used for energy purposes. Biogas recovery is the main measure in the waste sector and has led to a substantial decrease of emissions since 1990.

W02 – Improvement of energy efficiency of existing and new incineration plants REG IMP CO_2

FR: New waste incineration plants are required to produce a high energy yield. Existing plants with energy recovery must optimise their energy yield to the maximum. On the basis of a feasibility study with a BAT perspective (best available techniques), energy performance measurement formulas were definitively established in 2004.

BCR: The Region has only one waste incinerator (535 000 tonnes) in use. This household waste incinerator has to comply with standards for dioxins and will be equipped with denitrification equipment.

Flexible mechanisms

Institutional background

This chapter describes the allocation plans pursuant to the European Emission Allowance Trading Directive, on the one hand, and the potential use of the flexible mechanisms foreseen by the Kyoto Protocol, on the other.

The Kyoto Protocol incorporates the concept of flexible mechanisms in two separate forms, the transfer of emission allowances (or 'emissions trading') between Parties, with the goal of reducing greenhouse gas emissions, and the 'project-based' mechanisms such as the Clean Development Mechanism (CDM) and the Joint Initiative (JI).

Belgium will use the Kyoto mechanisms to respect its emission reduction commitment. The National Climate Commission has been named the Belgian DNA (Designated National Authority) and Focal Point. This political decision is currently being transposed into Belgian national law by a legal cooperation agreement between the federal government and the three regional governments. The agreement will include both the official designation of the DNA and Focal Point, as well as the transposition of Directive 2004/101/EC.

Measures on flexible mechanisms

M1: Allocation plans REG IMP CO_2

For the implementation of Directive 2003/87/EC, the regions are in charge of issuing greenhouse gas emission permits and the allocation plan for installations on their territories, excluding the support and safety installations for nuclear plants, which are the responsibility of the federal government. The Belgian National Allocation Plan is based on the sum of the three regional plans plus the federal plan.

FED: The Belgian federal government has published its National Allocation Plan (NAP) for CO_2 emissions under the EU Emission Allowance Trading Scheme. The NAP is to allocate 183.2 Mt CO_2 to installations covered by the scheme for the 2005-07 period. The regions were in charge of issuing GHG emission permits and drafting an allocation plan for installations on their territories. The European Commission has approved this National Allocation Plan.

FR: The Rational Use of Energy Decree of 2 April 2004 lays the basis for the allocation of emission rights to the plants coming under the EU Emission Trading Directive.

The definitive Flemish allocation plan was approved on 4 February 2005. Two public consultations were organised prior to this.

Table 4.4. Allocation of emission rights in Flanders (period 2005-2007)

Total	2005	2006	2007	2005-2007
BAU Total	41,804	42,189	42,650	126,643
BAU industrial installations	17,922	18,341	18,806	55,069
BAU energy production	23,882	23,848	23,844	71,574
Allocated number of emission rights for industrial installations	17,643	17,757	18,038	53,439
Allocated number of emission rights for energy production	16,992	15,738	14,484	47,241
Total number of allocated emission rights	**34,635**	**33,495**	**32,522**	**100,652**
Opt-out	269	269	269	807
Allocation reserve for newcomers	0	506	1,013	1,519

The table 4.4 shows the quantity of emission rights allocated in Flanders in the period 2005-2007.

WR: The GHG emission allowance trading scheme was adopted by the Regional Decree of 10 November 2004, in application of Directive 2003/87/EC. A Regional Allocation Plan was then adopted by the Walloon Government on 27 January 2005. 128 industries received a maximum greenhouse gas emission quota based on an energy audit performed at each site. The incentives to reduce industrial GHG emissions were reinforced by voluntary branch agreements which commit the main industrial sectors to improve their energy efficiency.

BCR: The Brussels-Capital Region has a limited number of industrial enterprises on its territory, so only 15 or so establishments are concerned by the Directive. Two thirds of these establishments form part of the tertiary sector, such as the European Parliament. Total emissions from these installations correspond to only around 2% of the region's total GHG emissions. The main source of emissions is the use of fossil fuels for the heating of buildings. The reduction in emissions expected from implementation of the CO_2 allowance trading scheme is consequently negligible for the Brussels Region.

M02 – Kyoto flexible mechanisms

REG | IMP | ALL

FED: In May 2005, the federal government launched its first JI/CDM tender for the purchase of emission reductions from JI and CDM projects, with an initial budget of € 9.3 million. The Call for Expressions of Interest (first phase of the tender) was open from May until September 2005 and 36 projects were received from countries in Asia, Africa, South America, Europe and Russia. In November 2005, the candidates selected during the first phase will be invited to submit a full proposal by March 2006. The projects selected during the second phase will be invited (indicative date - May 2006) to engage in negotiations with the federal government and to sign an ERPA (Emission Reduction Purchase Agreement), which constitutes a formal undertaking by the project participants to sell the emission reductions to Belgium. A new tender may be launched in early 2006 since the federal government's objective is to buy € 12.3 million worth of emission reduction credits for the period 2008-2012.

FR: The Rational Use of Energy Decree of 2 April 2004 on the reduction of the emission of CO_2 and other greenhouse gases by promoting the rational use of energy, the use of renewable sources of energy and the use of flexible mechanisms, forms the legal basis for the deployment of the flexibility mechanisms in Flanders.

The Flemish Climate Policy Plan 2002-2005 defined the following priorities for Flanders:

- devising an institutional and technical framework for the implementation of the two project-linked mechanisms: JI and CDM;
- definition and monitoring of the preconditions at ecological, social and economic levels;
- start-up of a number of pilot projects.

In September 2004, a first call was launched to companies with a view to the purchase of emission credits from project developers.

At the end of 2004, a policy preparation investigation was started into the financial, ecological and legal aspects of participation in a climate fund, with a view to acquiring emission credits via the flexibility mechanisms of the Kyoto protocol.

Under the Environment section of the 2004-2009 coalition agreement, the following provision was included on the deployment of the flexibility mechanisms of the Kyoto protocol:

'For the application of the flexible mechanisms, Flanders will apply for itself the principles as agreed in the Consultative Committee on 8 March 2004 with regard to the federal government. This means that in the first place use will be made of Joint Implementation and Clean Development Mechanisms but that the purchase of emission rights is not precluded under certain conditions. A technical committee has been set up to advise the government on this matter.'

In the context of drawing up the Flemish allocation plan for the first trading period 2005-2007, the Flemish government decided on 1 October 2004 to purchase the necessary emission credits as a supplement to internal reduction measures by the end of 2012. On the basis of the present forecasts, this would involve a quantity of 23.93 million tonnes of CO_2 equivalents. At the same time, it was decided to set up a suitable financing mechanism in the future to finance the project-linked mechanisms.

WR: In the Walloon Region, the legal basis is the Decree of 10 November 2004 establishing a Regional Allocation Plan for emission quotas. The Decree foresees the creation of Walloon 'Kyoto' funds which can be allocated for the realisation of Kyoto flexible mechanisms. On 23 December 2004, the Walloon government approved its participation in the World Bank Community Development Carbon Fund (CDCF) in the amount of $ 5 million. This participation is to be regarded as a first concrete element in order to fill the objective defined by the Walloon Air Plan (5.5 Mt CO_2 eq. for the period 2008-2012). The Walloon Region is currently studying other ways of meeting this objective.

BCR: The Brussels-Capital government decided in November 2004 to invest $ 9.5 million between 2005 and 2014 in the World Bank CDCF. This investment should provide the Region with about 1 Mt CO_2 eq. in CER for the first commitment period.

5. Projections and the total effect of policies and measures

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Introduction

The main objective of this chapter is to give an indication of future trends in greenhouse gas emissions and sequestration, given the current national circumstances and the policies and measures implemented and accepted within the current climate policies. Projections are given for all greenhouse gases considered in the Kyoto Protocol and all sectors. They are estimated at five-year intervals from 2005 to 2020 and compared to inventory data for 1990 and 2000.

Two scenarios are presented in this communication. First, a 'with measures' scenario evaluates future greenhouse gas emission trends under current policies and measures. Second, a number of additional measures and their impacts are presented. Together, they form the basis of a scenario 'with additional measures'.

The methods used to develop these projections are detailed in section 2 of this chapter. The models used are described, as well as the main assumptions. The main policy elements of the 'with measures' scenario are also described in this section. Section 3 presents the results of the projections and is divided into three parts. The first details the greenhouse gas emission projections in the 'with measures' scenario. The second analyses the sensitivity of the projections to changes in a number of key assumptions, such as the price of oil or future average temperature. The third evaluates some policies and measures that could be included in a 'with additional measures' scenario. Finally, section 4 presents a summary of this chapter.

Methodology

The national projections reported in this chapter are based on the sum of the projections developed by the three regions (Flanders, Wallonia, Brussels-Capital) as part of their respective climate strategies. Assumptions and key parameters were harmonised in a forecasting round held in spring 2005. Some parameters remain different, to reflect more accurately the activities taking place in each region. These assumptions are reviewed in the first part of this section. The policies included in the 'with measures' scenario are described in a second part. The resulting national GHG emission projections have been validated through an extensive comparison with the national projection prepared by the Federal Planning Bureau. This comparison has resulted in adaptations of some assumptions and/or parameters used in the regional projections. The models used by each region and by the Federal Planning Bureau are described in a third part of this section.

Demographic and Economic Assumptions

Assumptions on economic growth in the 'with measures' scenario are summarised in table 5.1. These figures are based on the Federal Planning Bureau's economic forecast up to 2010. To extend this forecast to 2020, growth rates from the European Commission (DG Transport and Energy) study *European Energy and Transport - Trends to 2030* were used. The projections presented here are based on a detailed bottom-up approach within each region of Belgium. This approach starts from the demand side and the energy needs of the different sectors to develop national energy projections. As such, energy demand relates to an activity forecast for each sector in each region and is not necessarily consistent with the economic assumptions mentioned in table 5.1.

Demographic expectations (table 5.2) are based on the prospects for the period 2000-2050 of the Belgian National Institute for Statistics (NIS), updated on the basis of the most recent demographic data. Actual values are thus used for the year 2000, instead of the NIS figures. The forecast up to 2020 has been estimated on the basis of the actual value in 2000 and the expected growth rates from the NIS forecast. Data and forecast on household size are not included in national statistics and were submitted by the regions.

Table 5.1: Macro-economic assumptions: annual GDP growth rate

	1990-2000	2000-2010	2005-2010	2010-2020
EU-15	2.1%	1.9%	2.2%	2.3%
Belgium	2.2%	1.9%	2.2%	1.8%

Sources: Federal Planning Bureau (to 2010) and European energy and transport – trends to 2030 (to 2020)

Table 5.2: Demographic assumptions

(Thousands)	2000	2005	2010	2015	2020
Population - Belgium	10 166	10 341	10 432	10 538	10 642
Number of households -Belgium	4 245	4 430	4 590	4 728	4 859

Source: Regional assumptions

Table 5.3: Energy price assumptions

Prices (€ 2000 / GJ)	2000	2005	2010	2015	2020
Hard coal 1.5% S	1.72	1.72	1.72	1.87	2.21
Hard coal 0.5% S	2.00	2.00	2.00	2.15	2.40
Heavy fuel oil	4.60	4.60	4.60	4.80	5.00
Natural gas	4.60	4.60	4.60	4.85	5.10
Bio-mass	Full potential is used				
Blast furnace gas	Full potential is used				

Source: Regional assumptions

Table 5.4: Price of CO_2 emission allowances

	2006	2008	2010	2012	2015	2020
Price in €/tonne CO_2	6	6	10	10	10	15

Source: Regional assumptions

Real fuel prices (table 5.3) have been kept constant between 2000 and 2012. These assumptions were also used in the context of atmospheric pollution policies. Prices after 2012 were estimated using the recent WETO 2030 study (World Energy, technology and Climate Policy Outlook, EUR 20366).

Table 5.5: Emission factors

(kt CO_2/PJ)	Belgium
Hard coal	92.7
Cokes	106.0
Brown coal, lignite	101.2
Other solids (wastes,, etc.)	Variable
Natural gas	55.8
Coke oven gas	47.4
Blast furnace gas: Flanders Wallonia	258.0 265.5
Rafinery gas	55.7
Heavy fuel oil	76.6
Petroleum cokes	99.8
Light fuel oil, gas oil	73.3
Petrol	68.6
LPG	62.4
Other fuels	56.4

Source: National inventory

International emissions trading

Under the European emissions trading system, energy-intensive industries and the electricity generation sector have received CO_2 emission allowances.

In this scenario, it is assumed that these allowances are sufficient for all industries. Indeed, in Flanders, allocation plans are based on a benchmarking agreement. If an installation belongs to the 10% most energy-efficient installations in the world, then sufficient free allowances are granted (assessed on the basis of detailed energy plans). In Wallonia, most energy-intensive industries are involved in branch agreements with the regional authorities; allocations are based on the emission reduction objectives to which the enterprises are committed. Large CO_2 emitters in the Brussels-Capital Region account for a very small part (less than 1%) of CO_2 emissions in Belgium. An emission constraint on these emitters would thus have a very small impact on the scenario and was therefore not accounted for.

For the electricity generation sector, emission allowances might be binding. The following evolution has been assumed for the price of an emission allowance for one tonne of CO_2. The figures may seem relatively low compared to the current price of EU allowances. These assumptions have however been agreed upon when the current price was much lower. Moreover, all national registries are not yet in place and the market is still in a warm-up phase, so that current prices do not necessarily reflect future prices.

CO_2 emission factors

The emission factors that were used for CO_2 are detailed in table 5.5. These emission factors remain constant throughout the projection period. Differences across regions reflect different industrial structures and technologies. For transport, projections were developed on a national scale with the Hermes model. IPCC emission factors were used, i.e. 74.07 kt CO_2/PJ for gas oil and 69.30 kt CO_2/PJ for petrol.

Climate assumptions

Climate conditions have a strong influence on energy use by households and in the services and agricultural (for greenhouses) sectors. Indeed, in Belgium, a large share (about 85%) of energy use in households and the services sector goes to the heating of buildings, while in the agricultural sector, about 60% of energy consumption goes to heating greenhouses.

A key parameter to estimate the influence of climate on energy use is the number of degree-days per year. Degree-days are computed as the number of days where the average temperature is below a certain level (either 15°C for the reference 15/15 or 16.5°C for the reference 16.5/16.5) times the value of the difference between that average temperature and the given level (here 15°C). This parameter is an indicator of average outside temperature and therefore an indicator of heating demand. Low outside temperatures correspond to a high number of degree-days and high energy demand for heating. A change of one degree-day lowers the energy use for heating by about 0.05%.

In the projections used in this report, it is assumed that the annual number of degree-days over the period 2000-2020 equals the average value of the period 1993-2003, i.e. 1 900 degree-days (reference 15/15, or 2 314 degree-days at reference 16.5/16.5). Two alternative values have been used in the sensitivity analysis (see p. 79). The first alternative value, at 2 010 degree-days, is the average value over the period 1971-2000. A second alternative value corresponds to a warmer climate. It uses the value observed in 2000, i.e. 1 714 degree-days.

Scenario description

The 'with measures' scenario indicates the likely evolution of greenhouse gas emissions in Belgium under current policies and measures. This scenario includes all policies and measures either adopted or being implemented by the end of April 2004, including the National Allocation Plan. It does not include additional measures that could be proposed in the revised *National Climate Plan*, under discussion at the time of writing this report, or that could be taken in view of post-Kyoto climate objectives. The major features of the 'with measures' scenario are described in this sub-section.

At the federal level, measures include those decided at the Council of Ministers of 19-20 March 2004, which aim at reducing emissions by 4.8 Mt CO_2 eq. per year during the 2008-2012 period. Flemish climate

policy is based on the *Flemish Climate Plan 2002-2005*, adopted on 28 February 2003, and its yearly progress report. The *Flemish Climate Plan 2006–2012* is expected to be submitted soon to the Flemish government. In the Walloon region, an *Action Plan for Climate Change* was adopted on 19 July 2001. It was supplemented by the *Walloon Plan for Sustainable Management of Energy* in 2003. In the Brussels-Capital Region, the climate change policy is set out in the Air and Climate Plan adopted by the Brussels-Capital government on 13 November 2002[34], which focuses in particular on the residential, commercial and transport sectors. This plan will be reinforced in 2006 mainly in the building sector with the regional transposition of the European Directive on the energy performance of buildings. Details of these plans and of the actions included in the 'with measures' scenario can be found in chapter 4.

The energy and transport sectors are two key emitters of greenhouse gases. Adopted policies or policies being implemented in these two sectors are thus worth detailing. For the energy sector, table 5.6 presents the structure of electricity generation in Belgium from 2000 to 2020. An important factor in this regard is the phase-out of nuclear energy, voted by the federal Parliament in 2003. The first nuclear power stations will close in 2015, the last in 2025. Accordingly, the share of nuclear electricity declines from 51.8% in 2010 to 31.7% in 2020. In this scenario, it is assumed that they will be mostly replaced by combined-cycle gas turbine power stations.

In the transport sector, full implementation of the automotive industry's voluntary agreement has been assumed. On average, CO_2 emissions from new cars will be limited to 140 g CO_2/km in 2008 (2009 for Japanese and Korean cars). No further improvement is assumed thereafter. The progressive renewal of the fleet will, however, make average CO_2 emissions per kilometre decline over the projection period.

Table 5.6: Structure of electricity generation

	2000	2010	2015	2020
Nuclear energy	58.2%	51.8%	43.4%	31.7%
Fossil fuels – classic	20.4%	12.7%	10.9%	6.7%
Natural gas - combined-cycle	12.4%	13.2%	21.5%	36.0%
Fossil fuels - combined heat & power	5.7%	14.3%	15.1%	16.2%
Biomass, biogas and waste	1.0%	3.0%	3.4%	3.8%
Wind and hydroelectricity	0.6%	3.6%	4.3%	4.2%
Other electricity sources	1.6%	1.5%	1.4%	1.3%
Total	100.0%	100.0%	100.0%	100.0%

Source: Regional assumptions

Models used

This section describes the three models used for the projections. Regional projections were prepared using MARKAL (Flemish region) and EPM (Walloon and Brussels Regions). The Federal Planning Bureau used HERMES to prepare a projection at country level.

MARKAL

MARKAL, a technico-economic model, assembles in a simple but economically consistent way technological information (conversion-efficiency, investment and variable costs, emissions, etc.) for the entire energy system. It can represent all energy demand and supply activities and technologies for local, national or multi-regional energy systems over a period of 30 to 50 years, with their associated emissions (CO, CO_2, SO_2, NO_X, VOC and PM) and the damage caused by these emissions.

Inputs needed by MARKAL are energy service demands (e.g. car use; residential lighting; steam heat requirements in the paper industry; etc.), primary resource potentials, policy setting and the descriptions of a set of technologies (e.g. efficiency, investment and operating costs, emission factors, etc.) as well as estimates of the existing stock of energy-related equipment in all sectors. MARKAL thus describes explicitly the use of technologies and fuels in all sectors. With these inputs, MARKAL computes the least cost combination of energy services required to supply the energy service demand.

The choice by the model of the generation equipment (type and fuel) is based on analysis of the characteristics of alternative generation technologies, the economics of the energy supply and environmental criteria. MARKAL is thus a vertically integrated model of the entire extended energy system.

The scope of the model extends beyond purely energy issues, for example to environmental issues related to the energy system. In addition, the model is well suited to the analysis of energy-environmental policies. MARKAL was used to develop the emission scenarios for the Flemish Region.

[34] Plan for structural improvement of air quality and for the fight against climate change, 2002-2010

EPM

EPM (Energy/Emissions Projection Model), developed by ECONOTEC, is a projection model for energy demand and atmospheric emissions that covers all relevant emission sectors (energy sector, industry, residential, commercial and transport).

EPM is a simulation model of the 'bottom-up' type, i.e. explaining energy consumption and GHG emissions from activity variables expressed as far as possible in physical units, and containing a detailed representation of emission sources and the main determining factors of the evolution of energy demand and the various types of emissions.

The model, which includes a technico-economic database on energy consumption and emission reduction measures, is used in particular for:

- the construction of a reference scenario (business as usual), representing the expected future evolution in the absence of any new emission reduction policy;
- the economic assessment of emission reduction potentials;
- the construction of emission reduction scenarios, based on reduction measures with a marginal cost below a given ceiling;
- the development of cost curves, providing either marginal or total cost as a function of the level of emission or energy consumption reduction;
- the assessment of the impact of existing or draft legislation on energy consumption;
- emission levels and costs of emission reduction policies.

The model covers energy consumption and atmospheric emissions of CO_2, CH_4, N_2O, SO_2, NO_x and VOCs. The case of fluorinated gases, handled for the Federal Department of the Environment, required a more specific approach.

HERMES

HERMES is the macro-sectoral model used by the Belgian Federal Planning Bureau for its national short- and medium-term forecasts and for scenario analysis. The simulation period varies from 1 to 12 years. HERMES fits into the tradition of annual econometric models based on time series analysis. Since disaggregation is a key feature of the model, it is possible to describe shifts among the different sectors or branches; it also reveals the various effects of measures or external shocks on separate branches.

HERMES is a medium-term demand-oriented model in which supply elements play an important role. The activity of the branches is determined mainly through the demand side. Production capacity is also demand determined in the long run, although supply effects are present. Contrary to technological models, HERMES does not explicitly integrate a description of the different production technologies. Adjustment of production to existing capacity plays a role in the explanation of prices, investments and imports. HERMES incorporates fundamental neo-classical mechanisms for the determination of the marginal technical coefficients, the explanation of investment and the computation of capacities. Supply-side effects are also incorporated into export equations. Technological progress is exogenously included in the production functions.

HERMES breaks down the economy into 16 branches and distinguishes five institutional sectors: households, non-profit institutions serving households, corporate enterprises (both non-financial and financial corporate enterprises), public administrations and the rest of the world. Household consumption is broken down into 24 categories. In addition, the energy demand of each economic agent (firms, government, households) is computed and allocated between 8 energy products. HERMES uses emission factors to compute emission of air pollutants and greenhouse gases, based on the energy use of each economic activity.

Projections and total effect of policies and measures

This section presents the greenhouse gas emissions projected in the 'with measures' scenario up to 2020. These emissions are presented for each greenhouse gas covered in the Kyoto Protocol. Total greenhouse gas emissions are presented in the summary (section 5.4) at the end of this chapter.

Greenhouse gas emission projections

CO_2 emissions

In the 'with measures' scenario, emissions (without LUCF) of carbon dioxide (CO_2) are expected to increase by 6.5% (or 8.1 Mt) between 2000 and 2020 (see table 5.7). The largest increase occurs in the transport sector, where emissions are expected to rise by 24% from 24 Mt in 2000 to 29.9 Mt in 2020. Although emissions of CO_2 per kilometre driven are declining slightly, this gain is largely offset by the steady expansion of transport activities and kilometres driven on Belgian roads.

Emissions from the transformation sector are expected to increase by 8.6% from 32.8 Mt in 2000 to 35.7 Mt in 2020. In this scenario, emissions are stable or decline slightly until 2010, because of the replacement of low efficiency thermal units, in particular those using coal. In 2015, however, nuclear power stations will start to close, as required by Belgian law. In this scenario, it was assumed that nuclear power stations would be replaced by highly ef-

Table 5.7: CO_2 projections for Belgium

kt	1990	2000	2005	2010	2015	2020
1 Energy	110 220	113 941	119 177	116 815	119 440	122 009
1A Fuel combustion	109 939	113 619	118 840	116 461	119 088	121 680
1A1 Transformation (including CHP) (*)	29 907	28 024	33 225	31 481	33 142	35 676
1A2 Industry (without CHP) (*)	32 882	32 520	28 162	24 955	25 294	24 990
1A3 Transport (road, railway, inland navigation)	19 752	23 808	25 443	27 719	28 816	29 869
1A4 Commercial / residential / agriculture	27 232	29 178	32 010	32 306	31 837	31 145
1B Fugitive emissions	281	322	337	354	352	330
2 Industrial processes	8 451	9 587	9 333	9 153	9 219	9 288
3 Solvent and other Product Use			0	0	0	0
4 Agriculture	0	0	0	0	0	0
5 Land-Use Change and Forestry	-3 103	-3 137	-1 996	-3 306	-3 300	-3 300
6 Waste	339	288	611	634	623	591
7 Other	0	0	0	0	0	0
Total (without LUCF)	**119 010**	**123 815**	**129 121**	**126 602**	**129 282**	**131 888**
Total (with LUCF)	**115 907**	**120 679**	**127 125**	**123 296**	**125 982**	**128 588**

(*) Note: Some differences exist because of the allocation of CO_2 emissions from industrial cogeneration auto-producers to the electricity generation sector in this scenario (2005 to 2020), while they are allocated to the industry sector in the national inventory (1990, 2000).

Sources: National inventory (1990-2000) and national projections (2005-2020)

ficient gas combined-cycle power stations. This explains most of the emission increase from 2010 to 2020.

Emissions from energy use in the residential, commercial and agricultural sectors also increase, by 6.6% from 29.2 Mt in 2000 to 31.1 Mt in 2020. It is worth noting that 2000 was a warm year, with only 1 714 degree-days, while this scenario has been developed with the assumption of 1 900 degree-days (see climate assumptions on page 73). This explains most of the difference between 2000 and 2005. After 2005, climate assumptions remain constant and emissions from the residential and commercial sectors are expected to decline, thanks to future improvements in the energy performance of buildings.

A decline in CO_2 emissions from industry is expected from 2000 to 2020, both from energy use (-.9%) and from processes (-3.1%). In this scenario, emissions from energy use in industry fall from 27.7 Mt in 2000 to 25 Mt in 2020, while process emissions fall from 9.6 Mt to 9.3 Mt.

Capture of CO_2 from annual forest biomass growth is relatively stable over time, at about -3.1 to -3.3 Mt per year (see also chapter 3). Indeed, forested areas, the main parameter of carbon sequestration in the current inventory and projection, are assumed to stay constant until 2020 in Belgium. The lower figures in 2005 can be attributed to important harvest on old spruce and pine stands. For the other LULUCF sectors, specific studies are in progress to estimate the carbon soil budget (forest and agricultural soils), and the impacts of land-use change on these stocks.

The residual category 1.A.5 'Other', which in the case of Belgium amounts to emissions of about 90 kt CO_2 (assumed to be stable up to 2020) and corresponds to military transport, does not appear in this table. It is however included in the historical data (up to 2000) but not in the projections (from 2005 to 2020).

Emissions from international bunker fuels are not accounted for in this projection. They amounted in 2000 to 26,266 Mt CO_2 eq., of which 99.96% CO_2. Emissions from bunker fuels increased by 60% between 1990 and 2003 (3.7% per year). According to the HERMES projections, they will grow by 2.7% a year between 2003 and 2010.

CH_4 emissions

Emissions of methane (CH_4) are expected to decrease by 24% (or 2.3 Mt CO_2 eq.) between 2000 and 2020 in the 'with measures' scenario (see table 5.8). The most important reductions are expected in the waste sector, where emissions decline from 2.0 Mt CO_2 eq. in 2000 to 0.7 Mt CO_2 eq. in 2020. This is largely due to the decline in landfill over the projection period. In Wallonia, for example, the dumping of organic waste will stop in 2010, pursuant to current regulations. The recovery of landfill gas is assumed to remain constant, at the 2002 level.

Important reductions are also expected in the agricultural sector, where emissions decline by 12% from 7.0 Mt CO_2 eq. in 2000 to 6.2 Mt CO_2 eq. in 2020. This reduction is linked to a decline in dairy and non-dairy cattle, while populations of swine and poultry (which produce less methane than cattle) increase. The main uncertainty in methane emission projections is the evolution of the animal population.

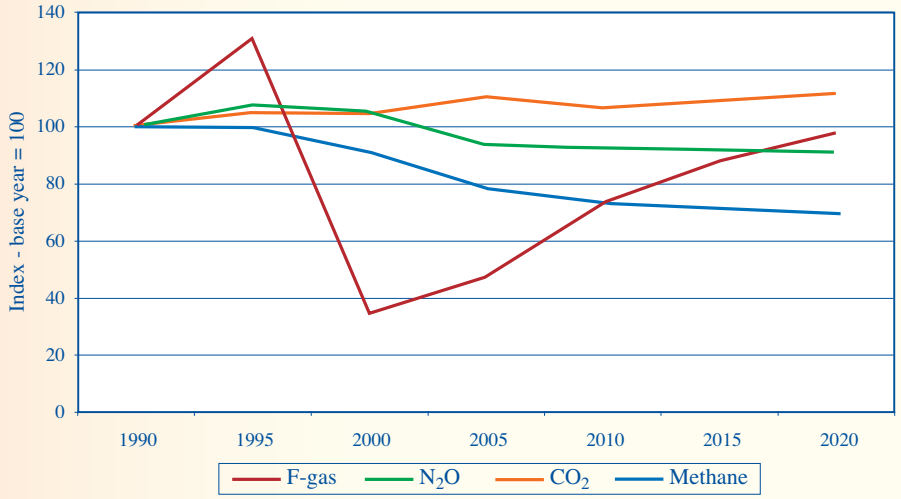
N_2O emissions

Emissions of N_2O are expected to decrease by 14% (or 1.7 Mt CO_2 eq.) between 2000 and 2020 in the 'with measures' scenario (see table 5.9). The most important reductions of N_2O emissions are expected in the industrial sector, with emissions declining by 31% from 4.6 Mt CO_2 eq. in 2000 to 3.2 Mt CO_2 eq. in 2020. Indeed, the regional governments and producers of nitric acid and caprolactam have agreed to reduce the emission factors of the production process. Compared to 1990 levels, emission factors are expected to be 50% lower in 2010 in the Flemish Region and 41% lower in the Walloon Region.

In the agricultural sector, N_2O emissions decline by 9% from 5.3 Mt CO_2 eq. in 2000 to 4.9 Mt CO_2 eq. in 2020. These reductions are mostly linked to changes in the size of the animal population. Dairy and non-dairy cattle are expected to decrease over the projection period, while swine and poultry levels will increase.

Emissions of N_2O from energy combustion are expected to increase, mostly in the transport sector. This increase, at

Figure 5.1: GHG emissions in Belgium: trends by gas



Sources: National inventory (1990-2000) and national projections (2005-2020)

Table 5.8: CH_4 projections for Belgium

kt CO_2 eq.	1990	2000	2005	2010	2015	2020
1 Energy	824	658	613	585	597	619
1A Fuel combustion	262	209	198	188	189	192
1A1 Transformation (including CHP)	3	7	13	17	18	20
1A2 Industry (without CHP)	57	44	41	27	27	26
1A3 Transport (road, railway, inland navigation)	73	50	40	44	45	47
1A4 Commercial / residential / agriculture	129	107	104	100	99	99
1B Fugitive emissions	561	449	415	397	408	427
2 Industrial processes	33	35	35	35	35	35
3 Solvent and other Product Use	0	0	0	0	0	0
4 Agriculture	7 162	7 011	6 638	6 499	6 361	6 179
5 Land-Use Change and Forestry	0	0	0	0	0	0
6 Waste	2 769	2 094	1 148	814	683	653
7 Other	0	0	0	0	0	0
Total	**10 788**	**9 798**	**8 434**	**7 933**	**7 676**	**7 486**

Sources: National inventory (1990-2000) and national projections (2005-2020)

0.2 Mt CO_2 eq. from 2000 to 2020, is nonetheless much smaller than the decline in other sectors.

The main uncertainties in N_2O emission projections are the evolution of animal populations and of the production of nitric acid.

F-gas emissions

Emissions of fluorinated gases (F-gas) decreased rapidly in the late 90s, thanks to a swift reduction in emissions from the chemicals sector. However, it is expected in the 'with measures' scenario that F-gas emissions will increase again and almost triple between 2000 and 2020, rising from 1.3 Mt CO_2 eq. to 3.6 Mt CO_2 eq. About 85% of this increase takes place in the refrigeration and air conditioning sectors, as shown in table 5.10. The use of F-gases in other activities also increases at a similar pace, but the quantity of F-gases used in these activities is relatively smaller.

The following policies are included in the 'with measures' scenario.

- the indirect impact on HFC emissions of European Regulation EC/2037/2000, prohibiting the use of CFC and HCFC in a number of applications;
- the Flemish[35] and Brussels[36] regional regulations to control emissions from refrigeration installations (intended for operators of installations).

[35] 14 maart 2003 – Besluit van de Vlaamse regering tot wijziging van het besluit van de Vlaamse regering van 1 juni 1995 houdende algemene en sectorale bepalingen inzake milieuhygiëne.

[36] 20 november 2003 – Besluit van de Brusselse Hoofdstedelijke Regering betreffende koelinstallaties / 20 novembre 2003 – Arrêté du Gouvernement de la Région de Bruxelles-Capitale relatif aux installations de réfrigération.

Table 5.9: N_2O projections for Belgium

kt CO_2 eq.	1990	2000	2005	2010	2015	2020
1 Energy	2 087	2 390	2 476	2 588	2 559	2 499
1A Fuel combustion	2 087	2 390	2 476	2 588	2 559	2 499
1A1 Transformation (including CHP)	284	307	358	372	367	334
1A2 Industry (without CHP)	662	539	528	496	488	480
1A3 Transport (road, railway, inland navigation)	356	756	800	873	903	933
1A4 Commercial / residential / agriculture	784	784	790	847	801	752
1B Fugitive emissions	0	0	0	0	0	0
2 Industrial processes	3 934	4 563	3 341	3 115	3 166	3 166
3 Solvent and other Product Use	253	254	256	256	256	256
4 Agriculture	5 617	5 348	5 034	4 997	4 930	4 851
5 Land-Use Change and Forestry	0	0	0	0	0	0
6 Waste	301	298	303	309	309	310
7 Other	0	0	0	0	0	0
Total	12 192	12 853	11 410	11 265	11 220	11 082

Sources: National inventory (1990-2000) and national projections (2005-2020)

Table 5.10: F-gas projections for Belgium

kt CO_2 eq.	1990	1995	2000	2010	2010	2015	2020
Refrig. & air cond. – installations			475	829	1 441	1 653	1 762
Refrig. & air cond. – other			126	299	510	696	807
Foams			112	126	164	212	271
Aerosols			76	128	178	224	268
Fire extinguishers			12	49	73	103	146
Solvents			0	11	11	11	11
SF6	1 663	2 205	109	80	84	111	113
Chemical industry			361	209	209	209	209
TOTAL	**3 671**	**4 795**	**1 271**	**1 731**	**2 671**	**3 220**	**3 587**

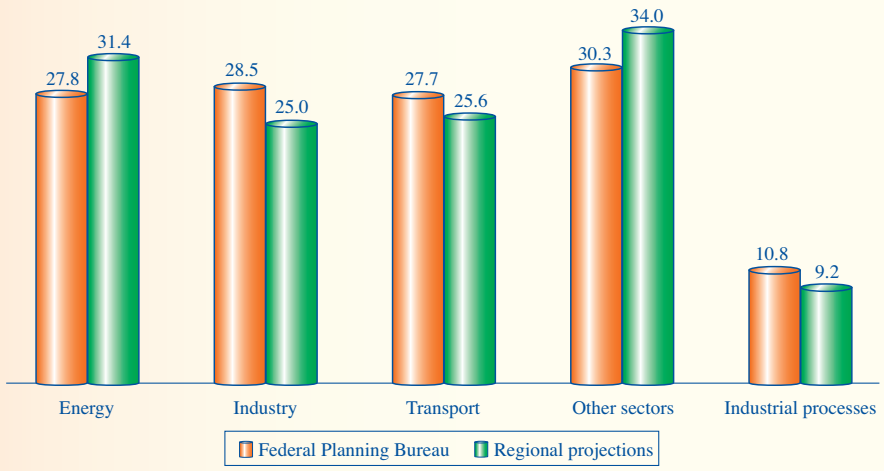
Source: Based on ECONOTEC-VITO projections

Comparison with other projections

The national projection was made by aggregating the results of the regional projections. For 2010, CO_2 emission levels obtained with this projection were then compared to the projections obtained with the HERMES model by the Federal Planning Bureau. The emission level estimated for the main sectors are shown in Figure 5.2. Total CO_2 emission levels are almost identical in the two projections, at 126.0 Mt for the regional projections and 125.7 Mt for the Hermes projections. Differences arise, however, at the sectoral level. Some of these differences can be explained by differences in the methodologies and models.

For energy and industry, for example, a large part of the difference in CO_2 emissions in 2010 can be attributed to the way emissions from CHP auto-producers are accounted for. In the regional projections, they are included in the energy sector, while in HERMES they are partially allocated to industry. In the case of transport, CO_2 emissions are mostly related to assumptions on road traffic levels. Projections from HERMES point to emissions of 27.7 Mt in 2010, against 25.6 Mt for the regional forecast. The national projection uses HERMES data for transport.

Figure 5.2: Comparison of CO_2 emission levels in 2010 (Mt)



Sources: Federal Planning Bureau and regional projections

Sensitivity analysis

Forecasting the future is always subject to uncertainties. A number of factors could influence the projections for future greenhouse gas emissions presented in the 'with measures' scenario. These could include, for example, slower or faster economic growth, or changes in average temperature. To assess the robustness of these projections, it is thus important to evaluate how GHG emissions would change if some of these key factors varied.

In addition to this sensitivity analysis, it is important to note that, for CO_2 emissions, the projections of the 'with measures' scenario have been compared, up to 2010, with those estimated by the Federal Planning Bureau (see above) using the HERMES model (as explained at p. 75).

Number of degree-days

Climate conditions influence energy demand for heating. In the "with measures' scenario, average climate conditions, as explained in 5.2.1.4, correspond to 1 900 degree-days a year and CO_2 emissions increase from 124.4 Mt per year in 2000 to 131.9 Mt in 2020. Two other assumptions about the future climate have been explored. The first corresponds to a colder climate, with 2 010 degree-days. In this case, CO_2 emissions increase to 133.5 Mt in 2020, i.e. 2.6 Mt above the level in the 'with measures' scenario. The second assumption corresponds to a warmer climate, with 1,714 degree-days (as observed in 2000, a warm year). In this case, CO_2 emissions increase to 129.4 Mt in 2020, i.e. 2.5 Mt below the level in the 'with measures' scenario.

Electricity imports

With the liberalisation of the electricity market, there are increasing uncertainties about the level of electricity imports. Liberalisation of the electricity market is likely to lead to an extension of transmission capacity and thus possibly to higher levels of cross-border electricity trading. One assumption of the 'with measures' scenario is that imports will rise slightly compared to the import level for the period 2000 to 2004.

If we assume that sufficient additional electricity generation capacity is installed in Belgium and that imports and exports are balanced in 2020, total CO_2 emission in 2020 would increase by about 1 Mt CO_2 compared to the emission level of the 'with measures' scenario. These estimates, computed with MARKAL, assume that additional production will come from gas combined-cycle power plants.

Electricity demand

In the forecast presented in the 'with measures' scenario, demand for electricity increases by an average of 1.2% a year from 2000 to 2020. It is nevertheless possible that measures currently under consideration or changes in the macro-economic environment could result in lower than expected growth of electricity demand. It has been estimated that, should electricity demand grow by 0.8% a year instead of 1.2%, emissions in 2020 would be about **2.1 Mt** lower than expected in the 'with measures' scenario. This estimate is based on the assumption that the electricity saved (6.323 GWh in 2020) is generated using the newest combined-cycle gas turbine power plants.

Higher price of crude oil

The 'with measures' scenario was estimated before the increase in oil prices in 2005. Using the HERMES model, the impact of higher oil prices on energy use in Belgium and related CO_2 emissions has been estimated. A first scenario was based on a price of $46.6 per barrel (of Brent) in 2005, $43.4 in 2006, and thereafter an annual increase equal to the increase in non-energy prices. A second scenario is based on a price of $57.4 for a barrel of crude oil in 2005 and $67.5 in 2006. From 2007 onwards, this price is again estimated using the growth rate of non-energy prices. The consequence of such an increase in oil prices is a decline in energy use and CO_2 emissions. In 2010, this results in a decrease of **2.8 Mt** of CO_2 emissions.

Alternative economic growth

The rate of economic growth has an impact on economic activity and energy use, and thus on CO_2 emissions. Other greenhouse gases might also be influenced, as agriculture and industrial activity would be influenced too. In this sensitivity analysis, using HERMES, the impact of two variants of economic growth on GHG emissions has been estimated. It has been assumed that changes in economic activity were caused by changes in the world economy, which would influence exports by Belgium.

Hermes used a reference scenario very similar to the 'with measures' scenario, with GDP growth of 1.9% a year on average between 2000 and 2010. If economic growth slows down to 1.6%, as shown in table 5.11, emissions decline by **2.6 Mt** in 2010. Conversely, an increase in economic growth to 2.2% a year causes an increase in GHG emissions of **2.6 Mt** in 2010.

Scenario 'with additional measures'

This section presents a number of additional measures and their impact. Taken together, these measures could provide an additional reduction of GHG emissions of 8.4 Mt CO_2 eq. These measures are described in more detail in the report prepared by Belgium under Article 5.3 of Decision 280/2004/EC (Report on Demonstrable Progress).

Belgium

Biofuels in transport

The 'with measures' scenario does not take into account the use of biofuels. As a result of implementation of EU Directive 2003/30/EC, an additional reduction of CO_2 of 1.4 Mt in 2010, 1.7 Mt in 2015 and 1.8 Mt in 2020 should be possible.

Transport policy

A scenario has been calculated based on more moderate growth in transport. This scenario results in CO_2 reduction potential of 2.1 Mt in 2010, 2.3 Mt in 2015 and 2.6 Mt in 2020. Additional policies and measures assumed in this scenario cover the following issues:

- limiting transport demand;
- improving the emission characteristics of vehicle fleets;

Table 5.11: Impact of higher oil prices

Mt CO_2	2005	2006	2007	2008	2009	2010
Changes in CO_2 emissions	-0.53	-1.44	-2.05	-2.42	-2.66	-2.81

Source: Federal Planning Bureau

Table 5.12: Impact of alternative economic growth

	GDP growth 2000-2010	Differences vs. 'with measures'
Reference scenario	1.9%	–
Low growth	1.6%	-2.6 Mt
High growth	2.2%	2.6 Mt

Source: Federal Planning Bureau

- reducing congestion through better traffic management;
- improving driving behaviour.

Additional measures in the chemical sector

Further negotiations with the chemical sector could lead to an additional reduction in emissions by nitric acid producers. It is assumed that, in the Flemish region, a 70% reduction of the emission factor could be achieved between 1990 and 2010, while in the Walloon region, according to the Action Plan on Climate Change (2001) a 54% reduction could be achieved over the same period. This would lead to a further N_2O emission reduction of 561 kt CO_2e.

Additional measures for F-gas

A number of additional measures have been considered to reduce F-gas emissions. They include the following:

- the future European regulation on certain fluorinated greenhouse gases;
- the future European Directive relating to emissions from air conditioning systems in motor vehicles and amending Directive 70/156/EC;
- the future Flemish regional regulation establishing a certification scheme for refrigeration technicians (in preparation);
- the future Walloon and Brussels regional regulations on refrigeration installation (certification scheme for refrigeration technicians and regulation for operators of installations, both in preparation).

Table 5.13 shows the detailed impact of such additional measures. An additional reduction of 1.3 Mt CO_2 eq. is possible with the implementation of these measures, mostly from reduced emissions in commercial refrigeration and mobile air conditioning.

Flemish Region

Energy efficiency in the services sector

In the Flemish Region, the implementation of a mandatory energy accounting system for office buildings has been analysed. This measure would be operational in 2006 for public buildings and in 2007 for private buildings with a usable surface of at least 1 000 m². The reduction potential of this measure is 0.2 Mt of CO_2.

Manure action plan

An additional action plan in the Flemish Region to reduce manure by reducing the size of the animal population (swine and poultry) has been estimated to bring about a reduction in methane emissions of 69 kt CO_2e and in N_2O emissions of 168 kt CO_2 eq., on a yearly basis from 2005 onwards.

Walloon Region

In the Walloon Region, the official policy on climate change is set out in an action plan adopted by the Walloon Government on 18 July 2001)[37]. Several measures, such as voluntary agreements with industry or the enforcement of thermal regulations in buildings have been enforced. Their impact has been estimated and is included in the 'with measures' scenario. Other measures only set out objectives whose achievement remains uncertain. They present theoretical emission reduction potential, which are considered hereafter.

Financial support for feasibility studies in industry

In the context of the energy audits conducted during the preparation of voluntary agreements with energy-intensive industries, several energy saving measures with significant uncertainties in terms of profitability or technical feasibility were identified. They were not taken into account in the definition of energy saving objectives of the industries participating in these voluntary agreements.

[37] « Plan d'action de la Région wallonne en matière de changements climatiques », 18 July 2001

Table 5.13: F-gas projections for Belgium – 'with additional measures'

Difference in kt CO_2 eq.	2000	2005	2010	2015	2020
Refrig. & air cond. – installations	0	0	-716	-896	-952
Refrig. & air cond. – other	0	0	-12	-131	-308
Foams	0	0	-10	-11	-10
Aerosols	0	0	-34	-43	-52
Fire extinguishers	0	0	0	0	0
Solvents	0	0	0	0	0
SF_6	0	0	0	0	0
Chemical industry	0	0	0	0	0
TOTAL	**0**	**0**	**-774**	**-1,081**	**-1,322**

Source: Based on ECONOTEC -VITO projections

Public authorities have put together a financial support mechanism to encourage industries to examine further the feasibility of those measures. Altogether, they present an additional energy saving potential around 2%, yielding a potential CO_2 emission reduction of 225 kt CO_2. Only a fraction of this potential should be implemented, as some studies are likely to conclude that the measures are not feasible.

Table 5.14: GHG projections for Belgium (Mt CO_2 eq.)

	Base year	2000	2005	2010	2015	2020
1 Energy	113.1	117.0	122.3	120.0	122.6	125.1
1A Fuel combustion	112.3	116.2	121.5	119.2	121.8	124.4
1A1 Transformation (including CHP)	30.2	28.3	33.6	31.9	33.5	36.0
1A2 Industry (without CHP)	33.6	33.1	28.7	25.5	25.8	25.5
1A3 Transport (road, railway, inland navigation)	20.2	24.6	26.3	28.6	29.8	30.8
1A4 Commercial / residential / agriculture	28.1	30.1	32.9	33.3	32.7	32.0
1B Fugitive emissions	0.8	0.8	0.8	0.8	0.8	0.8
2 Industrial processes	17.2	15.5	14.4	15.0	15.6	16.1
3 Solvent and other Product Use	0.3	0.3	0.3	0.3	0.3	0.3
4 Agriculture	12.8	12.4	11.7	11.5	11.3	11.0
5 Land-Use Change and Forestry	-3.1	-3.1	-2.0	-3.3	-3.3	-3.3
6 Waste	3.4	2.7	2.1	1.8	1.6	1.6
7 Other	0.0	0.0	0.0	0.0	0.0	0.0
Total (without LUCF)	**146.8**	**147.7**	**150.7**	**148.5**	**151.4**	**154.0**
Total (with LUCF)	**143.7**	**144.6**	**148.7**	**145.2**	**148.1**	**150.7**

Note: Emissions for the base year are calculated by adding the 1990 emissions for CO_2, CH_4 and N_2O, and the 1995 emissions for F-gas.

Sources: National inventory (base year, 2000) and national projections (2005-2020)

Using wood as an energy source

The Walloon authorities are supporting a large-scale programme to promote the use of wood as an energy source for heating as well as for steam and hot water production in industries. The objective of the action plan is to produce 5.55 TWh of heat from wood energy by 2010. If this objective is met, it could reduce the consumption of fossil fuels, yielding CO_2 emission reductions of some 1.2 to 1.6 Mt CO_2 (depending on the fuel replaced by wood). The results that will actually be achieved with this action plan are uncertain. First, they will depend on investments in the construction of district heating networks and, second, there are strong uncertainties about the long-term supply potential for wood.

Promotion of solar energy for residential heating

The Walloon authorities provide financial support for the installation of thermal solar panels for domestic heating. The objective of this plan is to install 200 000 m² of solar panels by 2010, which is estimated to yield CO_2 emission reductions of some 25 kt.

Aggregated projections

Under current policies, as described in the 'with measures' scenario, greenhouse gas emissions in Belgium (without capture by LUCF) are expected to increase from 146.8 Mt CO_2 eq. in the base year (see note under table 5.14 for definition of the base year) to 154.0 Mt CO_2 eq. in 2020, an increase of 4.9% (see table 5.14). The largest contributor by far to this increase is CO_2 emissions from energy used in the transport, electricity generation, residential and services sectors.

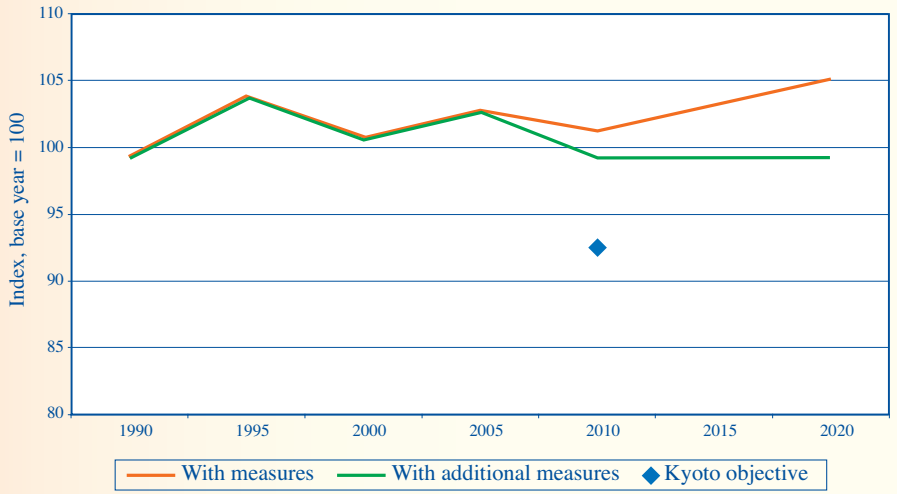
In the sensitivity analysis, the impact of changing certain key assumptions of these projections has been tested. Changes in expected climatic or economic conditions, for example, could result in lower or higher GHG emissions. In the analysis carried out for this report, these changes do not exceed, on an individual assumption basis, 3 Mt CO_2 eq. in 2020, i.e. less than 2% of total emissions. It is thus likely that, even if some of the key assumptions of the 'with measures' scenario were to change in the future, GHG emissions would still increase between 1990 and 2020, although the amount of this increase could vary to a limited extent.

The additional measures presented in this report allow further emission reductions in 2020, in the amount of 8.4 Mt CO_2 eq. The most significant additional measures focus on transport policy, the substi-

tution of wood and biofuels for fossil fuels, the reduction of F-gas emissions and further reduction of N_2O-emissions from nitric acid production.

Figure 5.3 illustrates these aggregated projections in the 'with measures' scenario and the impact of the additional measures. At this point, for the period 2008-2012, GHG emissions in Belgium are expected to remain higher than the level committed to under the Kyoto protocol. The National Climate Plan is currently being revised to take account of this and to propose new measures, including the use of flexible mechanisms, that would allow the country to meet its Kyoto objective.

Figure 5.3: Total GHG emission projections for Belgium



Note: Emissions for the base year are calculated by adding the 1990 emissions for CO_2, CH_4 and N_2O, and the 1995 emissions for F-gas.

Sources: National inventory (base year, 1990 to 2000) and national projections (2005-2020)

6. Vulnerability assessment, climate change impacts and adaptation measures

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Introduction

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change. Vulnerability is a function of climate variation, the degree to which the system responds to this variation, and its adaptive capacity. Accordingly, many factors are involved in its assessment, cumulating uncertainties from several sources. Knowledge of impacts in Belgium is still limited because very few impact studies are available, and issues are generally covered incompletely. In spite of the complexity of climate impact assessment, valuable information is progressively emerging on aspects of regional climate change, the main causes for concern, and possible adaptation measures.

Although impacts assessments are not systematically based on climate change scenarios [1], general knowledge of the features of projected climate change in the country is necessary. That is the purpose of the first section of this chapter, which reports results for the Belgian area based on the third assessment report of the IPCC and regional climate simulations over Europe from the EU PRUDENCE project. Results are provided for two widely used emission scenarios (A2 and B2 from IPCC [2]) based on a relatively large set of climate simulations which take a fair level of uncertainty into account. It is nonetheless kept in mind that these two emissions scenarios do not cover the full range of socio-economic scenarios and do not include climate mitigation policies.

The following sections present the available knowledge on impacts in all identified areas: biodiversity, agriculture, water availability, risks of flooding, human health, etc. Existing adaptation measures are reported, as well as known planned or potentially useful measures. The chapter then presents a summary of the possible impacts, together with an initial attempt to rate the corresponding vulnerability. This should be regarded as preliminary and indicative, because it is based on the available evidence, which is hard to summarize and still very limited.

Even less data is available for a discussion of economic impacts, which is not included here. We also exclude impacts of climate change policies (with the exception of biofuels in agriculture). Mitigation policies may have complex economic effects, including their cost, possible drawbacks in specific sectors as well as positive side effects, etc. This topic has few direct links with the impacts of climate change itself, and would not contribute to a clear overview of the difficult theme of impacts.

The last part of this chapter summarizes the role of Belgian development cooperation on adaptation regarding the improvement of developing countries' adaptive capacity, and cooperation in the field of research.

Assessment of impacts and adaptation measures

Climate change projections

Given a scenario of future global greenhouse gas emissions, the expected rise in the average global temperature is relatively well known. That is not the case, however, for the regional distribution of climate change, in particular with regard to the water cycle. Belgium is also a small country on a climate zone scale and most climate models have a resolution between 50 and 300 km. It is thus not easy to provide climate change projections for the country. A number of climate change simulations are now available, however, and these provide valuable information for Belgium.

Mean climate

Our analysis will be based mainly on two greenhouse gas emission scenarios (A2 and B2) from the IPCC (SRES report [2]), essentially because these are often used in climate model experiments. Scenarios differ in the underlying socio-economic hypothesis: A2 belongs to a family of scenarios aimed at short-term economic performance, while B2 is more oriented towards sustainable development. These scenarios are not extreme: both higher and lower emissions were considered in the IPCC SRES and Third Assessment Report.

Figure 2 reports mean temperature and precipitation changes for the period 2071-2100 compared to the period 1961-90, over an area roughly corresponding to Belgium (depending on model resolution). The coloured circles and arrows report results from general circulation models, with a resolution of a few hundred kilometres. The grey circles and arrows are based on the average of several high-resolution (about 25 to 50 km) regional climate simulations obtained from the PRUDENCE EU[38] project [**5**]). The error bars are an indication of the uncertainty at regional scale (global scale uncertainty is not included). All these results clearly show that at the scale of Belgium, the uncertainty is large: results vary widely between models.

However, a number of trends emerge:

- in both scenarios, temperatures rise significantly by 2050 both in summer and in winter [3]
- at the end of the 21st century, the rise in average temperature in relation to the end of the 20th century would be between 1 and 5°C in winter and between 1.5 and 7°C in summer; the larger changes are reported only for scenario A2, with the higher emissions.
- the projections for the change in precipitation until the end of the 21st century show a rise by 3 to 30% for winter (with few results under 10%) and a change in summer between the status quo and a drop by up to about 50%.

It is also important to remember that none of the SRES scenarios explicitly included a climate policy: emission reductions might result in less climate change than in the B2 scenario shown here[39]. Climate change might thus remain limited in Belgium, but only in a very optimistic scenario of world development and/or with effective mitigation polices. Indeed, Figure 2 shows that with a moderately optimistic socio-economic scenario (B2) and no specific climate policy, the summer temperature increase will very likely exceed +2°C from pre-industrial conditions.

Climate change may exceed the top of the range shown here if global emissions grow rapidly (as in some SRES scenarios of the A1 family) and/or the real climate behaves as foreseen in the models that show large changes. Some simulations show summer temperatures in Belgium at the end of this century similar to those of Southern Spain at the end of the 20th century, and at least one model produced summer maximum temperatures reaching up to 50°C [4].

At the moment, it is impossible to associate probabilities with socio-economic scenarios (which were all considered equal in the IPCC Third Report) and to predict how effective mitigation policies will be. For impact assessment, we need to consider the full range of climate change discussed.

Other changes

Typical 20th century cold winters will gradually disappear. In recent decades, a reduction in the amplitude of diurnal temperature changes has been observed (night minimums rise faster than day maximums). Increased cloud cover is a very likely contributor to this change and some models suggest that it will continue to increase in the future.

Extremes

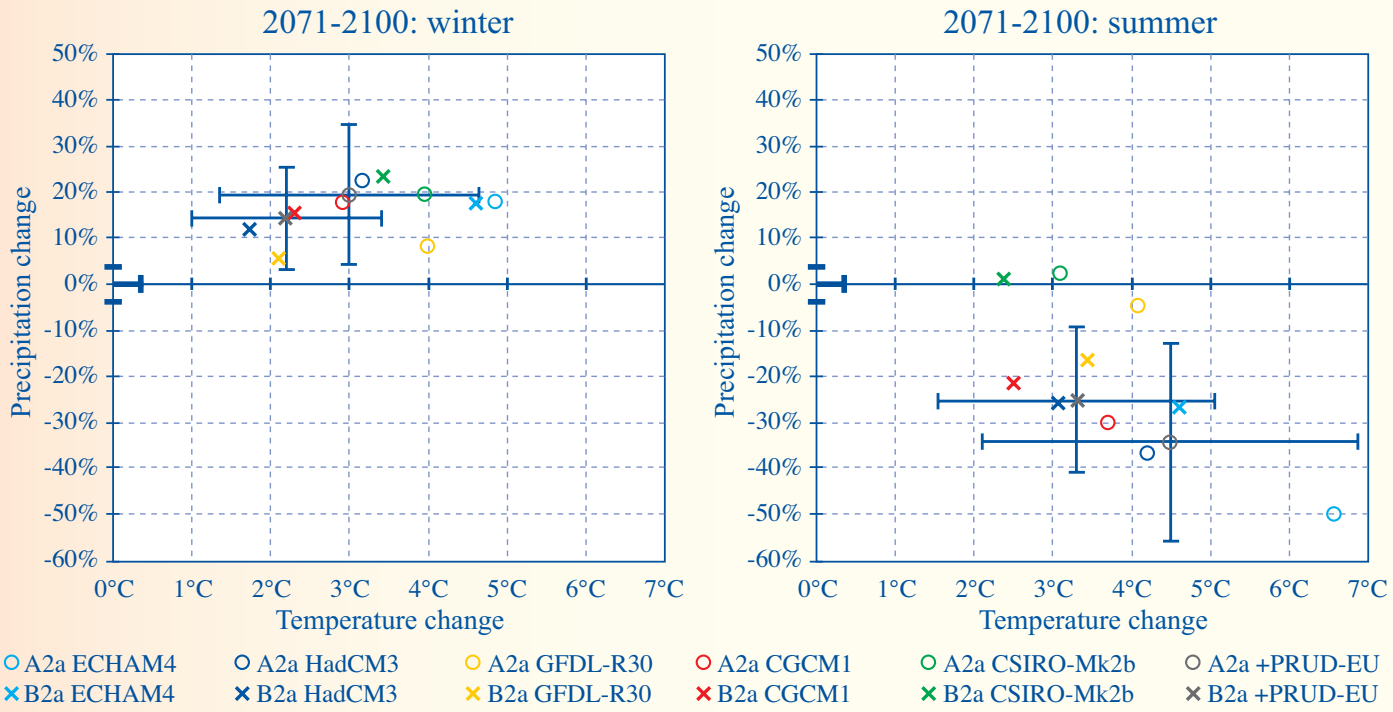
The probability of severe heat waves is expected to rise significantly. This is both a consequence of higher mean temperatures and increased variability [6]. Projections for the end of the 21st century (A2 scenario) show that about every second summer could be as warm or warmer (and as dry or dryer) than the summer of 2003.

There is considerable uncertainty over extreme winds and precipitation. It is very likely that there will be more frequent episodes of heavy rain, but this change cannot be reliably quantified at the moment (for the end of the 21st century in scenario A2,

[38] Results shown here are based on the appendix of the final report (http://prudence.dmi.dk) and global average changes from the IPCC Third Assessment Report.

[39] The B1 family of scenarios includes sustainability options that result in relatively low emissions and may in itself lead to a stabilization of CO_2 concentration at 550 ppm.

Figure 6.1 : Mean climate change over an area approximately equivalent to Belgium, for the period 1961-1990 to 2071-2100
Results are shown for two emissions scenarios (SRES A2, circles and B2, crosses), from 5 general circulation models (data provided by IPCC, coloured symbols), and for a set of regional climate models (based on results from the PRUDENCE project, Fifth EU Framework Programme for Research; the error bars relate solely to uncertainty in regional change, with an estimated 90% probability that the climate change will be in this range).



Source: Université catholique de Louvain [40], based on PRUDENCE [5].

[40] http://www.climate.be/impacts

model results for heavy summer precipitation range from insignificant changes to more than +30%). No statistically significant change was found in currently available observations for heavy precipitation (e.g. daily maximums), but further investigations are necessary before conclusions can be reached. Some general circulation (i.e. global) models suggest an increase in the intensity and/or frequency of the strongest storms over Europe, but there is still some debate on the explanation and generality of this result. An increase in extreme winds and North Sea storms, with increased risk of storm surge, was recently found in the framework of the PRUDENCE EU project; this is particularly interesting because it was obtained with several high resolution models, and it is thus probably more reliable.

Mean sea level

Changes in sea level will not be the same in all parts of the world, but future regional variations are poorly known. Regional changes stem from variations in thermal expansion, changes in ocean currents, and land movements (in particular postglacial rebound). In Belgium, observations for the period 1937-2003 in Ostend show an increase in mean sea level estimated at 16 cm/century, with no sign of recent acceleration [26]. Our current knowledge of sea level change in the 21st century remains limited to the global mean range reported by IPCC [7], with the additional effect of land movements

for Belgium[41]: +14 to +93 cm (for the period 1990-2100, including all uncertainty sources).

Beyond the 21st century

Part of carbon dioxide emissions remain in the atmosphere for centuries. If concentrations are stabilized due to a large reduction in emissions, the temperature increase will continue. In a moderate scenario, we may consider a stabilisation at 550 ppm CO_2[42] (depending on model sensitivity, this may be consistent with the EU target of limiting mean temperature increase to 2°C from pre-industrial to 2100). When adding up the results presented by the IPCC[42], this leads to a rise in the global mean sea level by the year 3000 between 4 and 8 metres (0.5-1.5m from thermal expansion, 3m from Greenland ice, 0-3m for Antarctic ice, 0.5m for glaciers).

While most climate models predict a slowdown of oceanic circulation in the North Atlantic (part of the planetary thermohaline circulation), current projections do not suggest that it will stop during the 21st century. The probability of this major event is not well known for the next centuries. It is a possibility, particularly following a large and fast increase in greenhouse gas concentrations. If the circulation changes, and in particular if the Gulf Stream (or more specifically the North-Atlantic drift) stops, projections suggest that in Europe the increase in mean temperature would be smaller but not replaced by cooling (for the annual mean: seasonal changes may be more complex, with a further disruption of the climate). In addition, a shutdown of the thermohaline circulation would cause a rapid rise in regional sea level along European coasts [8]: some 30 cm in a few years (and close to a metre after many centuries).

Ecosystems and biodiversity

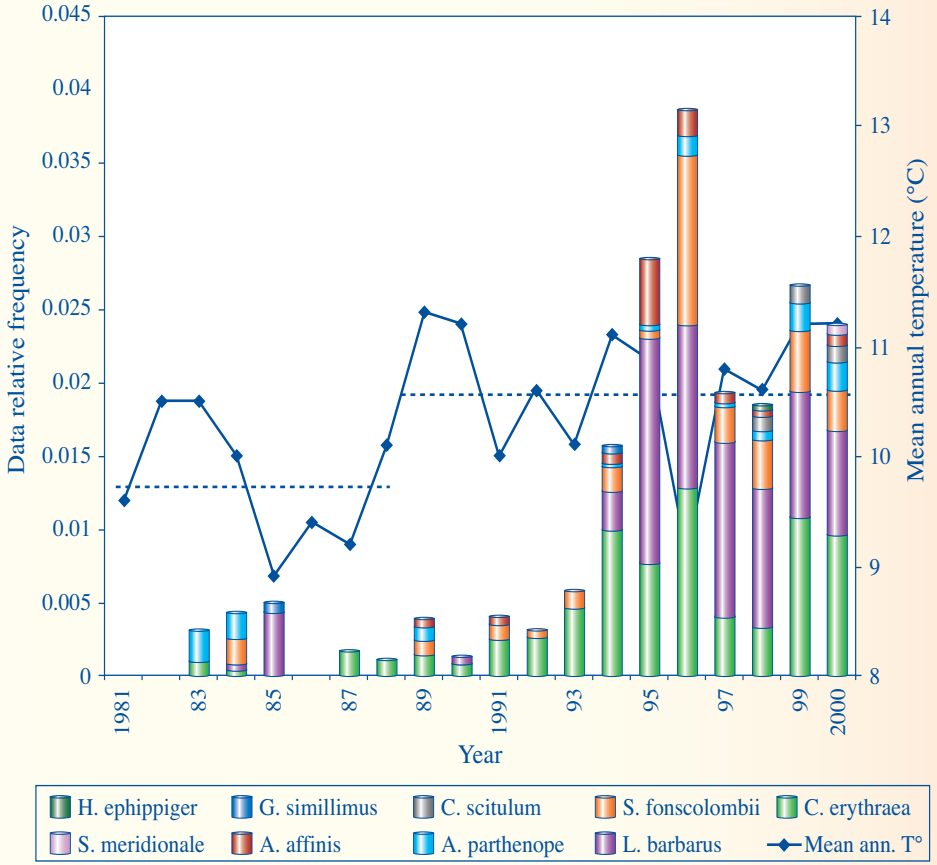
Changes in ecosystems are already being observed today, with species trying to adapt and/or move to the north. It is not a simple matter: interactions between species cause complex disruptions to ecosystems. In Belgium, biodiversity losses have been caused by air, water and soil pollution, destruction of habitats, agricultural and forestry practices, etc. Climate is becoming an important factor, however, and may be the main source of perturbation in the future. According to the IPCC, global impacts on biodiversity are an important cause for concern, even for relatively small increases in temperature (1-2 °C).

[41] Contribution of land movements to sea level rise is estimated at +5cm/century, mainly due to post-glacial rebound (which results in sinking land in Belgium).

[42] Pre-industrial CO_2 concentrations were about 280 ppm, concentrations at the beginning of the 21st century are around 375 ppm.

[43] http://www.gomphus.be

Figure 6.2 : Frequency of observation of southern dragonfly species in Belgium (fraction of the total number of observations). The green dots show mean annual temperatures.



Source: Gomphus[43] Working Group.

Migration of species

The northward progression of many species from warm regions is noticeable in the country. This change is clearly established among certain animal species (molluscs, dragonflies, butterflies, etc.) and certain plant species (e.g. liverwort; few other data are available specifically for Belgium). At the moment, the regression of species from cold areas is less evident.

The case of dragonflies has been studied particularly closely in Belgium (Figure 6.2, Gomphus Working Group[43]). The observation frequency of southern species has clearly increased in the last 10 years. A number of reasons point to climate as the main contributor to this change, in particular the fact that observations of several southern species are increasing in a rather synchronised way while non-southern species are not following these changes. Similar observations have been made for some birds.

While this may presently be regarded as a successful adaptation, migration of species may have adverse effects, as explained below. In addition, migration will not be possible for all species, especially the ones with low mobility capacities, particularly because landscapes and thus habitats are now highly fragmented. A particular case is that of freshwater fishes, of which many species could be threatened, but which may apparently redistribute through ship canals interconnecting watersheds.

Bioclimatic classification of species

Work has been done to build a (partial) classification of species found in Belgium in relation to their climate requirements [9]. This work is based on the current geographical distribution of species in Europe, used as an indication of the conditions required for their survival and growth. Species are divided into three categories, corresponding to cold, temperate and warm climate.

This gives a first estimation of the fraction of species adapted to rather cold conditions that may cease to exist in Belgium at some time in the future. These have been mainly located in two areas: in Haute-Ardenne (eastern Belgium) and in Lower-Kempen (north-east Belgium). Contrasting results have been found for groups of species. A large fraction of northern species is found for the bryophytes (mosses, etc.), as well as freshwater fishes.

In contrast, very few flowering plants are found in the northern climate category, meaning that the threat of climate change is low for these plants. This suggests that many terrestrial habitats could be preserved because these are constituted by such plants, which may favour the survival of associated species.

This classification is merely a first step since other climatic factors need to be taken into account, such as seasonality, snow cover, frosts and water availability. However, as explained in the previous section, the projections for these factors involve much more uncertainty.

Disruption of ecosystems

The arrival of new species adapted to the warmer climate may have adverse effects. Some species will disrupt the structure of existing ecosystems: relations between species are modified, in particular due to competition for food or habitat.

Species that are already present in Belgium but only in warmer areas such as buildings and/or cities may spread in the natural environment, where the result may be competition with indigenous species. For example, four species of ants are currently found in Belgium only in such warmer places [10]. The South-American Coypu has been present in the country since 1900 but its population has been limited by cold winters. Recently its population increased.

Phenological changes, or changes in the time of occurrence of biological processes during the seasonal cycle, also contribute to complex disruptions of ecosystems. A documented case [11] concerns certain populations of caterpillars hatching sooner when spring comes early. They do not find enough to eat because the buds of trees have not yet opened and so they are decimated; this is then harmful to tits etc. Another example relates to amphibians such as brown frogs, which reproduce earlier after warm winters and are more exposed to a specific predator, the salamander (this was studied in Great Britain; the situation may be different in Belgium but no data is available). There is little data on phenological changes available for Belgium. Unfortunately, observations by the Royal Institute of Meteorology were stopped in the 80s. Some new monitoring actions began recently, however. Shifts of up to 10 days and more were observed in the arrival date of migrating birds in Flanders, although further research is needed to confirm a link with climate change [12]. In the North Sea, the establishment of warm water species is already being observed, and some may compete with local species (see below).

Sea life and fishery

Identifying impacts of current temperature elevation on sea fauna and flora populations is difficult because natural changes, fishery and eutrophication are also taking place. There are signs, however, that the distribution of some species is moving to the north. It appears that catches of common shrimps in the southern part of the North Sea (in the vicinity of Belgium) has decreased in recent years. This cannot be explained by the pressure of fishing activity, which did not increase; instead it seems that the lower limit of the range of shrimps is moving to the north [13]. In a recent study for the North-Sea [14], U.K scientists estimated that two thirds of the most common bottom dwelling fishes have moved to cooler waters, going north or to deeper waters. Fishery is currently the most important pressure on commercial species.

[43] http://www.gomphus.be

The researchers concluded, however, that further temperature rises are likely to have profound impacts on commercial fisheries through continued shifts in range and alterations in interactions between species (predation, etc.).

In parallel, southern species such as sardine and anchovy are increasingly being observed in the North Sea. Species which had their northern range limit in the English Channel or extreme south of the North Sea are more regularly found near Belgium. Sea warming has probably contributed to the development of local communities of exotic species brought on by human activities (shipping). An example is the Pacific oyster, which is reproducing in Belgian waters, while it was believed that temperatures would be too cold for its larvae. This is causing competition with local species: Pacific oysters are taking the place of mussels.

Future warming is expected to increase biodiversity in the North Sea, mainly because warmer waters tend to suit more species. New species will arrive either as vagrants from more southern European waters or through the introduction and subsequent establishment of non-indigenous species from warm marine regions elsewhere in the world. Fishes from warm waters, however, are often commercially less valued than cold water species. Climate change will also add to existing pressures, in particular from fishery, and may have a significant adverse impact on this commercial activity in the future.

Summary

Climate change already has observable effects in Belgium. Although there are few studies of these effects, the dominant impression is that during the last century biodiversity has been much more threatened by other factors such as destruction of habitats, pollutants and exotic invasive species. However, if climate continues to change in a significant way, this new factor will add to the existing pressures threatening biodiversity. In some groups, a significant proportion of species needs a colder climate, as shown by a preliminary bioclimatic classification. In the future, not all of these will be able to adapt or migrate. Some of the species that may eventually disappear from Belgium may still be found in other countries, although they could possibly be threatened there too. Adaptation measures may help, for example by mitigating the problems of habitat fragmentation. Climate change has complex and profound impacts on ecosystems, however, changing the relative abundance of species and the competition between them.

The Hautes Fagnes natural reserve provides an example of the combined impacts of climate change and other factors. The peat bogs have been deteriorating for a long time for many reasons: drying out, pollution and tourism. If this deterioration continues and climate change increases, the most probable scenario is that the last peat bogs that are still almost intact will disappear within the next 20 to 50 years.

ADAPTATION - The general principle of adaptation measures for the natural environment is that a healthy ecosystem will be better able to resist and adapt to climate change. Ecosystems have already severely deteriorated due to a range of pressures from human activities, including habitat fragmentation and various pollutants. Climate change is a long-term issue, so action must be considered with a long-term view. The desirable measures can be summarized in three groups [10]:

Further creation of protected areas. Buffer zones (with partial protection) and migration corridors must facilitate the migration of species following changes in their habitats. It is important to protect areas taking future configurations of habitats, communities and ecosystems into account. Attention should be paid to areas that are less vulnerable to climate change than others and may become 'climate refuges'.

Reduction of all non-climate stresses. As stated above, healthy ecosystems will be more resistant to climate change. In addition, pollution and climate change have synergic adverse effects (e.g. toxicity of pollutants can increase with temperature; areas which have been drying due to human activities may also face higher stress from climate change). Actions against these factors may quickly have a positive impact on various aspects of the natural environment, in addition to reducing its vulnerability to climate change.

Active and adaptable management. Current knowledge of future climate change impacts is limited; management needs to be flexible to respond to the real evolution of problems. There is consequently a need for continued monitoring of the effects of climate change. For certain well defined problems which cannot be addressed by general measures, specific measures may be considered. For example, this may involve active displacement of species which cannot migrate, as well as control of parasites, diseases and invasive species.

Agriculture and forestry

Agriculture

An increase of less than three degrees in local temperature would have modest effects on agriculture in Belgium, according to all scenarios for the 21st century [3]. Excluding changes in the varieties grown, a rise in mean temperature tends to lower the yields of many crops. This is mainly a consequence of faster plant growth, resulting in more rapid maturity and reduced accumulation of organic matter. Up to around 2 – 3 °C, this yield reduction tends to be compensated for by the fertilizing effect of increased CO_2 concentration for most crops. Carbon dioxide also improves the efficiency of water use in plants, and increased temperatures are favourable for some crops like maize.

More studies are needed to improve knowledge of the impacts of extreme

events, which may be more significant. Heat waves and drought are a particular concern [15]. The warm summer of 2003 did not, however, result in lower yields in Belgium[44], probably because the drought was not severe enough during the growing season to have a significant impact. Nevertheless, the repetition of such events during the early summer and with an increased intensity may alter yields in the future.

A slow but significant reduction of organic carbon content of most agricultural soils has been observed in Belgium [17]. Although this is mainly a consequence of intense farming, increased temperatures also contribute to the decomposition of the organic matter in soil. This may affect the availability of water to plants and the fertility of soils, thus contributing to a reduction in yields.

ADAPTATION - Recent progress in agricultural policy promoting better recycling of organic matter in soils, as well as better use of mineral fertilizers, are helping to mitigate this problem.

Heavy rain events may also damage crops. Another concern is the probable spread of insect pests and diseases from southern countries.

ADAPTATION - Up to around 3°C, the expected impacts are thus quite limited. Adaptation measures such as changes in crop choices, changes in sowing dates, better recycling of organic matter in soils and possibly irrigation, may help reduce the effects of climate change.

Consistent with these results, the recently completed EU research project ATEAM[45] [16] suggests that socio-economic context, including agricultural policy, will remain the key factor driving land use, including cultivation. If global emissions of greenhouse gases are not appropriately mitigated, however, climate projections show that much larger changes are possible. In that case, substantial yield reductions may occur for some crops, but this was not studied in detail.

As a consequence of policy measures to reduce emissions, energy crops are expected to develop (biofuels, e.g. rapeseed oil and ethanol). The production of woody biomass is also likely to develop, in the form of short rotation coppice. This evolution would modify the face of the Belgian countryside.

Forestry

In 2000, Belgian forests covered 693 100 hectares or 22.6% of national territory. The majority of these forests (78.6%) are in the Walloon Region. Deciduous and coniferous species covered 51% and 49% respectively of the area. Belgium has the second highest net annual growth increment (after Germany). This large growth of biomass amount is due to good forest management practices and also to the age structure of tree populations. It is expected to continue for 10 to 20 years before reaching a limit.

To anticipate the effects of climate change on Belgian forest ecosystems, various scientific studies have been launched in the course of the past decade [17]. The results show that increasing CO_2 concentration in the atmosphere will accelerate forest growth. On the medium-term, this growth will, however, be limited by soil fertility on the one hand and the relative drought caused by higher temperatures and precipitation changes on the other.

The main conifers, spruce and Scots pine, will be increasingly ill adapted to the climate due to the milder and rainy winters. In time, a broad-leaved tree such as beech could also become poorly suited to the climate, which means it would no longer represent the natural vegetation (which is not always the case at present, moreover), but not necessarily that existing trees would disappear.

Although the direct link with climate change has not been demonstrated, beech stands were recently invaded by timber-boring insects, the impact of which was the destruction of more than 10% of standing volume. Climate change may favour the extension of the distribution of pests to the north or lower latitudes. *Xylosandrus germanicus*, a beetle attacking several tree species accidentally introduced into Europe about 50 years ago, has an altitude range limit of 350 m in Belgium. Global warming could allow this species to settle permanently in the whole of the Ardenne area, which until now has been free of it [18].

In recent years, certain exceptional climatic events such as storms or long periods of drought have also had significant impacts on growing stock. The impacts of one-off events are all the more pronounced on weakened stands. In time, the impact of droughts could be alarming. There are not yet enough findings, however, on the limits of the resistance to climate change of current stock.

ADAPTATION - For approximately the last 15 years, the regional administrations in charge of forest management have encouraged the replacement of conifers such as spruce and Scots pine by other species better adapted to mild and rainy winters, e.g. Douglas fir and broad-leaved trees. Regulatory and financial incentives are used, in particular subsidies for planting in accordance with a guide to species adapted to the present climate. More generally, forestry practices try to favour the species best adapted to (present-day) local conditions, which constitutes a first step towards adaptation to future changes. The diversification of species and the conservation of ecosystems that remained little altered by human activity also help enhance the adaptive capacity of forests to changes [19]. Although regulations do not yet explicitly take the future evolution of the climate into account, this is increasingly a factor of consideration in planting choices. The strengthening of measures to limit windfallen wood is also being considered (clearings, lower density stands, etc.).

[44] National Institute of Statistics.
[45] ATEAM: Advanced Terrestrial Ecosystem Analysis and Modelling www.pik-potsdam.de/ateam.

Other indirect effects are also expected, but are still hard to quantify for the moment. Policies and measures to develop biomass energy production will probably have an impact on both the choice of species (favouring fuelwood, for example) and forestry practices (development of short rotation stands).

Floods

As explained in the 'climate scenario' section, there is considerable uncertainty over precipitation changes: the country is small, natural variability is quite large and models involve errors. The models do agree, however, on an increase in winter precipitation (+3 to +30%, also depending on socio-economic scenario). In summer, mean precipitation is expected to decrease, although the magnitude of this is unknown (from negligible change to around -50%). In contrast, the frequency of heavy precipitation events is likely to increase, but more research is needed to quantify this change, which could be from insignificant to relatively large.

During the winter months, the groundwater recharge is expected to increase. This may partly compensate for the summer drying, but in specific regions (mining areas in particular) higher aquifers may possibly contribute to flooding [20]. Studies [21] showed increases in the flow of watercourses reaching 4 to 28% in 2100, and a rising risk of flooding for all studied catchments.

The frequency of floods increased in Belgium in recent decades, with important flooding in 1995, 1998, 2002, 2003 and 2005. It is well known that building practices are a major contributor to this trend, due to the reduction of ground surface permeability as well as construction of buildings in flood prone areas. Projected changes in winter precipitation and the likely increase of extreme events are nonetheless expected to raise the risk level further.

ADAPTATION - In the Walloon region, a new flood prevention plan was approved in 2003 (PLUIES plan). This global plan aims to improve knowledge of the risk of flooding, reduce and decelerate the run-off of water on slopes, improve the management of rivers, decrease vulnerability in zones liable to flooding and improve crisis management. SETHY (Services d'ETudes Hydrologiques) is responsible for real-time monitoring of watercourses, hydrology studies, coordination and flood alert. Its work is based on a network of stations measuring the level of watercourses and amounts of rain. Rules banning the construction of buildings in areas prone to flooding have been imposed[46].

In the Brussels-Capital Region, flood policy is based on both a palliative approach (network of storm drain) and a preventive approach. The preventive approach is given priority and can contribute to adaptation to increased precipitation. Prevention includes two dimensions: improved soil infiltration and retention of water at the source. Various measures are being implemented to recover rain water (the installation of rainwater tanks is compulsory for new housing and promoted through regional grants for existing housing) and to increase infiltration and evapotranspiration (limit on built-up areas, choice of porous materials, plantings and green roofs). The 'blue network' being implemented since 1999 by the Brussels Region is an integrated programme for the purification of Brussels' rivers. Where possible, it aims to restore the continuity of the surface hydrographic system and to get clean water circulating in it, to benefit from its 'flood buffer' function. In the Brussels Region, the sewage system is an all-in-one network: sewers evacuate not only wastewater but also rainwater and other waters. This programme also contributes to the upgrading of rivers and wetlands, and lightens the load on purification stations.

The principal palliative measure is the construction of a network of storm drains, generally underground, to recover rainwater from heavy precipitations so as to regulate the arrival of runoff water in the sewage system. The region has more than 10 storm drains, some of which have a capacity of around 40 000 m^3. They are big enough to absorb floods likely to occur once every 10 years. If the volume of heavy rains increases by 10%, which is a possibility within 50 to 100 years, this level would drop to flooding likely to occur around every six years. An additional drain is being built currently and another is in the planning stage.

In Flanders, building plans, as well as any plan that might have consequences on water, are checked for their hydrological consequences (procedure called "watertoets", in the framework of the Coördinatiecommissie Integraal Waterbeleid[47]). It applies in particular to zones prone to flooding, important for infiltration, or close to a drinking water catchment area. The objective is to avoid negative impacts on the water system, but also to reduce the risk and consequences of flooding. As a consequence, the authorities can demand specific measures if required, such as the use of permeable ground surfaces. In specific situations, the process may lead to the rejection of the building project, even in areas formerly indicated as suitable for building. Maps identifying flood risks have been prepared to facilitate the implementation of these measures.

At the federal level, recent legislative changes introduce cover against flooding and other natural hazards in household fire insurance policies [22]. Unlike the previous situation, the cover against natural disasters will not be provided by state funds, except when the global cost exceeds a threshold linked to the turnover of the insurance companies. While the new laws[48]

[46] In the SDER (Schéma de Développement de l'Espace régional) and CWATUP (Code wallon de l'aménagement du territoire, de l'urbanisme et du patrimoine).

[47] Flemish governement Decree of 18 July 2003.

[48] Laws of May 21, 2003 and September 17, 2005.

are not primarily targeted at adaptation to climate change, they may possibly have a dissuasive effect on residential construction in areas in where the risk of flooding is higher, in particular if this results in higher insurance premiums. The system is still new, however, and prices are not yet known. In addition, there is a mechanism (price setting board) to limit the premiums for existing constructions in high-risk areas by sharing the cost among all insured parties. There are plans to draw up a map of the high-risk zones in cooperation with the three regions and to exclude any new construction in these zones from the premium limitation mechanism, making such constructions probably uninsurable.

Water resources

Summer demand will increase, in particular if irrigation becomes a widespread agricultural practice. Dry summers, with increased evaporation and possibly reduced precipitation, will probably reduce the groundwater level significantly ([20], [23]). In contrast, increased winter precipitation will contribute to larger groundwater recharge. Changes to aquifer level have consequences on the timescale of a year or more, and should thus partly cancel each other. Due to the high uncertainty over precipitation changes, particularly in summer, it is very difficult to come to a conclusion. Increased evaporation due to temperature change is a fact, and it may be that parts of Belgium will increasingly need to import water from others. In parts of the country, specifically in Flanders, the availability of water per capita is low [24]. Water management is already an important concern in Flanders, which imports a significant fraction of its drinking water from Wallonia. Climate change will represent additional pressure on water resources, especially in summer. During present-day dry years, the availability of water is also reduced in canals, so that groups of ships have to cross the locks together. Reduced water flow in summer may also impact on surface water quality.

ADAPTATION - Measures have been taken to tackle the current issues of water management in Flanders, and will contribute to mitigate future water resources problems. A large-scale information campaign to promote water savings was launched in 2000 and is still under way[49]. Part of the measures mentioned above in the framework of flood prevention will also contribute to water availability. Current measures to improve surface and groundwater quality (e.g. in connection with nitrates from agricultural fertilizers) will help sustain the availability of affordable drinking water. Recent measurements show that the concentration of nitrates in surface water is indeed decreasing. In the future, the management of canals may be adapted through the installation of additional water pumps.

Coastal region

Climate change exposes the coastal region to three main types of impact: floods during storms, coastal erosion, and deterioration to or loss of natural ecosystems, including wetlands.

To give an overview of the land area that may need protection by dykes in the future, Figure 6.3 shows the area which is currently below sea level (negligible in Belgium), then the area corresponding to an increase of 1 or 8 m in mean sea level. Sea level increases slowly; the + 1 m level may be reached in the early 22nd century due to fairly high emissions in the 21st century, while the 8 m level may be reached after 1 000 years in a moderate scenario with stabilisation of greenhouse gas concentrations.

The Belgian coast has a length of 65 km, half of which is protected by a dyke. Beaches and dunes also have an important role in protection against flooding. Beach erosion is variable: some beaches are stable, a small fraction is growing, but the majority has been eroding continuously for a long time. Tides and sea currents along the coast contribute to this erosion. Strong winds, which may increase due to climate change, are removing sand from the beaches and dunes.

ADAPTATION - Since 1960, erosion has been compensated for by moving sand to the beaches, as was done recently in Ostend, where the level of the beach was raised to temporarily decrease the risk of flooding in the town. It is currently considered that compensating for erosion by adding sand when needed will continue to be possible. When dykes need to be built, a 60 cm rise in sea level is taken into account. For the 21st century, the cost of adaptation is regarded as moderate [26], but a further rise in sea level would make adaptation much more difficult. Belgian researchers are taking part in the new EU project Safecoast[50] aimed at protecting North Sea coasts.

Flooding occurred in the past in the Schelde estuary and its tributaries, leading to the adoption of the so-called 'Sigma-plan' (http://www.sigmaplan.be) several decades ago. In this framework, 13 'controlled flooding zones' were established. These zones are managed so that occasional flooding during very high tides is tolerable and helps lower the water level. Dykes protect the land behind the flood zone.

ADAPTATION - With the current climate, the risk level is estimated at one flood every 350 years, but the risk is expected to rise to up to one in 25 years in 2100 due to climate change. The Sigma-plan has been recently revised. The resulting plan, adopted in July 2005, involves new controlled flood zones. A 60 cm rise in sea level is now taken into account.

As a rule, a rise in sea level may either cause coastal ecosystems to move inland or disappear. In Belgium, the population density is high, and no significant displacement of natural zones is possible. The Zwin reserve, a small wetland area at the border

[49] 'Elke druppel telt' project, http://www.waterloket-vlaanderen.be/

[50] www.safecoast.org

Figure 6.3: Land area below mean sea level (in blue)
Upper panel: current situation; low -lying land (polders in the Netherlands) is protected by dykes. Central panel: mean sea-level increased by 1 m. Bottom panel: mean sea level increased by 8 m, a possible situation by the year 3000.

Source: N. Dendoncker, Université catholique de Louvain, in [3].

between Belgium and the Netherlands, is a particularly important case that illustrates the complexity of the impacts of a rise in sea level. The ecological value of this natural zone is connected with the fact that seawater regularly enters the area, while there is no freshwater input. Its natural evolution would result in a slow filling of the water input channel by sand. However, this invasion by sand has accelerated in recent decades, probably due to the sand that is brought to the nearby beaches to counteract erosion. In the near future, it may be expected that the major problem will still be this silting-up process. If the rise in sea level reaches one or more metres, however, the nature reserve would probably be lost. In addition, increased temperatures may cause drying of the soil. A study has been started to define a structural solution for preserving the Zwin as a wetland area.

Other expected impacts of an increase in sea level are a rising groundwater level and an increase in soil and groundwater salinity.

Infrastructure, energy & industry

As explained in the 'climate scenarios' section, it appears probable that the magnitude or frequency of the most severe storms will increase, although this is not yet certain. The experience of the severe storms that struck in France at the end of 1999 ('Lothar' and 'Martin') shows that there may be serious damage to buildings and other infrastructure such as power lines.

Increased temperatures will reduce energy needs for warming in winter but increase summer needs for air-conditioning. The need for adaptation to severe heat waves is a new concern, and a lot of infrastructure is likely to be poorly adapted, e.g. some roads, or power stations which rely on river water for cooling.

Human health

Heat waves

In Belgium, the heat wave of the summer of 2003 does not seem to have had health consequences as severe and difficult to manage as those in the French cities of Paris and Lyon, the most heavily affected. However, the number of deaths in excess of the mean has been estimated at about 1300 in the 65 and older age group, equivalent to +19% deaths during the first weeks of August [25]. Since high ozone concentrations usually come with heat waves, research is still needed to assess the respective importance of these two factors. It is clear, however, that heat waves have a significant adverse impact in our country. It is also expected that warmer temperatures will reduce the prevalence of some winter diseases (e.g. cardio-vascular), although no detailed study of this issue is available for Belgium. Problems caused by prolonged exposure to heat include exhaustion due to sweating, causing water and salt deficiencies, and heat stroke caused by loss of temperature control in the body, a severe condition that can rapidly cause death. The most vulnerable groups are babies and young children as well as elderly people. The heat wave of August 2003 was probably the most severe observed in Belgium. Part of its impact is thus connected with the limited experience of such events in the country, while climate change may cause such heat waves every other summer by the end of the century.

ADAPTATION - As a first step towards adaptation, the federal government has set up a 'heat waves and ozone plan'[51] introducing phased-in measures and communication actions. The first phase takes place every summer and focuses mainly on preparatory actions and public information and calls for solidarity with people at risk. The pre-alert phase is declared when minimum and maximum temperatures exceed for two days the limit under which they remain 95% of the time. The alert phase is declared when a heat wave of three days or more is forecast by the Royal Institute of Meteorology or ozone concentrations above the EU information threshold are forecast by the Interregional Environment Unit. Warnings are sent to emergency and geriatric departments of hospitals, rest homes, etc. A survey on the application of measures in these organizations is being conducted. This monitoring is one of the elements which the authorities takes into account in deciding whether it is neces-

[51] Federal Public Service Health, http://www.health.fgov.be/AGP/Canicule/Canicule/Plan%20chaleur/ozone_FR.pdf

sary to move into the crisis phase, which implies the creation of a crisis unit and additional measures, e.g. in hospitals.

Another type of adaptation to heat waves is the structural protection of buildings: thermal insulation, solar protection by external blinds and windows, ventilation, etc. Initial regulations with this aim in view are being established in the framework of implementation of the EU Directive on the energy performance of buildings[52]. This is particularly the case in the Flemish Region, which recently established regulations specifically aimed at reducing the risk of overheating in new houses[53]. The other regions are expected to follow.

Other health issues

Although we do not have specific data for Belgium, it appears likely that the amount of pollen in the air is increasing due to warmer temperatures, longer emission season, increasing carbon dioxide concentration or nitrate fertilizers [26]. This may contribute to the observed increase in prevalence of allergies, specifically asthma and hay fever.

The number of cases of Lyme disease increased rapidly during the last decade in Belgium, from under 100 to almost 1 000 per year. Ticks are responsible for the transmission of this disease, which leads to a severe condition affecting the skin, heart, nervous system, eyes, kidney and liver. Children are particularly susceptible to tick bites because they play outside and are closer to the ground. It is not yet certain that the increased prevalence of the disease is significantly linked with climate change. No specific studies are available for Belgium, but a study conducted in Sweden shows that mild winters with increased daily minimum temperature are correlated with higher numbers of ticks. Climate change may thus play a role in the rise in number of people affected, and this adverse trend may thus continue in the future.

ADAPTATION - So far, adaptation is regarded as consisting in better knowledge of the issue by health professionals.

Continued research is needed to give a better view of the health risks in Belgium. More information will be available in a report by the Federal Council for Sustainable Development currently under preparation [27].

Tourism

In Belgium, a moderate rise in the mean temperature should be rather positive for tourism. A similar effect has been observed in Great Britain: after one or more sunny summers, more British tourists stay in the country, and there are also more foreign tourists [28]. Additional efforts will nevertheless be needed to maintain beaches due to increased coastal erosion. This is not expected to be a severe problem during the 21st century, but if the rise in sea level reaches one or several metres in the coming centuries, it may become a critical issue. There are also limits to tolerable temperature increases, in particular due to heat waves, even though the drier air should make heat more acceptable. River sports and associated activities in Wallonia would be negatively affected by reduced river flow in summer, but warmer temperatures may also favour "nature" tourism. Winter sports, which are already impossible during the warmer winters, may completely disappear. Rainy and possibly cloudy winters will not favour outdoor activities.

Indirect impacts of climate change on other sectors may also have effects on tourism, e.g. deterioration of natural zones, damage to infrastructures or historic buildings due to flooding. It should also be kept in mind that socio-economic factors may also have significant impacts on tourism.

Summary and vulnerability assessment

The following table summarizes projected impacts and adaptation measures. We also try to rate the importance of each impact. This should be regarded as preliminary and indicative; it is based on our current evaluation of the issues and is not the result of a detailed quantitative assessment.

The importance of impacts is reported in terms of vulnerability. Using the definition of the IPCC Third Assessment Report, vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change. Vulnerability is a function of climate variation, the degree to which the system responds to this variation, and its adaptive capacity. When rating vulnerability, we take possible adaptation measures into account, as explained below, because the existence (or not) of such measures is an essential part of the problem. Because it is determined by many factors, vulnerability is rather difficult to assess, but it is of key importance for policy implications and society's perception of climate change. That is why we propose this preliminary evaluation of vulnerability while acknowledging that there

[52] Directive 2002/91/EC, which the Member States must implement by January 2006.

[53] Besluit tot vaststelling van de eisen op het vlak van de energieprestaties en het binnenklimaat van gebouwen (17 juni 2005) http://www.energiesparen.be/energieprestatie/infopunt/download.php

is currently limited information available, particularly in quantitative terms. In spite of its limitations, information is nevertheless available and we are confident that this summary provides a useful view on future impacts. It is the result of an assessment by a group of experts, although it cannot encompass all available sources of information in Belgium. More research is needed to improve this assessment, as pointed out in the conclusions of this chapter. The ranking of the importance of impacts provided here reflects our current understanding; an effort is made to show where there are high uncertainties, but future assessments based on more data may lead to different conclusions.

It is important to note that we define three levels of vulnerability:

- **high vulnerability** (■) means that this impact may have severe consequences and that we are not sure whether affordable adaptation measures can be found;
- **medium vulnerability** (■) means that severe impacts are unlikely but significant impacts are likely, even after implementation of simple adaptation measures;
- **limited vulnerability** (■) means that no severe impact is projected, the issue will probably be unimportant, at least when simple, low-cost adaptation measures are implemented;

A question mark means that the rating is particularly uncertain. This is mainly due to the limited evidence for the assessment because of a lack of appropriate information or studies. Uncertainty is also due to limited predictability of the future (e.g. human behaviour), but this seems to be a secondary limitation at the moment.

Two climate scenarios are also considered, and relate to 'low' and 'high' climate change conditions by the end of the 21st century (and the following centuries for the rise in sea level). This is quite arbitrary since we do not have enough information to investigate scenarios corresponding to a mitigation of greenhouse gas emissions[54]. As a first step, the 'low' scenario refers to climate change under the mean values shown for the B2-PRUDENCE scenario in Figure 6.1, while the 'high' scenario refers to climate change above the mean values shown for A2-PRUDENCE. Note that the ensemble mean temperature increase from PRUDENCE in summer is about 50% higher in Belgium than in the global average, so that a stabilisation to +2°C globally (from pre-industrial), as in the UE mitigation objectives, roughly corresponds to +3°C in Belgium.

[54] Note that the ensemble mean temperature increase from PRUDENCE (see Climate change projections p. 85) in summer is about 50% higher in Belgium than in the global average, so that a stabilisation to +2°C globally (/ pre-industrial) corresponds roughly to +3°C in Belgium.

Table 6.1: Summary of climate change impacts, adaptation and vulnerability.

Ecosystems Terrestrial life	Vulnerability limited medium high LOW scen. ? HIGH scen. - species move north (observed); locally, • those adapted to warmer climate increase • those adapted to colder climate may decrease - new species -> competition with existing ones - complex perturbation of ecosystems (e.g. broken food chain due to different changes among species)
Sea life	- species move north (observed) - possible impacts on fishing
	Existing measures, which needs to be strengthened: - reduction of all non-climate stresses -> healthy ecosystems - further creation of protected areas, migration corridors - active and adaptable management: respond to observed evolution

Agriculture and forestry

Agriculture

Forests

- compensation between two effects:
  - CO_2 increases photosynthesis rate and water use efficiency (most crops)
  - Warming reduces yield of a number of crops
- increased frequency of dry summers and heat waves may damage crops, grasslands and forests; irrigation may become necessary
- increased migration and distribution of pests
- increased decomposition of organic matter, reducing soil fertility
- increased salinity of soil in polders
- increased damage to forests due to extreme storms (probably limited + knowledge incomplete)
- vulnerability is greater for forestry because adaptation is slower (life cycle of trees, slower change)

Impact of response measures:

- change of land use and landscapes due to expansion of biofuels and wood energy production

Existing measures: Forest management focuses on plantation of species adapted to mild and rainy winters such as Douglas pine and broad-leaved trees. Regulations favour the planting of trees adapted to current climate and thus more resistant to change

Future needs:

- When appropriate, change the selection of crops and agricultural practices according to climate (more difficult with large temperature increases and frequent dry summers).
- Further study and explicit integration of climate change impacts in forestry.

Water resources

More evaporation and possibly less precipitation in summer reduce groundwater level; increased winter precipitation has the opposite effect.
Water availability is already limited in parts of the country (specifically Flanders); future evolution is poorly known and is a growing concern.

Existing measures:

- information campaign on water savings
- measures to improve water quality

Future needs (based on existing measures): increased import of water from (sub)region to (sub)region will likely be needed, as well as other measures regarding drinking water production and demand in Flanders.

Floods (inland)

- increased river flooding in winter
- probably increased risk of flooding due to heavy rain

Existing measures:

- monitoring of river flows
- ban on construction in flood sensitive areas
- improvement of water infiltration in soils, better use of natural ponds and rivers to retain water in urban area (Brussels region)
- building of storm-basins

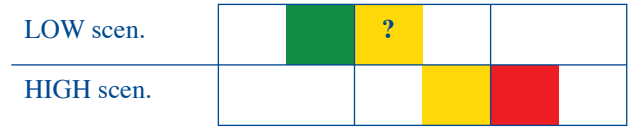
Coastal area

- increased coastal erosion
- storm-related floods
- deterioration of natural ecosystems (indirect or long-term)

Existing and planned measures:

- protection of low level rivers on the basis of recently updated 'Sigma plan', which projects new controlled flood zones and accounts for +60 cm sea level.
- beach nourishments (i.e. addition of sand)

Human health



- heat waves: increased mortality, troubles such as heat stroke, consequences of more frequent ozone peaks
- probable contribution to increased prevalence of Lyme disease
- possible contribution to increase in pollen associated allergies

Existing measures (continuation and reinforcement needed):

- federal plan on heat waves and ozone
- regulations on structural protection of buildings (first steps)

Tourism

- impact of a moderate temperature rise should be positive
- reduced river flow in summer -> impact on river sports, etc.
- even less snow in winter, but more rain -> fewer outdoor activities

Industry, energy and transport

- reduced energy demand for warming in winter, increased demand for cooling in summer
- probable (but not certain) increase in damage due to the heaviest storms
- possible difficulties in industries and sectors adapted to a colder climate (e.g. power stations cooled by river water)

Cooperation on adaptation

Development cooperation

The environment as a whole is still among the more modest concerns of Belgian development cooperation and adaptation to climate change is not frequently an explicit objective. Actions to decrease the vulnerability of less favoured populations, however, notably in the sectors of education, access to basic health care for all and basic infrastructures, contribute in part and implicitly to improving their capacity to adapt to climate change.

Development cooperation presently grants priority to certain environmental aspects that are useful in terms of adaptation, the most important of which by far is water supply and purification. Other environmental aspects such as the treatment of solid waste in urban areas, combating desertification in arid and dry sub-humid areas, and the sustainable conservation of biodiversity also come into play.

Based on statistics for the past four years (2001-2004), Belgian development cooperation actions that include an environmental objective make up 6.2% of total project funding. There are no indicators identifying the contributions of development cooperation to developing countries' efforts to adapt to climate change, with the result that the resources invested in such projects are not known precisely.

Belgian cooperation contributes indirectly to populations' adaptive capacity. It is nevertheless to be feared that, without a more explicit awareness of climate change and its probable impacts, such impacts will too often be neglected. There is consequently a need to integrate the issue of adaptation to climate change into development cooperation plans and strategies.

The fund donors represented in the Development Assistance Committee of the Organisation for Economic Cooperation and Development (DAC/OECD) are initiating such a movement. A handbook of policy guidelines is being developed in collaboration with the Environment Policy Committee to promote and disseminate best practices, develop instruments for estimating the economic costs of adaptation (and non-adaptation), and put in place methods for monitoring progress. Belgium is participating actively in this process with a view to improving its future policies.

Cooperation in the fields of research and adaptation policies

The Federal Science Policy Office recently joined the project "Climate Impact Research Coordination within a Larger Europe" (CIRCLE), funded by the European Union to ensure better coordination of national and regional scientific activities

The essential objective of CIRCLE is to coordinate European research on climate change impact assessment and adaptation to facilitate the research needed by European and national decision makers to design effective yet economically efficient and feasible adaptation strategies. It is assumed that national adaptation plans can be much more scientifically sound and economically viable if prepared on the basis of a regional exchange of knowledge, relevant threats and relevant solutions. CIRCLE intends to evaluate carefully which fields of research are most suitable for joint activities including multi-country programmes and which topics are most suitable to optimise adaptation measures in terms of targeted and economic approaches.

Research cooperation with other European countries focuses on several themes related to climate change impacts, such as coastal zone management. Belgium is part of the ESPACE (European Spatial Planning: Adapting to Climate Events) project funded by the European Union (INTERREG initiative) and the UK government. ESPACE aims to recommend adaptation to climate change within spatial planning mechanisms at local, regional, national and European levels (e.g. regarding the management of water resources).

Conclusions and suggestions for future investigations

There is still high uncertainty over regional climate change and extreme events. We are, however, beginning to build significant knowledge of the future climate in connection with socio-economic and emission scenarios. The knowledge of impacts seems more limited, particularly when it comes to a quantitative assessment. Damaging processes are frequently known, but with little or no indication of their possible extent or severity. It has been very difficult to analyse and compare vulnerability to climate change in different sectors. It is thus highly desirable to conduct detailed studies of each sector accounting consistently for the evolution of all relevant climate and non-climate factors. The first steps in this direction have been taken for specific sectors (e.g. agriculture). Much more in-depth studies, including observations of ongoing changes, will be needed to obtain a clear picture of vulnerability to climate change and possible adaptation measures in the country. These should account for all rel-

evant climatic and non-climatic parameters and refer to a common set of regional climate change scenarios when required. The new multi-annual research programme 'Science for Sustainable Development' (2004-2009) launched by the Federal Science Policy Office is expected to help fill this need.

Currently available information suggests that ecosystems and forestry have some vulnerability even with less than a 3°C increase in the regional mean temperature (in summer, from end 20th to end 21st century). The coastal zone, water resources, risks of flooding and human health may also become causes for concern in this scenario, although this involves more uncertainty. With a temperature increase of about 3°C or more, ecosystems and forests would likely face severe threats, while droughts and heat waves would be a serious concern in the fields of health and water availability (particularly in Flanders), and there could also be negative effects for agriculture and soils. Because sea level rises slowly, the vulnerability of the coastal zone should not be high during the 21st century, but very large and rapid cuts in emissions are needed to avoid a rise in sea level of several metres during the coming centuries.

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7. Financial resources and technology transfer

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Introduction

Legislative and institutional framework of development cooperation policies and programmes

The Law of 25 May 1999 on international cooperation is the reference for Belgium's development cooperation policy. The most important goal is sustainable human development, to be achieved by combating poverty on the basis of partnership and in compliance with the criteria on relevance to development, as defined by the Development Assistance Committee of the Organisation for Economic Cooperation and Development (DAC/OECD). The law introduced the principle of geographical and sectoral concentration of aid.

In implementation of the federal government coalition agreement of 2003, Belgium's direct bilateral ODA targets 18 countries, 13 of which are located in Africa. Ten of these countries belong to the group of Least Developed Countries (LDCs). Five sectors are given priority: i) basic health care; ii) education and training; iii) agriculture and food security; iv) basic infrastructure; and v) conflict prevention and the consolidation of society. On top of these priorities three crosscutting themes relate to gender, environment and welfare economics. In addition, the commitment made in Monterrey to increase Belgium's Official Development Assistance (ODA) to 0.7% of gross national income (GNI) by 2010 was confirmed by law in 2002. The promotion to ministerial rank in 2003 of the member of the government responsible for development cooperation is indicative of the importance the latter has acquired in government policy. The policy note of October 2004 by the Minister for Development Cooperation confirmed that the Millennium Development Goals (MDGs) remain the driving force behind Belgian development cooperation. The minister identified the promotion of effectiveness and improved consistency as strategic priorities. The Belgian parliament monitors cooperation policy, and helps to shape policy through its legislative function.

Following the 1999 reform of the federal administration, Belgium consolidated new institutional structures and took measures to adapt these to the new international context of development cooperation. As a result of this reform, in 2003 development cooperation was incorporated into the Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation (FPS FA) as the Directorate General for Development Cooperation (DGDC).

Development cooperation is primarily the responsibility of the federal government at present. However, the principle of transferring certain aspects of development cooperation to the federated entities (Regions and Communities), on the basis of responsibilities allocated to these entities internally, is embodied in the special

Law of 13 July 2001 transferring various competencies to the the federated entities, and was confirmed in a government statement of July 2003. This implies increasing the share of the budgets allocated to the regions and communities, keeping the overall budget target of 0.7%. This process is still under discussion. The priorities remain the development of synergy between federal and federated entities, which can carry out development cooperation activities based on their own competencies, as well as overall policy coherence.

Moreover, the bodies involved in indirect cooperation, particularly non-governmental organisations (NGOs) and universities, also play an important role in terms of specific types of development, information and mobilisation support. They receive appreciable backing from the DGDC.

Belgian Official Development Assistance

After reaching US$ 1.85 billion in 2003 as a result of a large-scale debt forgiveness operation, Belgian ODA dropped to US$ 1.46 billion in 2004. The ODA/GNI ratio has moved sharply up and down in line with debt forgiveness operations, rising from 0.43% in 2002 to 0.60% in 2003 before falling back to 0.41% in 2004. There has been, however, an appreciable upturn in public funding of aid since 1999. In 2004, Belgium ranked ninth among DAC/OECD countries in terms of the percentage of GNI, with a ratio above the DAC average (0.25%) and almost equal to the average figure by country (0.42%). Belgium is therefore in line with the target the European Union Member States have set of devoting 0.33% of their GNI to ODA by 2006. With its commitment to reach the 0.7% level by 2010, it is ahead of European commitments for 0.51% by 2010 and 0.7% by 2015. As a result of this commitment (0.7% of the GNI by 2010), aid will be increased by 0.05 percentage points per year up to 2010, starting from the expected level of 0.45% of GNI for 2005, or USD 1.45 billion.

The majority (60%) of Belgian official development assistance is managed - directly or indirectly - by the Directorate General for Development Cooperation (DGDC). The Federal Public Service Finance also plays a key role, managing country-to-country loans and contributions to international organisations, i.e. 10% of ODA. In addition to DGDC, other directorates-general of the FPS Foreign Affairs play an important role, since the Foreign Ministry is in charge of conflict prevention and part of humanitarian aid (i.e. 5% of the ODA budget). Measures are also taken by the regions and communities, the provinces and a large number of municipalities (5% of ODA), and depending on the year of debt relief, a variable share is managed by the National Delcredere Office (Belgian's leading overseas export credit insurer).

On the basis of statistics for the period 2001-2004, Belgian ODA specifically earmarked for environment protection amounted to € 82 million, while interventions for which environment was one of the main objectives represented € 162 million (i.e. 3.14% and 6.17% of total ODA respectively). For the time being, however, there are no indicators or specific markers are available to identify contributions from development cooperation targeted at sustaining specific efforts in the field of climate change. It can only be assumed that actions to decrease the vulnerability of disfavoured populations, in the fields of education, health and basic infrastructure, contribute partly and implicitly to adaptation to climate change. A better integration of climate change in development cooperation programmes and strategies is a priority. In this respect, the recommendations of the DAC call for DGDC to step up its role of providing coordination with the regions and communities on multilateral and globalisation issues.

Financial contributions to multilateral institutions and programmes

Via the multilateral budget the DGDC finances a number of environment-related programmes that deal with climate change, biodiversity and actions to combat desertification (Rio Conventions). The main contributions to multilateral institutions and programmes are listed below.

GEF

The Global Environment Facility (GEF), established in 1991, helps developing countries fund projects and programmes that protect global environment. This international cooperation mechanism collects new and additional funds, which can be grants or soft loans to combat global deterioration of the environment. The breakdown of the GEF in the different areas of action is presented in Table 7.1.

In the funding negotiations for the current period (2003-2006), Belgium has been advocating a substantial increase in GEF resources. Since 2003, the Belgian contribution - which is borne exclusively by the DGDC - has been substantially increased, to over € 10 million a year (Table 7.2). Belgium is thus meeting its obligations deriving from international environmental treaties. For the period 2004-2005 Belgium is once again a Board member of the Multilateral Environmental Fund.

Table 7.1. GEF: breakdown of different action programmes (US$ million)

	1991-2002		2002		2003	
Biodiversity	1485.8	39%	109.9	27%	147.2	27%
Climate Change	1409.4	37%	138.4	35%	176.4	32%
International Waters	550.8	14%	81.1	20%	83.1	15%
Ozone	169.9	4%	0	0%	2.1	1%
POPs	20.9	1%	20.9	5%	59.3	11%
Desertification	0	0%	0	0%	19.2	4%
Intersectoral	210	5%	50.1	13%	68.3	12%
Total	**3846.8**	**100%**	**400.4**	**100%**	**555.6**	**100%**

Source : Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation.

Table 7.2. Financial contribution to GEF as of 30 June 2003 (US$ million)

	GEF-1 (1995-1998)	GEF-2 (1999-2002)	GEF-3 (2003-2006)
Global Environment Facility	32.00	34.20	41.80

Source : Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation.

UNEP

The DGDC´s financial commitment to the UN Environment Programme for 2004-2007 amounts to € 12 million. The contributions are intended for three policy areas: maintenance and management of water quality, evaluation of the state of the environment and integration of sustainable environment into the national action plans to reduce poverty. UNEP programmes in the Belgian partner countries have priority.

Belgium is also maintaining its effort to strengthen scientific cooperation and technological transfer both between donors and between North and South in the fields of water assessment and protection of the marine environment from land-based activities. In addition, Belgium supports developing countries in the elaboration of an environment policy in conformity with international environment agreements and strives for greater synergy among all actors of multilateral environment programmes. The integration and mainstreaming of environment issues into the Poverty Reduction Strategy Papers (PRSPs) is of the utmost importance.

World Bank

The World Bank Group is a major partner of Belgian development cooperation, given the volume of Belgium's obligatory contribution, which in 2004 amounted to more than € 74 million. The DGDC also works closely with the World Bank on a voluntary basis. In keeping with the concentration policy, moreover, in 2004 it was decided to allocate the voluntary contributions to only three programmes focused on the Millennium Goals. Thus for the period 2004-2006, € 6 million were earmarked for the new phase of the 'Belgian Partnership for Poverty Reduction'. Through this World Bank programme, Belgium supports the preparation and implementation of poverty reduction plans in the six African partner countries: Mali, Niger, Mozambique, Rwanda, Burundi and DR Congo.

Belgium also participates in the 'Clean Air Initiative' (CAI), part of the Sub-Saharan Africa Transport Programme (SSATP), which concentrates on air pollution problems in urban regions in Africa (Cotonou and Ouagadougou). The Water and Sanitation Programme (WSP), more specifically the collaboration with the Regional Water Sanitation Group in East and Southern Africa, has also received support from the Belgian government. In 2004, all efforts under this programme were concentrated in DRC.

European Development Aid

European Development Aid (EDA) is governed by the Cotonou Agreements between 77 of the ACP (African, Caribbean and Pacific) countries and the European Council and EU in 2000. The financial arrangements are registered by the Protocol of the Ninth European Development Fund (EDF) for the period 2000-2005, in the amount of € 13.5 billion. 90% of these

resources are used to combat poverty in LDCs. The main goal of EDA is economic sustainable development for the long term, using the partners' Poverty Reduction Strategy Papers (PRSPs). The Belgian contribution to the EDF amounted to € 86.9 million in 2004, while an additional contribution of € 4.9 million was made to the European Development Bank (EDB). It is currently not feasible to provide an analysis of the allocation of these amounts to environment issues. A specific effort for climate change (mitigation or adaptation) cannot be established.

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 Montreal Protocol Multilateral Fund on the mitigation of climate change are difficult to assess. Yet payments to the Montreal Protocol Multilateral Fund may be indicative of a country's commitment to international cooperation on sustainable development. The Belgian federal government's contributions to the current replenishment period of the Multilateral Fund amounted to € 2.03 million in 2003 and € 1.7 million in 2004. This amount will remain stable for the new replenishment period 2006-2008.

Table 7.3. Financial contributions to multilateral institutions and programmes (€ thousand)

ID	Area	yr	Total	%CC	Adaptation	Mitigation
WB	Belgian Poverty Reduction Partnership	2003	2 355	25%	589	
		2004	1 000	25%	250	
	Clean Air Initiative (CAI)	2003	174	100%		174
		2004	0	100%		0
	Water and Sanitation Programme (WSP)	2003	400	50%		200
		2004	400	50%		200
EDA	European Development Fund (EDF)	2003	86 259	3%		2 588
		2004	86 867	3%		2 606
	European Investment Bank	2003	0	3%		0
		2004	4 903	3%		147
MLF	Montreal Protocol Multilateral Fund	2003	2 030	50%		1 015
		2004	1 700	50%		850
IFAD	Special Programme for Africa	2003	728	75%		546
		2004	1 468	75%		1 101
Rio	UNCCD (Desertification)	2003	70	50%	35	
		2004	70	50%	35	
	UNCBD (Biodiversity)	2003	190	25%	48	
		2004	117	25%	29	
	UNFCCC (Climate Change)	2003	273	100%	273	
		2004	212	100%	212	
UNEP	General contributions	2003	0	33%	0	
		2004	621	33%	205	
	Earmarked contributions	2003	3 634	33%		1 199
		2004	3 564	33%		1 176
FAO	Earmarked contributions	2003	3 966	10%		397
		2004	3 526	10%		353
CGIAR	General contributions	2003	1 983	10%	198	
		2004	1 855	10%	186	
GEF	Global Environment Fund	2003	10 495	32%	3 358	
		2004	10 495	32%	3 358	
UNESCO	Earmarked contributions	2003	400	32%	128	
		2004	400	32%	128	
			230 155		9 032	12 551

Source : Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation.

Special Programme for Africa - IFAD

For the last few years the Belgian federal government has supported the Special Programme for Africa under the International Fund for Agricultural Development (IFAD). Field projects comprise rural development, water management, forestation and soil deterioration in those areas of sub-Saharan Africa that are especially vulnerable to climate change. These programmes, implemented by the Belgian Survival Fund (BSF), were reduced to € 727 587 in 2003 and € 1 467 600 in 2004. The new Memorandum of Understanding has been signed and new projects are in preparation.

Rio Conventions

The Belgian contributions to the core budget of the UN Convention to Combat Desertification (UNCCD) amounts to € 70 000 yearly. In addition, certain activities in Africa have been supported through the desertification programmes of the UN Development Programme (UNDP) and UN Environment Programme (UNEP).

The contribution to the core budget of the UN Convention on Biological Diversity and the Cartagena Protocol on Biosafety in the amount of € 190 175 in 2003 was divided in 2004 between the federal level (30% for DGCD) and the federated entities (70%). The total Belgian contribution amounted to € 117 419.

Belgium contributed € 273 371 to the core budget of the UN Framework Convention on Climate Change and the Kyoto Protocol in 2003. In 2004, the total amount of € 212 234 EUR was divided between the federal level (30% for DGCD) and the regions and communities (70%).

Other programmes

To a certain extent, other programmes not directly focused on climate change have benefits in term of mitigation or adaptation. Certain actions of the multilateral programme of the Food and Agriculture Organisation (FAO) contribute to mitigation: urban and pre-urban agriculture in RDC, Ivory Coast, Bolivia and Namibia; and participatory management of land use in Cambodia, Senegal, Niger and Burkina Faso. The UN Development Programme (UNDP) is involved in a project for the rehabilitation of part of the electricity network in Iraq (ENRP).

Among the actions under the framework of the Consultative Group on International Agricultural Research (CGIAR), some are directly related to sustainable agriculture. These include actions by the International Livestock Research Institute (ILRI) for the improvement of the management of grasslands, and the introduction of new agricultural products by the International Institute of Tropical Agriculture (IITA).

Belgian bilateral ODA

Belgian bilateral ODA is delivered through two channels:

- direct bilateral cooperation (or government cooperation), which is made up of the different forms of aid managed at federal level or by regions / communities;
- indirect bilateral cooperation, which consists of the programmes co-financed by the DGDC, but prepared and implemented by so-called indirect players, mainly recognised NGOs, Belgian universities and scientific establishments and associations specialised in training human resources in the developing countries.

There are also special programmes relating to humanitarian aid and conflict prevention, aw well as the Belgian Survival Fund (BSF). Indirect cooperation is steadily increasing and is substantial, having accounted in 2003 for 29% of Belgium's overall ODA not including debt reduction operations.

The geographical concentration of bilateral cooperation is increasing significantly: the five main recipients of bilateral aid accounted for an average of 64% of total bilateral aid in 2002-03, compared to 34% in 1997-98. More than half of Belgian aid goes to the LDCs and great priority is given to Central Africa, which received an average of more than 60% of the bilateral aid disbursed by Belgium in 2002-03.

The main bilateral aid programmes related directly or indirectly to climate change issues are listed below. These programmes or projects are to be found in the sectors of forestry, agriculture, water (supply and treatment of wastewater), energy, environmental protection and integrated development. All actions taken into account are Official Development Assistance (ODA) and have been reported by Belgium to the DAC/OECD (Development Assistance Committee). As a whole, in these sectors, € 26.3 million can be considered to have been allocated for climate change in 2003 and € 20.5 million in 2004. Of these amounts, 37% concerned adaptation to climate change and 63% mitigation. Table 7.4 gives the complete overview of Belgium's efforts. The figures below relate to implementation of programmes/project in the fields mentioned above. For figures on capacity building and technology transfer, see p. 107-109.

We would point out that although DGCD, which compiles these figures, renewed its database in 2005 and is now using the Rio markers regularly, making a distinction between actions in climate change, biodiversity and/or desertification remains difficult, and a distinction between mitigation and adaptation is almost impossible at this stage. An internal campaign for better interpretation of every environmental action will be organised in 2006/2007.

Forestry

Contributions of € 1.8 million in 2003 and € 1.5 million in 2004 were invested in forestry. About 80% of these amounts came from bilateral sources and were allocated mainly to forest management and the integration of natural resources into wider poverty reduction programmes (e.g. in Kenya). The remaining 20% were used for actions by NGOs in protection programmes in Guatemala and Senegal.

Agriculture

Totals of € 20.9 million and € 19.8 million were spent on tangible actions in agriculture. Of these amounts, 20% came from bilateral sources and 42% from indirect sources. NGOs, universities and specialised institutes play an important role in sustainable agriculture. 36% of these actions are financed multilaterally and the remaining 2% were financed by the regions. Almost 85% of the programmes/project in this sector concern the development of agro-systems. Of these projects, only 10% can be taken into account for mitigation. 10% of the agricultural programmes are dedicated to management issues and the reform of agriculture on environmentally sound bases. This type of intervention is counted 50% as adaptation to climate change. The sustainable use of water in agriculture, which represents 5% of the actions considered, can be fully counted for mitigation.

Water

On the whole Belgium spent € 21.1 million on water supply and treatment in 2003 and € 15.4 million in 2004. The breakdown between bilateral and indirect actors is 73% and 11% respectively; the multilateral sector and the regions accounted for 9% and 7% respectively. The management of water systems took up some 5% of all efforts over the period 2003-2004 and can be counted 50% as adaptation to climate change. The remaining 95% was used for the protection of water basins and resources, the production of drinking water, and the construction of water supply and treatment plants. The protection dimension is taken into account 100% for mitigation, and production and construction 50%.

Energy

The amounts delivered by Belgium in the energy sector were € 3.7 million in 2003 and € 2.3 million in 2004, of which 52% was covered by bilateral cooperation, 42% by multilateral (UNDP project in Iraq) and 6% by indirect cooperation. Half the resources were allocated to energy transmission and the rehabilitation of existing networks. These efforts are counted 50% for mitigation of climate change. Efforts in non-renewable energy and nuclear energy are counted 20% for mitigation, whereas wind and solar energy have been taken fully into account for mitigation.

Table 7.4. Bilateral and regional financial contributions related to climate change (2003-2004) (€ thousand)

Area	yr	Total	% CC	Bilateral	Multi	Indirect	Region	Adaptation	Mitigation
Forestry	2003	1 833	100%	1 230	0	603		1 737	96
	2004	1 446	100%	1 305	0	141		1 382	64
Agriculture	2003	20 912	20%	1 435	660	1 928	191	1 191	3 023
	2004	19 842	14%	585	890	1 306	70	945	1 906
Water	2003	21 095	57%	8 996	1 049	1 283	765	744	11 349
	2004	15 426	56%	6 066	0	1 731	817	141	8 473
Energy	2003	3 656	42%	1 394	128	0	0	0	1 522
	2004	2 339	42%	129	612	248	0	0	989
Environment	2003	16 387	38%	411	5 761	88	16	4 944	1 332
	2004	16 906	37%	55	5 755	165	269	5 529	715
Integrated Development	2003	12 786	3%	177	38	163	5	383	0
	2004	12 362	3%	123	63	177	8	371	0
		144 990		21 906	14 956	7 833	2 141	17 367	29 469

Source : Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation.

Environment

Belgium made available for environmental programmes € 16.4 million in 2003 and € 16.9 million in 2004. Most of these efforts were financed multilaterally (94%); bilateral aid made up only 2%, indirect some 1% and the regions contributed 3% of the total amount for the environment. Most of these resources were delivered for multilateral programmes related to adaptation to climate change (GEF, MLF). Most projects/programmes concerning biodiversity also contain a climate change component and are counted 50% for mitigation. Only 1% of all projects are 100% focused on mitigation to climate change. In the area of land use and soil deterioration, 75% of the projects can be considered as being related to mitigation to climate change.

Integrated Development (urban and non-urban)

Belgium makes a very strong contribution to integrated development in urban and rural areas: € 12.8 million and € 12.4 million respectively in 2003 and 2004, covered by bilateral (40%) and indirect (46%) actions. Multilateral cooperation accounted for 13% and the regions some 1%. It is difficult to identify the projects and programmes that have a climate change dimension. A rough estimate is that some 3% of the total effort for integrated development is targeted at adaptation to climate change.

Other actions

Federal government

The Royal Belgian Institute for Natural Sciences (RBINS) plays a pioneering role in the development and operation of the Clearing House Mechanism in the least developed countries. The DGDC and the RBINS concluded a general agreement for the financing of the new four-year programme running until 2007 (the contribution for 2004 amounted to € 375 000).

On combating desertification, Belgian projects have been addressing the issues of soil deterioration and deforestation for a number of years. These activities have been channelled through direct bilateral aid by means of DGDC projects, as well as through indirect bilateral aid by means of NGOs, universities and scientific institutions, with the financial support of DGDC. The details of these actions were reported to the UNCCD Secretariat in 1999 and 2000.

Flemish government

The efforts of the Flemish government in relation to climate change and development are concentrated in the sectors of agriculture, water, and natural resource management. In the agricultural sector, some Flemish municipalities and provinces are active in rural development programmes in different parts of the developing world. The Flemish Government governs a large water and sanitation programme in the Sekhukhune district in South Africa. The Flemish government has also conducted a sustainable land resource management programme in the same district and a sustainable natural resource management programme in the province Kwa Zulu Natal.

Walloon government

The Walloon government's efforts on climate change concern agriculture, water and environment. The Walloon municipalities and provinces are active in the sector of agricultural development in different countries. A large integrated water management programme is being conducted in Benin, following on from an important programme in Haiti in the area of water engineering conducted by the Walloon government. Wallonia participated in a large programme of the European Bank for Reconstruction and Development (ERBD) with particular emphasis on environmental investments in developing countries.

Activities related to technology transfer and capacity building

The DGDC as well as the federated entities have always included the aspects of technology transfer and capacity building in their bilateral agreements. The transfer of environmentally sound technology should allow rapid growth by the 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. Multilateral and indirect actors conduct most activities in the field of capacity building and technology transfer. Although precise estimates of the share of the programmes and projects related to climate change are difficult to make, the following is an overview of the efforts dedicated to capacity building and technology transfer, based on the same methodology as that used for the bilateral analysis.

Forestry

No activities in capacity building (CB) or technology transfer (TT) were scheduled in 2003-2004.

Agriculture

Considerable amounts are spent by Belgium for agricultural research and capacity building in agriculture and forestry: € 11.7 million in 2003 and € 7.6 million in 2004. Most efforts on agricultural research go to the Consultative Group on International Agricultural Research (CGIAR); the Vlaamse Interuniversitaire Raad (VLIR) and the Conseil Interuniversitaire de la Communauté française (CIUF), with their annual scholarships for foreign students, contribute to a range of programmes. Sustainable agriculture and land management are important issues in these programmes and contribute to CB in climate change. It is estimated that 25% of the research programmes and 15% of the CB programmes include a climate change component.

Water

Relatively limited amounts are earmarked for CB and TT in water management: € 0.8 million in 2003 and € 0.7 million in 2004. These efforts are divided equally among bilateral (26%), multilateral (23%), indirect (34%) and regional cooperation (10%). Belgium does not support specific water research programmes, but does invest in broader research programmes on water. Examples are the contribution of DGDC towards water projects of the VLIR and the Flemish contribution to the Science Trust Fund of the UNESCO with water as its first priority.. Half the other projects are related to CB in integrated water management.

Energy

Belgium invests limited amounts in energy CB and TT: € 0.1 and € 0.2 million respectively in 2003 and 2004. These efforts are supported by the FPS Economy and the CIUF.

Environment

Limited amounts are dedicated to CB and TT in purely environmental programmes: € 1.0 million in 2003 and € 0.2 million in 2004. The bulk of these efforts are supported by bilateral (42%) and regional (52%) cooperation. Bilateral efforts are concentrated in one country: Burkina Faso. A factor of 50% is used to calculate the contribution to climate change.

Specific activities at the federal and regional levels

At the federal level, most bilateral projects of the DGDC include training segments, either in the developing country itself, in Belgium or both. DGDC also supports International Course Programmes and International Training Programmes at Belgian universities.

In April 2003, Belgium organised a regional UNFCCC workshop on technology transfer (EGTT-meeting), in Ghent. The University of Ghent organised five lectures on the different aspects of technology transfer under the UNFCCC and the Kyoto Protocol for a broad public from the government and the private sector. The Flemish region supported these lectures and the participation of experts from non-Annex 1 countries in the workshop through financial contribution of € 29 970. A report on the lectures by the international speakers also made recommendations to the Flemish government on implementing TT obligations in its climate policy.

The Flemish government also provides financial support for:

1. two environmental education projects that deal with, among other themes, the rational use of energy:
   - 'Ecoschools project: Education for the environment': drawing up of a peer-reviewed manual for South African primary schools and coaching of three pilot schools in the province of Gauteng in South Africa. One of the core themes was 'energy' (2004-2005, budget 62.182 €).
   - 'Ecoschools project: Implementation of environmental management in primary schools in South Africa': builds on the above project, by disseminating the manual and the methodology in more schools in the province of Gauteng and Limpopo and by developing an environmental management system (2006-2007, budget 81.495 €). Energy and water will get focal attention, in line with MDG 7 and the Kyoto and post-Kyoto policy in South Africa.
2. four projects for small renewable energy systems in developing countries
   - Cuba (Guantanamo province): sustainable electrification of isolated villages by means of small autonomous PV or hybrid (wind and PV) systems, with focus on local participation and education. Two projects were carried out. Period: 2001-2005. Budget: € 198 000
   - Zimbabwe (Manicaland): sustainable electrification of isolated villages by means of small autonomous PV systems and biomass installations, with focus on local participation, demonstration and education. Period: 2002-2005. Budget: € 99 000
   - Congo (Mbuyi Mayi): electrification of a technical working facility by means of a PV system. Period: 2004-2006 (at the earliest); Budget: € 99 000

In agriculture, two projects are being implemented in sustainable agriculture and livestock in South Africa and Chile. Small water projects are implemented, by both the Flemish and Walloon municipalities and provinces in different parts of the world. Support from the Flemish government for eco-clubs in Chile and regional

support from the Walloon government for environmental projects in Rwanda are other actions that contribute to CB and TT.

The complete overview of Belgian efforts in capacity building for climate change and technology transfer issues is given in table 7.5.

References

GEF Annual Report (2003)

Belgium (2005), OECD-DAC Peer Review: Main Findings and Recommendations

Annual report of DGDC (2004)

Table 7.5. Bilateral and regional financial contributions related to efforts in CB and TT (€ thousand)

Domain	yr	Total	% CC	Bilateral	Multilateral	Indirect	Region	Adaptation	Mitigation
Forestry	2003	0	100%	0	0	0	0	0	96
	2004	0	100%	0	0	0	0	0	64
Agriculture	2003	11 682	20%	0	1 677	608	18	2 303	3 023
	2004	7 627	22%	0	1 470	166	48	1 684	1 906
Water	2003	747	50%	150	82	93	49	374	11 349
	2004	701	50%	90	80	150	31	351	8 473
Energy	2003	133	100%	133	0	0	0	133	1 522
	2004	217	100%	144	0	73	0	217	989
Environment	2003	960	50%	131	5	0	344	480	1 332
	2004	165	50%	47	0	10	26	83	715
Integrated Development	2003	0	3%	0	0	0	0	0	0
	2004	0	3%	0	0	0	0	0	0
		22 232		695	3 314	1 100	516	5 625	29 469

Source : Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation.

8. Research and systematic observation

The preparation of this chapter was coordinated by:

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Belgian Science Policy

General policy

Science, technology and innovation (STI) are policy areas that come under the authority of all the federated and federal entities in Belgium. STI is principally the remit of the regions, though the communities, also exercise authority within their own spheres of competence. As an exception to this rule, certain responsibilities for scientific research fall to the federal government.

The communities have the main responsibility for fundamental research in universities and applied research in higher education institutes. The regions are responsible for economically oriented research, technological development and the promotion of innovation. The federal government is responsible for scientific activities linked to its own areas of competence and develops STI activities of national and international interest, in agreement with the communities and regions. Cooperation and consultation between the federated entities is organised through the Inter-Ministerial Conference on Science Policy (CIMPS-IMCWB), which includes representatives of the federal state, the communities and the regions.

Federal state

At federal level, the Council of Ministers of the federal government is the executive body responsible for STI policy. The administrative structure charged with implementation of the federal science policy is the Belgian Science Policy Office (ex-Federal Office for Scientific, Technical and Cultural Affairs), placed under the authority of the Minister responsible for scientific research. The Belgian Science Policy Office prepares and implements actions falling under the federal government's responsibility described above: 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 task of the Belgian Science Policy Office is the implementation and coordination of scientific and technical activities requiring a multi-annual approach. Other federal public services administering significant research budgets are Economic Affairs (nuclear research, joint research centres, patents, measurement and certification, and standardisation), National Defence, Social Affairs, Public Health and Environment, Justice, Development and Cooperation.

Walloon region

The Walloon Minister of Research and New Technologies is responsible 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 are completely autonomous in developing these activities. The administrative body in charge of preparation and implementation of the policy is the Directorate General for Tech-

nologies, Research and Energy (DGTRE). This administration develops projects and 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.

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 implementation of 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 institutes and for fundamental research (including FNRS[1] and 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 and public services.

Brussels-capital region

In the Brussels-Capital region, scientific research is dependent on the Ministry for Employment and the Economy. At administrative level, the Brussels Institute for Encouragement of Scientific Research and Innovation (IRSIB), created by the decree of 26 June 2003, is responsible for financing scientific research and technological innovation in companies, universities and higher education institutes in the region.

Other administrations, such as IBGE or AED, finance one-off studies directed more towards the definition and assessment of their policies. The Brussels Enterprise Agency (ABE) helps companies evaluate, start up and develop projects of an innovative nature or with technological content.

http://www.bruxelles.irisnet.be/en/region/region_de_bruxelles-capitale/ministere_de_la_region_de_bruxelles_capitale.shtml

http://www.ibgebim.be/

http://www.irsib.irisnet.be/

http://www.abe-bao.be/

Flemish region

Responsibility for Flemish STI policy is shared by the Minister for the Economy, 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 institutes. The administrative body responsible for preparation, implementation, follow-up, evaluation and promotion of 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 government 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 implementation of Flemish Technology and Innovation policy. In particular, IWT manages financial support for industrial research and technology transfer in Flemish industry. IWT also has the task of coordinating all technology transfers and innovation intermediaries in Flanders.

To improve priority-setting and the organisation and coordination of research in the field of environmental and energy technology, the Flemish Government established in 2004 the Environmental Technology Platform. The idea is to enhance synergy between innovation, environmental and energy policy in Flanders. The Platform will also stay tuned in to federal and European policy actions, as far as relevant. It will consequently bring together companies, research institutions and public authorities active in the field of environmental and energy technologies. The Platform aims to encourage better and more coordinated use of financial instruments in the field of energy and environmental technologies and research in strategic environmental and energy areas through clustering and scaling up. In addition, the platform will create a new (virtual) centre of competence in environmental and energy technologies. It is expected to be a virtual cluster of knowledge and expertise in the research institutes, universities and secondary schools in Flanders and will focus on:

- valorisation-development of existing knowledge and expertise for market applications
- new knowledge-development for a limited number of topics by clustering existing research capacity.

Research priorities of this centre will be defined by the steering committee of the Environmental Technology Platform. For

its start-up phase (foreseen for 2005), € 7 million has been allocated to this centre of competence.

Research activities

Research activities in Belgium (both research on climate system and policy support research), are carried out in universities [2] and in several institutes, among which: the Royal Belgian Institute of Natural Sciences (IRSNB-KBIN), 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 Institute for Forestry and Environmental protection (IBW/IN - AMINAL). Research activities conducted by these universities and institutes in the field of climate change take place either in federal or regional programmes, or through participation in international research. These research activities are described below.

International co-operation

The trans-boundary nature 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, create the need for international cooperation on research and observation, scientific assessment and integration. Belgium plays an active part in this effort.

Belgian participation in international research programmes

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

- European Community Sixth Framework Programme for Research and Technological Development.
- International Geosphere and Biosphere Programme (IGBP)
- Land Use and Land Cover Change (LUCC) programme
- 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)
- 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 below)
- Network for the Detection of Stratospheric Change (NDSC)
- Energy Technology Systems Analysis Programme (ETSAP - IEA and OECD)
- Global Monitoring for Environment and Security (GMES)

Scientific integration and assessment

Belgium contributes to international efforts to develop scientific integration and assessment through the participation of Belgian experts in international expert panels and 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 Coordination Unit (EORCU).

Federal research programmes and activities

Implementation of actions falling under the federal science policy is mainly the responsibility of the Belgian Science Policy Office. Its departments concerned with climate research, for example, are:

- Research Programmes
- Space Research and Applications
- International Cooperation.

Climate Research in the Belgian Science Policy Office is mostly integrated into the Scientific Support Plan for Sustainable Development, SPSD 1 (1996-2000) and SPSD II (2000-2005), and will be pursued in the framework of the Science for Sustainable Development Programme (2005-2009). A partnership agreement is in force between the federal and regional authorities for these programmes. The project selection procedure is based upon calls for proposals, evaluation by foreign experts and the strategic advice of a programme committee. Potential users of research results sit in user committees at the project level.

The programmes are briefly presented below.

The Second Scientific Support Plan for Sustainable Development Policy (2000-2005)

The second Scientific Support Plan for Sustainable Development Policy (SPSD II) was given a total budget of € 57.88 million. It is divided into two coordinated structures:

Part I. 'Sustainable production and consumption patterns'

Funding of € 6.57 million has been committed to 18 projects with a duration of 2 or 4 years directly or indirectly related to climate change: four projects contribute to the development of models to evaluate different aspects of climate change policies; seven 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; three projects study the residential and transport practices of households to support energy-related policies; and one project analyses the relationship between product policy and climate policy.

Part II. 'Global change, ecosystems and biodiversity'

Part II is divided into three sub-units: atmosphere and climate, ecosystems and biodiversity. A total of € 13.06 million funds 14 projects with a duration of 2 or 4 years directly related to climate change. Three projects concern the Antarctic (ice-sheet dynamics, late Quaternary climate history, biological pump in the Southern Ocean); the 11 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, the effect of climatic extremes on biological invasion, strategic exploration and climate modelling.

Complementary budgets were available within the SPSD II framework for the clustering of projects which cover different aspects of common and complex problems. Six clusters related directly or indirectly to climate change are financed with a total of € 0.44 million for the period 2004-2006.

For further information on the preceding actions see: http://www.belspo.be/fedra

The results of global change research activities conducted between 1990 and 2002, supported by the Belgian Science Policy Office, were subject to an assessment and integration. This process focused on a selection of scientific information and resulted in the following two reports (Belgian Science Policy Office ed., 2004):

- 'Belgian global change research 1990 – 2002: Assessment and integration report'
- 'Belgian global change research 1990 – 2002: Synthesis of the assessment and integration report'

The thematic sections of the assessment and integration report are structured around policy-relevant questions and answers. Apart from policy support tools and neutral advice, this state-of-the-art knowledge document also provides an overview of the relevant scientific knowledge and expertise in Belgium. The reports can be ordered and/or downloaded via the Science Policy Office website: http://www.belspo.be/

Science for Sustainable Development Programme (2005-2009)

The research programme 'Science for Sustainable Development' was approved by the Council of Ministers on 4 March 2005. It has a total budget of € 65.4 million for the period 2005-2009. Its priority research areas are the following: Energy, Transport and mobility, Agro-food, Health and environment, Atmosphere, Climate, Terrestrial and marine ecosystems, and Biodiversity. The programme also encourages the submission of proposals related to standardisation.

Different calls for proposals with a duration of two or four years are prepared by interdisciplinary networks of two to five teams. Call 1 (mid-2005) comes within the research areas 'Climate' and 'Atmosphere' (including Antarctica). This call is granted a budget of maximum € 13.25 million. New projects will subsequently begin in December 2005/January 2006.

The various research areas are sub-divided into two main sections. The objective of the first, 'Understanding the climate system and atmospheric processes', is to improve our understanding of the evolution of the climate system and atmospheric processes as well as the interactions between these processes. The second, 'Support for the preparation and evaluation of climate policy' is oriented towards providing multidisciplinary support to the preparation and evaluation of the emissions reduction policy and the policy of adaptation to climate change. A third is open for research to support the development of standards for monitoring and implementing the climate and atmospheric policy.

Antarctica, which makes a special contribution to the study of climate change, is one of the privileged research areas (see http://www.belspo.be/belspo/antar/index.htm for details).

Research to support measures for greenhouse gas emission reduction in specific sectors such as energy, transport and land use as well as studies on the biological, physical and chemical consequences of climate change on ecosystems and biodiversity will be addressed under call 2 (end 2005 – beginning 2006).

Remote sensing 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 years of expertise and will support various 'poles of expertise', each of which is 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 approximately € 1.1 million.

Scientific support for the exploitation of the VEGETATION instrument (2001-2005)

The programme of 'Scientific support for the exploitation of the VEGETATION instrument', covering a five-year period, was launched in parallel with 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 (pre-)operational developments in the area of 'monitoring of vegetation and related parameters on a global and regional scale'. The total budget for this programme is € 300 000, of which € 200 000 is being assigned for research (see http://telsat.belspo.be/ for details). The VEGETATION-2 instrument is set to remain operational until 2008 at the very least.

ESA - PRODEX

Belgium has supported several climate related projects via the PROgramme for the Development of scientific EXperiments (PRODEX) of the European Space Agency (ESA) since 1988. PRODEX finances proposals addressing the development of new instruments for ESA (or other space agencies) satellites, the calibration and validation of satellite data, their processing including the development of algorithms, the development of specific applications and the general scientific data use of the instrument.

ESA - EOEP

Belgium has participated since 1999 in ESA's voluntary Earth Observation Envelope Programme. Several of the scientific missions developed through this programme are relevant to climate studies, e.g. GOCE (observation of global ocean levels), ACE (Atmospheric Climate Explorer) and CRYOSAT (study of ice).

ECMWF

The European Centre for Medium-range Weather Forecasts (ECMWF) is specialised in medium-range (up to 10 days), monthly, seasonal and multi-annual weather forecasts through the development of sophisticated atmospheric computer models in combination with observational data. ECMWF is also increasingly involved in the monitoring and prediction of atmospheric composition (greenhouse gases, aerosols, pollutants, etc.), in particular through its leadership in the GEMS project. Belgium is a member of this intergovernmental organisation and contributes annually around € 1 million.

Walloon region

Research on energy

The budget of the Walloon Region for research and development related to energy amounts to around € 10 million a year. It encompasses grants for research projects. Following the IEA classification, the major research areas are renewable energy (45%) and energy conservation (35%), followed by power and storage technologies (15%).

The Walloon Region regularly issues calls for proposals to enterprises and universities on specific thematic priorities of research, named 'Mobilising Programmes', the results of which are likely to be of interest to existing companies or might lead to the creation of new one. Programmes in the area of NNE RTD were:

- Cogénération: l'Énergie totale (combined heat and power generation): two calls, on the priority theme of micro-cogeneration and biomass cogeneration. The budget for the period 2000-2001 was € 5.1 million.
- PIMENT (Projets Innovants relatifs à la Maîtrise de l'Énergie utilisant de Nouvelles Techniques – Innovative projects on energy management using new technologies): two calls, on the general subject of energy efficiency and reduction of CO_2 emissions. The budget for the period 2002-2003 was € 8.4 million.
- PILES À COMBUSTIBLE (fuel cells): materials and components of PEM fuel cells. Deadline: 1 October 2004. Budget: € 1.2 million.

Since 1990, the Walloon Region (with the other federated authorities) has participated in implementing agreements (IA) of the International Energy Agency (IEA), granting research teams funding of € 1.4 million/year. The main IA are 'Energy Conservation and Emissions Reduction in Combustion' (ECERC), 'Energy Conservation in Building and Community Systems Programme' (ECBCS), and 'Solar Heating and Cooling' (SHC). The Walloon Region also financed, in collaboration with the other regions via the CONCERE/ENOVER group, the participation of the Scientific and Technical Centre for Construction (CSTC) in the 'Hybrid Ventilation' annex of the IEA IA ECBCS.

Various research projects and studies are financed to study specific items, or to disseminate scientific and technical information to the building sector. These have included, for example, interior insulation, natural and artificial lighting, the adaptation of technical specifications to energy efficiency in new buildings and in retrofit, training and guidance programmes for the development of a reference manual, and a CD-ROM called 'Energie +', compiling knowledge and experience in energy efficiency in buildings.

The 'Action Plan to Prepare Wallonia for the Future', adopted in 1996, reflects the R&D strategy the Walloon government wishes to promote. Further to adoption of the plan, the efforts of the Walloon government have to be oriented towards clearly identified technological niches, to be defined with all the players concerned. The reorganisation of the region's support for R&D will result in better integration of the regional policy into European R&D programmes. The 'Plan for Mastering Sustainable Energy' was endorsed by the Wal-

loon Parliament in December 2003 and fixes guidelines for 2010.

Other sectors

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

The Carbon sequestration potential of forest ecosystems (1999-2003): This study continues the work begun in 1997 by the Faculté Universitaire des Sciences Agronomiques de Gembloux (Agricultural University of Gembloux) on the impact of forest ecosystems on climate change. The objective is to deepen our understanding of carbon sequestration by root biomass and to improve experimental devices and the system for use of the data from the experimental site.

Estimating emissions of atmospheric pollutants by the agricultural sector (2000-2001). Two recent studies aimed at improving our understanding of emissions of NH_3, CH_4, and N_2O from the agricultural sector were carried out by SITEREM and the Agricultural University of Gembloux. The studies were supported by the Walloon authorities.

On a wider scale, as part of the town and country planning and transport policies, on 7 May 1998 the Walloon government decided to create the Standing Conference on Spatial Development (CPDT), with the aim of federating research in an area that has not been studied sufficiently in Wallonia, compared to other countries.

Most of the region's government departments and the three important French-language universities are partners in an ambitious, multi-annual research programme. The research being undertaken by teams based at the University of Liege (LEPUR) and Catholic University of Louvain (CREAT) under the work programme for 2002-2005 focus on the following objectives:

- evaluation of spatial planning measures needed to limit the growth of car-based mobility
- spatial planning measures to reduce the expansion of mobility (adequacy of functions, mixed-use)
- measures to favour modal shift
- evaluation of urban planning measures to improve energy performances
- evaluation of measures to limit the effects of modification of hydrologic regimes

Further research will include three complementary themes: enhancement of energy performance in urban planning, development of sustainable urban forms and rationalisation of transport (notably of goods).

See http://cpdt.wallonie.be/Index_texte.htm for details.

The DGRNE also financed a number of studies on the projected analysis of CO_2 emissions and CH_4 and N_2O emissions using the EPM micro-economic model developed by ECONOTEC.

French community

The French Community of Belgium, through its ARC programme (Action for Concerted Research), also finances an important research project related to the emission of CO_2 by crops, conducted by the Agricultural University of Gembloux (FUSAGx). A state-of-the-art installation for the measurement of carbon exchanges has been put in place in Lonzée. A detailed analysis of CO_2 exchanges between agricultural lands and atmosphere allows both an assessment of the role of these ecosystems in the global carbon cycle and better follow-up of crop development. The CO_2 fluxes exchanged by a Belgian crop (Lonzée) were measured at different spatial and temporal scales in order to establish the carbon budget. This measurement site is involved in the European network CarboEurope-IP.

Flemish region

The Flemish innovation policy aims to extend and deepen scientific know-how and technological skills in order to strengthen Flanders' integrated innovation capacity and to achieve by 2010 a leading position in Europe's knowledge economy. This policy is implemented through a system in which the Flemish government provides specific horizontal financing instruments that are open to all technological disciplines. Basically, the Flemish government acts as a stimulator and facilitator for science, technology and innovation, irrespective of the scientific domain or discipline.

From a financial perspective, the role of stimulating and facilitating R&D is based on three pillars:

- Support for short- and medium-term research
- Support for medium-term and long-term research
- Providing venture capital.

The funding of **short- and medium-term research** is channelled through the innovation stimulation programmes co-ordinated by the Institute for the Promotion of Innovation through Science and Technology in Flanders (IWT-Vlaanderen), which is the funding agency for applied (industry related) R&D in Flanders. IWT supports RTD projects for industrial basic research activities, for industrial development activities, and for strategic basic research of industrial relevance. The RTD projects are funded as follows:

- projects for industrial basic research activities: a subsidy of 50% of the overall project costs (with an additional 10% for SMEs);
- projects for industrial development activities: a subsidy of 25% (with an additional 10% for SMEs);

- in addition to the subsidy, SMEs can apply for a subordinated loan up to 80% of the project costs;
- extra incentives are available for Eureka (+10%), Aeronotics and Space (+ 10%).

These horizontal financing instruments are open to all technological disciplines. Selection criteria are based on scientific relevance and use perspectives.

A specific stimulus for research on rational use of energy or renewable energy is provided by the 'Sustainable Development' programme. Additional financial incentives (+10%) are available for and priority is given to projects that can prove significant added value in terms of sustainable technological development (STD). This added value is measured in terms of eco-efficiency improvement.

Networking between industrial actors and researchers is stimulated through the Flemish Innovation Networks. Within this context, two thematic innovation networks, entitled 'Flemish Cooperation Network Fuel Cells' and 'Cooperation Network Generations', have been launched. They bring together a number of companies and research institutes to stimulate information dissemination and innovation in the fields of hydrogen and fuel cell technology and renewable energies.

Medium-term and long-term RTD projects are funded by:

- The Programme for Strategic Basic Research (managed by IWT). This programme provides funding (up to 100%) for research projects with an industrial or societal valorisation perspective of 5 to 10 years. It is open for foreign participation by research institutes (including universities) but only at the request of a Flemish partner. The funding for the foreign partners is limited to 20% of total project funding.
- The industrial research fund for the stimulation of strategic basic research with industrial finality at Flemish universities.
- Support for the Flemish strategic research centres. Flanders has previously made strategic choices for the concentration of research in specific fields of application. Accordingly, specific research centres have been established: IMEC (Interuniversity Micro-Electronics Centre, VIB (Flemish Institute for Biotechnology), Flemish Institute for Technological Research and iBBT (interdisciplinary institute for Broad Band Technology). The long-term strategic research programmes of these institutes are supported under a management agreement between the Flemish government (managed by AWI) and the strategic research institutes. These institutes are funded by the Flemish Government (AWI) through an annual allocation. Two basic research institutes are involved in the energy field: Vito and IMEC. Long-term strategic research on photovoltaic is implemented by IMEC. IMEC is Europe's leading independent research centre in the field of microelectronics, nanotechnology, enabling design methods and technologies for ICT systems. IMEC is also active in the development of integration technologies for miniaturized fuel cells in MEMS (power-MEMS), to be applied in portable applications. VITO, founded in 1992, is the Flemish Institute for Technological Research and is a specialised research centre with a semi-private status that operates under the auspices of the Flemish government. The energy division consists of several research groups that focus on:
  - rational use of energy
  - transport and the environment
  - product and process assessments
  - energy technology.

More recently VITO started a specific strategic research activity (programme) dedicated to hydrogen and fuel cell technology.

The third financial pillar covers the stimulation of entrepreneurship and the creation of high and medium technology spin-offs through a policy framework for **venture capital**. Accordingly, the Flemish government created in 2005 the so-called Innovation Fund.

A good deal of attention is given to the stimulation of **international cooperation**. In its multilateral policy the Flemish government concentrates its activities on:

- the stimulation of Flemish participation in international research programmes (e.g. European Framework Programmes, EUREKA, COST, etc.)
- participation in strategic networks
- participation in ERA-net initiatives (e.g. HYCO, PV-ERA-NET).
- the setting-up of bilateral cooperation

In spite of the absence of specific thematic R&D programmes in energy research in Flanders, the total amount of funding increased during this period by a factor of 3.5. The success of the IWT funding system is mainly responsible for this increase.

With respect to content, energy related projects can be divided into three main categories:

- projects related to traditional energy generation systems, transport and management, accounting for 40% of the funding;
- projects related to new and/or renewable energy sources, accounting for 34% of the funding;.
- projects related to energy saving and rational use of energy, accounting for 26% of the funding.

Brussels-capital region

IRSIB supports the research programmes of universities and higher education institutes in the region, on subjects such as mobility, the environment and sustainable development, by financing grants

for eminent foreign researchers and doctoral or post-doctoral study grants.

http://www.irsib.irisnet.be/

In the context of implementation of its Air and Climate Plan, IBGE financed several studies related to the region's climate policy, including: 'Business as Usual 2010' scenario of greenhouse gas emissions; potential for reduction of CO_2 emissions; cost/benefits analysis of implementation of the Air and Climate Plan; clean cars; impact of driving practices on consumption; etc. Research has also been carried out on the concept of eco-construction and its practical implementation.

http://www.ibgebim.be/

Systematic observation

General approach to systematic observation

As agreed by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU), the Global Climate Observing System (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).

Although Belgium has no particular policy yet with respect to the GCOS, it takes part in various climate-related monitoring activities, both nationally and within European programmes. These monitoring activities are not formally included in the GCOS, although a number of procedures are used 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 programme on coordination and data and information management.

Since 2004, Belgium has been one of the countries (currently numbering 55) that have teamed up with the European Commission and over 40 international organizations, including CEOS, in the GEOSS initiative (Global Earth Observations System of Systems). The GEOSS 10-year implementation plan adopted in 2005 summarizes the steps to be taken to establish the capacity to monitor continuously the state of the Earth, to increase understanding of dynamic Earth processes and to further implement international environmental treaty obligations.

To date, Belgium has no focal point for GCOS nor does it have an active Focal Point for the GTOS. The situation is different for GOOS, however. The Belgian Science Policy Office launched early in 2001 a feasibility study for the optimization and the practical arrangements of Belgian participation in EUROGOOS, which is an association of marine operational research agencies in Europe whose members seek to foster European cooperation on GOOS.

Ministries and institutions in charge

There are no specific ministries or institutions in charge of the GCOS, though the following bodies could possibly play a role in the future. The Belgian Science Policy Office acts as a national space agency. The federal institutions in charge of systematic observations are the Royal Meteorological Institute (RMI), the Belgian Institute for Space Aeronomy (BISA), and the Management Unit of the Mathematical Model of the North Sea and the Estuary of the Scheldt (MUMM), all three of which depend on the Belgian Science Policy Office.

Actions to strengthen international and intergovernmental programmes related to global climate observing systems.

BELGIUM AND THE *GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY* (GMES) INITIATIVE

GMES is an initiative of the European Commission that by 2008 will provide the enlarged Europe with an operational observation and information system with respect to the environment and security. The European Commission has selected the optional European Space Agency (ESA) Earth Watch programme to carry out GMES as well as its Sixth Framework Programme.

The Federal Science Policy Office coordinates GMES for Belgium (interdepartmental consultation, promotion of GMES, monitoring of GMES participation and web service).

With respect to the carbon cycle and atmospheric research and development (observations, monitoring and modelling, etc), Belgium is involved in three EC projects. Regarding land cover and vegetation observation, monitoring and modelling, Belgium is involved in two projects (see http://telsat.belspo.be/gmes/ or http://www.gmes.info/ for details).

Belgian scientists also participate in PROMOTE, a project running under GSE, the ESA-GMES Service Element (See http://www.esa.int/esaLP/LPgmes.html for details).

Meteorological and atmospheric observation

Observation networks

The Royal Meteorological Institute of Belgium (RMI) has a number of networks for systematic observation of meteorological variables. Some (such as the synoptic network) are essentially used for operational purposes, while others are mainly intended for research work.

The RMI networks for meteorological observation are the following:

- 11 automatic synoptic stations; data are transmitted to weather forecasting centres through the Regional Meteorological Data Communication Network (RMDCN).
- around 240 climatology stations for daily measurements of precipitation: the full set of daily pluviometric observations is reported monthly to the European Centre for Medium-Range Weather Forecasts (ECMWF) for the quality assessment of the European Forecast Model.
- 25 radiometric stations (measurement of solar and infrared radiation), among which one WMO Regional Radiometric Centre; data from all these stations are provided to the WMO World Radiation Data Centre (WRDC) in St. Petersburg.
- One radiosonde station for the measurement of vertical profiles of temperature, humidity and wind up to about 30 km (two times a day, at 00.00 and 12.00 UT, 3 days a week).

Around 40 thermometric and 100 pluviometric stations have long observational series (over 30 years) and are therefore suitable for climate monitoring. 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.

Participation in 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 of five primary stations and 40 complementary stations located all over the world. Belgium takes part in observation at the international Scientific Station Jungfraujoch, which is one of the five primary NDSC stations, and at the Observatoire de Haute Provence, Harestua, Uccle and Ile de la Réunion which are complementary stations. NDSC-relevant molecules (e.g. HCl, $ClONO_2$, HF, COF_2, HNO_3, NO_2, NO, O_3, CFC-12, HCFC-22, BrO, CO), measured from 1989 to the present, are archived at the NOAA (National Oceanic and Atmospheric Administration) Data Host Facility (Washington, D.C.) and at NILU (Norwegian Institute for Air Research).

The Belgian Institute for Space Aeronomy (BISA) has taken on a leading role in the exploitation of NDSC data on a global scale in the validation of satellite data, in particular for GOME and ENVISAT, and co-chairs the NDSC Satellite Working Group. BISA staff members also co-chair the UV-Vis and Infrared Working Groups of the NDSC, and are members of the NDSC Steering Committee.

A station for observation of the ozone layer is located at the Royal Meteorological Institute of Belgium (RMI). This station comprises the following observations:

- Several times per day: observation of the total amount of ozone. These observations are reported to the WMO World Ozone and Ultraviolet Radiation Data Centre (WOUDC) in Toronto.
- Several times per day: observation of the spectrum of UV-B radiation. These observations are used as input in a model for forecasting the UV Index provided to the media.
- Three times per week: balloon sounding for observation of the vertical distribution of ozone and meteorological parameters.

Terrestrial observation

Worth particular mention in the field of terrestrial observation is Belgium's contribution to France's SPOT satellite programme since 1979.

One of the instruments on board the SPOT satellite is the VEGETATION instrument, a joint initiative by France, Sweden, Italy, the EC and Belgium. The images produced are used to monitor the world vegetation cover, deforestation and desertification, to forecast agricultural production, to study the effects of climate change and, in combination with ecosystem models, to estimate carbon sequestration. With the support of the Belgian Science Policy Office, the CTIV (VEGETATION image processing centre) is hosted in the Flemish Institute for Technological Research (VITO). The CTIV processes and archives the data and operates the VEGETATION image catalogue.

Space based observation programmes

European Space Agency

Belgium participates in the optional programmes of the European Space Agency (ESA) that manage the ERS (European Remote Sensing) and ENVISAT (ENVIronmental SATellite) satellite missions. Concerning 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 atmospheric concentrations. The ATSR (Along-Track Scanning Radiometer) instrument, included in both missions, measures the temperature of the ocean surface with accuracy greater 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 also participated actively in the ESA's PRODEX optional programme since 1988 (page 114).

Belgium was one of the four participating states in the ESA optional Data User Programme (DUP) (1996-2003). This programme specifically supported initiatives aimed at bridging the gap between Earth Observation application research, and the provision of an operational product destined for the commercial market. Seven Belgian DUP projects (two of which are still in progress) are directly related to climate change issues, i.e. global aerosol mapping, forestry mapping, ozone monitoring, draught early warning, climate analysis maps, carbon flux estimation, and tropospheric emission services. In 2003, this program was renamed Data User Element (DUE) and integrated into the ESA optional Earth Observation Envelope Programme (EOEP), in which Belgium has participated since 1999 (page 114). Belgium also strongly supports the GMES initiative of the EC and ESA (page 114).

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, dedicated to climate change studies.

Belgium also contributes to definition studies for MTG (Meteosat Third Generation).

Belgium's Royal Meteorological Institute (RMI) participates in the Ozone, Land and Climate Satellite Application Facilities (SAF) and will participate in the planned SAF for Hydrology. The purpose of these SAFs is to develop and provide a whole range of specialized data products from the EUMETSAT satellite raw data, e.g. evapotranspiration by the SAF-Land.

Belgium also participates in the Jason-2 optional programme of EUMETSAT, a satellite which aims to determine precise ocean altimetry and physical parameters, relevant e.g. for climate studies.

More information concerning these activities can be found on:

- 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
- http://dup.esrin.esa.it/

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9. Education, training and public awareness

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Aim of this chapter

This chapter reports on the accomplishments, lessons learned and experiences gained in the field of education, training, public awareness and participation related to climate change. The initiatives reviewed are mainly public sector actions, but where appropriate, the actions of non-governmental, community-based or private-sector organisations are mentioned as well. Many of the educational projects or training programmes mentioned focus on energy or mobility/transport, two crucial climate change issues that touch virtually all citizens. The review in this chapter does not claim to be exhaustive, but is meant to give examples of initiatives that contribute to awareness raising among the Belgian public.

Section 2 of this chapter probes the level of public awareness and understanding of the climate issue. A third section examines the global governmental plans and strategies in which the educational dimension of climate change is addressed. A fourth section concentrates on education through the school system. Next, the chapter looks at the many educational and training initiatives targeting different societal groups: young people, the general public, professionals and enterprises, etc. It then goes on to describe the launch of the United Nations Decade of Education for Sustainable Development (2005-2014) in Belgium. A final section 7 then outlines the major information resources on climate change-related topics for Belgium.

Public awareness of the climate issue

To get an idea of how well the Belgian public is acquainted with the climate change issue, we can have a look at a poll commissioned by the European Commission's Directorate General Environment on the attitudes of European citizens towards the environment. This survey was carried out both in 2002[55] and 2005[56] and climate issues are covered in its questions. In Belgium, a representative sample of about 1 000 persons were interviewed. The questionnaire used for the 2005 version has been considerably changed from the 2002 survey. It is nevertheless possible to compare the 2002 and 2005 results on some questions.

Climate change and related issues seem to be a growing concern for people in Belgium. In 2002, almost one out of three interviewees in Belgium said they were very worried about air pollution (22%), the climate (29%) or natural resources (32%). When asked to list the five main items of concern out of a list of 15 environmental

[55] The 2002 survey can be downloaded at http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_180_en.pdf

[56] The 2005 survey can be downloaded at http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_217_en.pdf

issues, 45% of the respondents of the 2005 survey mentioned climate change, 48% air pollution, 27% natural disasters and 25% depletion of natural resources.

The perceived awareness and knowledge level on climate change issues seems adequate for about half of the Belgians interviewed: in 2002, 48% were very well or fairly well informed on air pollution, 45% on the climate and 58% on natural disasters. When asked in 2005, however, to name five items for which sufficient information is lacking out of a list of 15 issues, 32% chose climate change, 25% air pollution and 17% the consequences of current transportation modes. These findings illustrate that a continuous effort to raise awareness and disseminate information to a broad public remains necessary.

Surprisingly, belief in the effectiveness of awareness raising campaigns seems to be declining. When asked to name three out of eight strategies effective for solving environmental problems in 2002, raising general awareness was counted among the three best solutions by 46% of the respondents, the highest percentage for this question. In 2005, this number had dropped to 35%; more respondents mentioned taxation for those who cause environmental problems (50%), stricter regulations with heavy fines (48%) and better enforcement of existing environmental legislation (44%). The attitude seems to be that awareness raising campaigns will only lead to behavioural changes when they form part of a wider set of measures. People are certainly aware that their attitudes and behaviour towards environmental issues make a difference: in 2005, 56% of the respondents felt very or fairly involved in environmental issues and 93% often or sometimes make an effort to protect the environment.

Still according to the 2005 survey, however, 59% of the Belgian respondents can be described as 'sceptics' (people stating that they often or sometimes make an effort but who are convinced that this will not have much of an impact as long as others - citizens and big polluters such as corporations or industry – do not do the same), whereas only 20% can be labelled 'convinced' (people stating that they often or sometimes make an effort and who are convinced this is having an impact). In short, we can say that to be effective, awareness raising campaigns should be used in tandem with the consequent implementation of tougher measures.

General standpoint and policy actions of the governments

Many measures of the National Climate Plan 2002-2012[57] are 'no regret' options, subsidies, standardisation or tariff initiatives. The Plan repeatedly states, however, that these measures should be supported by educational actions and awareness campaigns among different target groups.

The Federal Plan for Sustainable Development 2004-2008 (FPSD)[58], which was approved in September 2004, reflects the federal government's priorities of energy saving, renewable energy and a modal shift in transport. The FPSD stresses for example the need to promote public transport and 'soft' modes of transport (cycling and walking) through public awareness campaigns or actions in the sphere of travel between home and work.

Substantial parts of energy and mobility policy in Belgium do not depend on the federal government level, but form part of the remit of the regional governments. Similarly, the field of education and training is mainly a responsibility of the linguistic and culturally defined community governments. The published plans stress the role of general education and propose a number of awareness and information measures.

The Flemish Region has drawn up a distinct Climate Plan: Het Vlaams klimaatbeleidsplan 2002-2005[59]. It outlines four priority measures/projects that have a direct link with awareness: (1) Campaigning for behavioural changes concerning rational use of energy (RUE), (2) information streamlining on RUE between enterprises, (3) promotion of energy-efficient driving habits and (4) an information and awareness campaign on RUE in the subsidised housing sector. According to a follow-up note (February 2005) to the Flemish Climate Policy Task Force[60], implementation of all but the last measure (4) is progressing according to plans. The preparation of the second Climate Plan 2006-2012 is accompanied by a broad consultation of all relevant stakeholders, known as the Flemish Climate Conference. More than 250 experts are working on seven climate themes

[57] The National Climate Plan 2002-2012 can be downloaded at http://mineco.fgov.be/energy/climate_change/home_fr.htm

[58] Federale regering (2004). Federaal plan inzake duurzame ontwikkeling 2004-2008. Staatssecretaris voor duurzame ontwikkeling. http://www.plan2004.be

[59] The Flemish Climate Plan can be downloaded at http://www.energiesparen.be/beleid/vlaamsklimaatplan.php

[60] The follow-up note can be downloaded at www.energiesparen.be/documenten/vkp_klimaatnota050204.doc

like buildings, sustainable energy and transport. One of the 10 strategic recommendations of the first phase of this process puts emphasis on the need for more coordinated action in the field of education, training and awareness. The Flemish government will take this into account when drafting the new climate plan.

The Walloon Region has published two key documents as a response to the climate change issue: the Walloon Air Quality Plan[61] and the Plan for Sustainable Energy Management in Walloonia[62]. The strategy of the Walloon Region focuses on awareness, education and training to change behaviours in the long term. Campaigns focus in particular on children, consumers and professionals in specific sectors. Examples of themes covered by these campaigns are the rational use of solvents or the consequences of automobile use.

The Brussels-Capital Region plan on air quality[63], Plan for the structural improvement of air quality and the fight against climate change, 2002–2010, focuses in particular on the housing and services sector, which is also one of the main targets for its awareness and information campaigns. For businesses, a technology information centre is proposed.

Education through the school system

Educational final objectives

In Belgium, education is a responsibility of the communities. The French, Flemish and German Communities outline the specific content of education in the so-called 'final objectives'. These are the core curricula, which specify for the different educational levels the baseline objectives for knowledge, insight, skills and attitudes, set by the governments as indispensable.

In the Flemish Community, Environmental Education (EE) has become an integral part of the final objectives of the primary as well as the secondary educational levels. It comprises climate change aspects, as exemplified by the following objectives for secondary education[64]:

- The pupils are prepared for a sustainable use of raw materials, goods, energy and means of transport
- The pupils are able to develop a behaviour pattern that reduces individual motorized mobility and opts for a convenient way of transport.

In the French Community as well, legal efforts have been made to introduce education on the climate change issue more easily into the classroom[65]. The School Missions Decree (1997) and the definition of the basic skills (1999) common to all educational networks both represented quantum leaps forward, favoured interdisciplinary approaches, field experiences and project-based learning, and invited schools to incorporate EE into their curricula. Cooperation between the Walloon Region and the French Community, agreed in 2003, opened up possibilities for enhanced cooperation between the educational (community) and environmental (regional) administrations[66].

So although syllabi in Belgian primary and secondary schools usually do not contain specific chapters on climate change, the issue is increasingly being tackled in a transversal, interdisciplinary way.

School education on climate change

Environmental Education

Environmental Education (EE) is a global and systemic educational approach that seeks to develop skills, knowledge and values that promote behaviours in support of a sustainable environment. It is not confined to formal schooling, but also occurs in a wide range of non-formal educational settings, at work and at home.

EE has firmly taken root in the Belgian educational landscape. The focus in this section 4.2 will be on EE activities that concern the climate change issue and that take place within or closely linked to the formal school setting. The main EE networks, which set the tone for EE discussions in Belgium, will be presented, indicating the way climate change is tackled transversally in classrooms. In cooperation with and in addition to these efforts, many different public, non-governmental or private sector actors propose an increasingly large number of school activities, educational initiatives, support measures and subvention systems, all of which are developed for school contexts and aim to change children and young people's attitudes as well as behaviours linked to mobility, energy, consumption and climate change. Some of the most relevant of these initiatives are also outlined below. The information is presented as follows: Flemish Community (4.2.2), French Community (4.2.3.) and Brussels-Capital Region (4.2.4.).

Flemish Community

In 1997, an EE network called NME (Natuur- en Milieueducatie)[67], which involves all relevant stakeholders, was launched in Flanders. Coordination and consultation for this network is handled by a

[61] http://air.wallonie.be
[62] http://energie.wallonie.be/xml/dgtre.html?P=NC&IDD=6921
[63] www.ibge-bim.be
[64] http://www.ond.vlaanderen.be/dvo/secundair/index.htm
[65] The homepage of the French Community Department of Education: http://www.enseignement.be/index.asp
[66] http://www.coopere.be/
[67] http://www.milieueducatie.be

specialised unit within the Flemish government. The website of the EE unit includes a search engine visitors can use to find appropriate educational tools out of a large range. The search is based on keys such as target group (education, nature guides, adults, government, etc.), theme (including energy, traffic, sustainable consumption, etc.), material (book, CD-ROM, brochures, game, poster, model, field study materials, etc.) and activity (campaign, workshop, course, bike tour, game, quiz, etc.).

A large share of the EE activities proposed are suitable for school contexts, the MOS project (Environmental Care at School)[68] being emblematic in this regard. The MOS project, which was kicked off in 2001 and has included the former Green School project since 1 September 2002, is an integrated school project involving all actors: the school board, teaching staff, maintenance staff, parents and especially the children and young persons themselves join forces to turn their school into an environmental friendly entity. Efforts to enhance environmentally friendly attitudes and behaviour are made in terms of syllabi content, school management and the more or less immediate surroundings of the school. Concrete actions include the introduction of a waste prevention plan, the organization of an environmentally friendly playground, the installation of drinking fountains, an impetus to bike to school, energy audits, use of energy-saving lamps, energy-saving installations, environmentally friendly cleaning products and so on. The children and young people thus learn, gain experience and acquire attitudes that will allow them to take responsibility for a more sustainable society as future citizens.

The tools available as part of the MOS project include a step-by-step manual on environmental care implementation, a book of practices, a brochure, a video, posters, bookmarkers and an environmental audit CD-ROM.

In 2005 1 733 primary schools (44% of the total in Flanders) and 765 secondary schools (56%) had been awarded the MOS label. The themes covered by an MOS project are as broad as waste prevention, water, traffic, nature at school, energy, etc. In recent years, however, some have had a direct link with the climate change issue. Some examples:

- In connection with the start date of the Kyoto Protocol, the MOS schools organized a Warm Jumpers Day on 16 February 2005. In some 500 schools, heating systems were put a couple of degrees lower than the usual setting, resulting in a total saving of 57 tonnes of CO_2. In several schools, awareness activities supplemented the campaign, such as the planting of Kyoto trees, energy debates, a petition, the knitting of an enormous scarf, etc.
- In autumn 2005, a training course was held in MOS schools to show how the energy use of a school can be mapped, interpreted and compared with that of other schools. The idea was to detect which energy-saving measures might prove most effective in a given school situation.

In Flanders, EE activities in schools are further supported through subsidies, such as the Flemish Community's DynaMo2 funding initiative[69] which grants up to € 1 500 to school teams (board, teachers, youngsters, etc.) proposing an inventive project. Environmental care is one of the themes eligible for funding.

French Community

'Réseau Idée' (Idea Network)[70] is the main Environmental Education (EE) organization in the Walloon Region and the French Community of Brussels-Capital Region. Réseau IDée operates as a network whose main objective is to strengthen ties between all the actors involved: teachers and educators from all levels, youth workers, parents, eco-consultants, etc. An extensive pool of pedagogical tools and relevant documents (addresses, activity catalogues, book references, etc.) is made available to anyone interested. Réseau IDée has also developed a number of educational websites. The site World in Movement[71], for example, is a webzine dedicated to education for sustainable development. This site spotlights people who regularly propose activities and tools that create more awareness of the interdependence of economic growth, social progress and the environment. Réseau IDée has also organized 10 meetings on EE since 1989, again for all actors involved.

The Walloon Region has supported additional initiatives on climate, energy or transport. All are clear examples of EE actions within the formal school system:

- The 'Ecoles pour Demain'[72] (Schools for Tomorrow) campaign has been implemented by the NGO Coren[73] since 1995 and is supported by the Walloon Region. This campaign offers a global framework and panoply of activities (activities, training, study days, etc.) to primary and secondary schools to help them to improve their environmental performance. Energy, air and transport are some of the themes addressed by the intervention. About 300 schools have already benefited from the programme and 187 have obtained the 'Ecoles pour Demain' label from the Walloon Region, based upon their successful participation in the project.
- The Wind Academy project of the association Vents d'Houyet[74] is an ephemeral 'academy' that travels from village to village to present wind energy as an alternative energy source to children aged 8 to 15 years. The project consists of a small, inflatable tent used for projections and discussions, a meteorological station attached to a stratospheric balloon, an educational exhibit, a solar merry-go-

[68] http://www.milieuzorgopschool.be
[69] http://64.78.63.10/web/canon/dynamo/home.html
[70] http://www.reseau-idee.be/
[71] http://www.mondequibouge.be/
[72] http://www.ecolespourdemain.be
[73] http://www.coren.be
[74] http://www.vents-houyet.be/academie/aca_projet.htm

round and objects illustrating wind generated sounds (e.g. wind organ).
- The International Polar Foundations[75] has organised educational activities on the greenhouse effect and climate change in different schools.
- The Heliomobile is a travelling activity that has made presentations on solar energy in many Walloon schools.

The Walloon Region also promotes the use of bicycles in the school context. Instructor-monitors have been trained and can be consulted by municipalities, schools and organisations that want to work out action plans.

A last example of EE in French-speaking schools concerns the so-called Green Classes. In Walloonia and Brussels, two networks of local nature areas offer green classes/sojourns: the Centres de Dépaysement et de Plein Air (CDPA)[76] and the Centres Régionaux d'Initiation à l'Environnement (CRIE)[77]. The basic idea is that one week of the school term is spent at the countryside, in a local environmental setting, offering a very effective tool for awareness raising and education on the environment and sustainable development. Though CDPA and CRIE were originated by the French Community and the Walloon Region respectively, the cooperation on environmental education between the two government levels agreed in 2003 has created more synergy, better structured environmental activities and heightened visibility for both networks.

Brussels-Capital Region

Whereas Réseau IDée (cf. 9.4.2.3) is also the principal EE network for the French Community in the Brussels Capital Region, the NME-Link network[78] is the main EE organization for the Flemish Community of that same Region. It also functions as a network and its main objective is to strengthen ties between the different actors involved in education on sustainable development. The network has projects introducing EE in the formal school system, in civil society organizations and, since 2003, also in the non-formal youth sector. Examples of interventions are the MOS project (cf. above), a campaign helping young people to take a stand in the mobility/traffic debate[79] and the pilot project Energy, A World in Movement, initiated in collaboration with the NGO Coren.

The Brussels Institute for Environmental Management (IBGE/BIM), the regional administration for environment and energy, has developed an educational packet focusing on tangible behavioural changes that can be adopted to save energy. After being tested in 2004, this packet will be disseminated in 20 primary schools during the school-year 2005-2006 and replicated thereafter. Another educational packet for secondary schools, based more broadly on sustainable development, will be developed from 2006.

The Brussels energy agency, the Urban Centre- ABEA[80], supported by the Brussels-Capital Region, coordinates the European FEEDU-project (Full Energy for Education), running from January 2005 to January 2007. Some 15 primary schools in the Brussels Region will cooperate during the 2005-2006 school year to make 10 to 12 year-old children more informed on rational energy use, mobility and renewable energy sources. The project has two parts. The first concerns the development of an action programme within schools on the theme of energy education. Activities can include basic lessons on energy concepts, games and experiments, energy audits in the school or at home or guided visits. The second part consists of training for primary school teachers on energy education, which provides them with appropriate teaching tools. Best practices from the participating country partners are shared. The global methodology encouraged by the FEEDU scheme is interdisciplinary. Its educational potential is project-based: the children analyse the situation and look for solutions. Their knowledge is tested at the beginning, in the middle and at the end of the project.

Higher education

Climate change issues are being given more and more attention in higher education: courses on climate change have been developed and special research units on environmental issues, climate change or glaciology have been created. For example, the Pôle Universitaire Européen de Bruxelles Wallonie[81], which groups 11 universities or higher education institutes in Brussels, offers specialised master's level training in environmental management at Free University of Brussels (ULB).

Two prominent activity tracks of the Université catholique de Louvain (UCL) further illustrate the way climate change is treated in higher education settings in Belgium.

- A post-graduate programme in environmental science and management is organized[82]. This specialised training, which covers climate and energy related issues, aims to train students in interdisciplinary dialogue, action and decision-making in the environmental field.
- An Architecture and Climate research unit was established in 1980[83]. The objectives of this unit are to develop the theory of climatic architecture and sustainable architecture, the achievement of optimal energy efficiency in tertiary sector buildings and their facilities, support for the teaching of architecture at the university and the development of specific teaching methods geared to the establishment of continuing training courses for architects and energy technicians.

[75] http://www.educapoles.org
[76] http://www.restode.cfwb.be/cdpa/index.htm
[77] http://www.crie.be/
[78] http://www.nme-link.be/v2
[79] http://www.mobilie.be
[80] http://www.curbain.be
[81] http://www.ulb.ac.be/poluniv-bxl
[82] http://www.cgse.ucl.ac.be
[83] http://www-climat.arch.ucl.ac.be/US_index.html

Empowering the future: areas of action and target groups for learning

Initiatives with an international scope

This chapter deals mainly with educational and awareness efforts on the national level. Given the global nature of the climate change challenge, however, actions to reduce greenhouse gas emissions are needed in both developing and developed countries. The climate change issue has yet to be mainstreamed within international cooperation and development theory and practice, but some Belgian climate change initiatives in this field do exist. Three examples of educational or awareness activities with a clear international scope or impact are described below:

- In spring 2003, researchers from Grefe (research team on environmental education and training, part of Liege University)[84] participated in the training of 15 future environmental educators from four ACP countries in the Indian Ocean (Madagascar, the Seychelles, Mauritius and Comoro Islands). The 15 educators subsequently provided 150 local teachers with tools for environmental education, in order to introduce this new dimension into the school programmes.
- In the field of sustainable energy management, the Walloon Region has developed action programmes targeting southern countries; on a bilateral level (mainly through the Foreign Affairs Department of the Walloon government), through multilateral cooperation (mainly by contributing to activities of the IEPF, the Institute for Energy and Environment of French-Speaking Countries[85]) or through use of the Clean Development Mechanism procedures. Project implemented include training on the maintenance of RES equipment (Morocco), development of an energy score board (Benin), the BioTerre biomass project (Senegal), etc.[86]
- The European Regional Workshop on the Implementation of Article 6 of the UNFCCC took place in Belgium, at the Grand-Hornu site, from 6 to 8 May 2003[87]. The purpose of the workshop was to contribute to the further development and implementation of the New Delhi work programme on Article 6, as adopted by the Conference of the Parties at its eighth session, in the wider European region and to take forward work on assessing needs, identifying priorities, sharing experience and exchanging information on related activities between UNFCCC Parties and interested stakeholders in this region. As called for in the New Delhi work programme, the workshop also aimed to enhance cooperation and coordination between Parties at the regional level in developing and implementing Article 6 activities, including the identification of partners and networks with intergovernmental and non-governmental organizations, the private sector, regional and local governments, and community-based organisations.

Young people

Children and young people constitute the general public and the decision makers of tomorrow. Sustained action to make this target group aware of climate change issues should not be limited to the formal school setting. In Belgium, parallel initiatives exist in other spheres of young people's lives:

- In Flanders, the JeROM project[88] (Youth, Space and Environment) provides youth with opportunities and suggestions for making a contribution to an environmentally friendly and sustainable world. A survey in 2001 resulted in the final report 'Youth Work and Environmental Education' in which the rationale of Environmental Education for youth, outside the school context, is developed.
- Two actions have been developed: 'Camping in an environmentally friendly way' (1) and 'Environmentally friendly infrastructure for youth' (2).
  (1) JeROM subsidised the Loslopend Wild (Game at Large) campaign conducted by Steunpunt Jeugd vzw[89]. Information on environmentally friendly and energy-saving camping was made available to young people and youth organizations.
  (2) The Ecospot[90] project concentrates on youth centres and is run in cooperation with the Federations of Youth Centres. The project first assesses the environmental situation in youth centres (Ecoscan). The results are collected and published on the project website. In the next phase, youth centre workers develop ideas to improve environmentally friendly behaviour. The different centres mobilised to organize a collective activity at the end of November 2005. A number of youth centres will also be coached on organising an internal environmental care system, starting at the beginning of 2006.
- A non-profit organization called APERe[91] aims to enhance young people's awareness of the challenges of en-

[84] http://www.ful.ac.be/recherche/grefe/grefe.htm
[85] http://www.iepf.org
[86] These examples are mentioned in the Plan for Sustainable Energy Management in the Walloon Region.
[87] http://62.225.2.52/meetings/workshops/other_meetings/items/1090txt.php
[88] http://www.jeromweb.be
[89] http://www.steunpuntjeugd.be/themas/loslopend_wild
[90] http://www.ecospot.be
[91] http://www.apere.org

ergy use and climate change, spanning different spheres from childhood, over school attendance to leisure activities. APERe has received annual subsidies from both the Walloon Region and the Brussels-Capital Region and specializes in the production and dissemination of awareness-raising tools on renewable energy. The organisation participated in the 'Kids 4 energy' project[92] aimed at evaluating information, education and training programmes on energy efficiency for children. The project was carried out by organisations from nine European countries; it ended in 2004. The results were a Best Practice guide for energy education programmes, cards to be used for energy education, a database of European energy education programmes, etc.

The General public

Information and training initiatives

To influence the attitudes and behaviour of the public at large, many actions, initiatives and projects have been set into motion. Examples of initiatives to inform and train people, especially in the fields of energy and transport, are presented below.

- The General Environment and Nature Policy Division of the Flemish Community encourages cooperation between socio-cultural organisations on the one hand and environmental education organisations on the other. These initiatives are earmarked for a wide audience, first and foremost for all the organisations' members and active volunteers. A few examples:
  - Four educational training packs for socio-cultural workers were developed (energy-aware housekeeping, environmentally friendly housekeeping, the ecological footprint and food). These programmes are custom-made for civil society organizations, easy to use and amusing.
  - A teaching pack targeted at adults with limited schooling on topics such as the environment in general, mobility, consumption, energy and techniques, etc.
  - Ready-made and custom-made activities for local volunteers and members of socio-cultural organisations are available (e.g. an energy quiz, an energy-aware romantic evening, etc.).
  - An environmental care system for socio-cultural training centres, with special attention to the aspects of energy and mobility, has been disseminated. The initiative focuses on making visitors, mainly students, aware of the issues.
- The Walloon Region's 12 local energy information stands conduct three kind of audits at private homes:
  - Qualitative audit: general information to launch a construction or renovation project, possibly integrating notions of bio-climatic architecture.
  - Electric audit: concerns electrical household equipment, lighting and electrical heating.
  - Thermal audit: evaluation of the energy performance of the building and its heating system, proposals for possible improvements, study of integration of solar systems.
- In Flanders, different non-governmental organisations are working to promote sustainable and energy-saving ways of living. The Bond Beter Leefmilieu, the umbrella organisation of some 125 environmental groups in Flanders, has set up a website on the subject[93]. Experts with experience in environmentally friendly building can be contacted, and every year in October, owners of energy- saving dwellings open their doors to the public. Another organisation called VIBE[94] informs and trains people about healthy and environmentally friendly (re)construction and living. It organises information sessions and workshops, publishes the periodical 'Living with Nature', issues a label for professionals in the construction sector and organises study visits. The general public, organisations and local governments are its target public. Similarly, another organisation called Dialoog[95] offers households information and support for sustainable living. Activities are structured into three pillars (construction/renovation, water and energy) and include RUE sessions, construction evenings, construction teams (advice and guidance), workshops, etc. Dialoog also cooperates with cities and provinces to strengthen local sustainable living policies. Similar services are also offered by private sector actors, such as Livios[96].
- The Walloon Region publishes a free quarterly for the general public called 'Réinventons l'Énergie' ('Reinventing Energy'). The objectives of creating awareness of the climate issue and changing people's behaviour are addressed through the following features of the magazine:
  - Update on energy issues relevant for households in the Walloon Region.
  - A central educational page on a specific aspect of the energy question, matched with numerous practical recommendations.
  - An 'experiment' column for children
  - Interviews in the Walloon Region.

  In addition to the 'Réinventons l'Énergie' magazine, a regular electronic newsletter, 'Actualités Info-énergie', keeps readers informed on the latest events in the energy field focusing on the Walloon Region.
- The VMM[97], an environmental administration of the Flemish Region, publishes the free periodical 'De Verrekijker' ('The Binoculars') three times

[92] http://www.kids4energy.net
[93] http://bondbeterleefmilieu.be/klimaatnet
[94] http://www.vibe.be
[95] http://www.dialoog.be
[96] http://www.livios.be
[97] http://www.vmm.be

a year, making environmental information (notably on water and air) accessible to a large public. Climate change is often discussed in this periodical.

- As part of its effort to raise awareness, the Walloon Region publishes several informative brochures for the general public, available in print or in electronic format. Some readily available examples are titled:
  - Renewable energy in the Walloon Region.
  - Saving energy while heating the house.
  - 101 ideas to save energy in the household.
  - Energy explained to children.
  - Building with Energy: practical kit for potential builders.
  - 8 good reasons to install a solar water heater.
  - 8 good tips to successfully install a solar water heater.
  - Optimize your house.
  - The paths of energy.
- In the Brussels-Capital Region, the regularly updated website of the Brussels Institute for Environmental Management (IBGE/BIM) presents information on the environmental and energy situation and regional policies. The public can also find a 'pollution meter' that continuously monitors overall air quality and the road traffic situation in the capital area. To heighten drivers' awareness, the pollution meter has also been installed on main access roads to the city.
- The Flemish Region has a wide range of free information brochures that concern energy saving. About 300 000 copies of these brochures are distributed yearly through different channels (municipalities, libraries, website, Flemish Infoline, enterprises, etc.). The regional government also systematically participates in all principal building fairs/exhibitions to directly inform citizens on energy saving issues.
- In 2004, three rational use of energy (RUE) projects were initiated in some 180 subsidised housing units in the Brussels-Capital Region. Training for the inhabitants was followed by a phase evaluating the actions by measuring energy consumption levels. The results of this pilot initiative are being used as a starting point for a larger scale project starting in 2005.
- On the federal level, accessibility sheets for public buildings have been made available. The purpose of the cards is to facilitate modal shift from cars to other modes of transport by making better information on the alternatives available. The visitor finds information, such as a map with the precise location of the building, the public transport time schedules to get there, the location of the nearest bus stop or train station, the possibility of parking a bike, etc.

Large-scale campaigns

On top of information and training initiatives, information campaigns are often a well-chosen strategy to get a given message across to 'the man in the street'. These campaigns often involve temporary, strategic alliances between public- and private-sector actors, non-governmental organisations and the media, in an effort to bridge the gap between scientists, technicians and the public on complex issues such as climate change. Some examples of nationwide, regional or local awareness raising campaigns in Belgium follow.

- The Soltherm[98] action plan initiated by the Walloon Region seeks to promote solar energy. Various tools and strategies are used: information dissemination (brochures), free services (advice through the Walloon Region local information stands), financial aid (investment grants) and an economical, quality network of producers, installers and architects.
- 'Impact of climate change in Belgium' was published in 2004. This outstanding report was commissioned by Greenpeace and coordinated by UCL university[99]. The publication was given considerable press coverage and as such contributed to creating public awareness.
- In the Brussels-Capital Region, the Brussels Institute for Environmental Management (IBGE/BIM) organises an annual campaign on rational use of energy, as well as a campaign to promote grants for energy-saving investments.
- In Flanders, the ROB (Calm on the road) campaign promotes environmentally friendly driving. The accompanying website[100] offers various tips, a forum for local municipalities to share experiences and campaign materials.
- As with the first Plan, the release of the second Federal Plan for Sustainable Development 2004-2008 has been seized as an opportunity to make the general public aware of sustainable development issues. Three of the six main themes addressed in this Plan are directly related to climate change: managing natural resources responsibly, combating climate change and developing a sustainable transport system. As required by law[101], the draft of this plan was submitted to a public consultation. This consultation round took place between 15 February 2004 and 14 May 2004 and was accompanied by a large-scale information campaign. A few numbers reveal the scope of this effort:
  - 25 000 printed copies, 3 000 CD-ROMs and 8 440 downloads of the document were distributed;

[98] http://www.iwallon.be/soltherm
[99] http://www.climate.be/impacts
[100] http://www.ikbenrob.be
[101] The law of 5 May 1997 on coordination of the Federal Policy for Sustainable Development.

- 108 public debates were held throughout the country;
- A large-scale media campaign (newspapers, magazines, radio, etc.) was launched, 5 100 posters were printed and distributed, and a special website[102] was created.

- In 2003, the pilot action 'Chasse au Gaspi' (Tracking down Waste) was launched. Initially, about 100 households in the Walloon Region agreed to implement the recommendations set out in the 'Action Manual for Energy Saving'[103] and to observe the evolution of their energy consumption during a three–month period. In 2004, 37 households agreed to take the experiment further. The project illustrated that substantial energy savings can be reached without big investments or loss of comfort: the participating households, although already sensitive to the climate issue, managed to reduce their CO_2 emissions by another 7.5%. Throughout the action, 'Chasse au Gaspi' was widely covered by the print and audiovisual media.

- Since 2002, a yearly event called Energy Day is organized in the Walloon Region. On this occasion, about 100 households, companies or municipalities open their doors to the general public to present the energy saving techniques they have introduced while maintaining their comfort and cost efficiency. In conjunction with the public transport companies, several 'discovery routes' leading visitors to some of the participating initiatives are traced. This one-day campaign attracted some 11 000 visitors in 2004 and about 12 500 in 2005.

- In the framework of European Mobility Week, held yearly from 16 to 22 September, a range of activities and campaigns are organized in Flanders, Brussels and the Walloon Region[104]. Numerous organisations, cities, municipalities, schools and transport companies make an effort to create widespread interest in the use of public transport, car sharing and environmentally friendly means of transport (walking, biking). The highlight of this campaign is the one-day restriction on the use of motor vehicles in (parts of) many cities and municipalities. In general, the different regions are stepping up their cooperation and the national level is harmonising Mobility Week campaigns. The following are a sample of some of the many activities held in 2005:
  - The Bond Beter Leefmilieu[105], the umbrella organisation of some 125 environmental groups in Flanders, conducted the Biking to Kyoto campaign[106], encouraging businesses and local administrations to motivate as many of their employees as possible to travel to work by bike. Participating companies or administrations contribute at least € 0.025 to a Kyoto fund for every kilometre travelled by bike.
  - In the Brussels-Capital Region, the Car-Free Sunday in 2005 was matched with free use of public transport and admission to the Brussels heritage days, 'Brussels, a 175-year-old capital'. Many activities such as pedestrian and bike tours, activities for children, exhibits on mobility and so on are organised in the 19 municipalities of Brussels.
  - In the weeks prior to the Mobility Week, the Flemish government conducted a roadside billboard campaign on the theme of using public transport to avoid traffic jams. It included a TV advertisement broadcast by all the major channels.

- Since 2000, the Flemish Region has annually conducted two to four large-scale media campaigns to promote the rational use of energy. The campaigns basically announce the different grants available for energy saving behaviour, such as the distribution nets, tax measures, the encouragement of energy efficient building and renovation or the announcement of the energy performance regulation that will be introduced in 2006. The energy website[107] of the Flemish government's Natural Resources and Energy Department plays a key role in these campaigns and gives an overview of all energy grants, up to municipality level. The campaign slogan is straightforward: 'Saving energy: you and the environment both gain!'

- Since 1998, the Flemish Region has annually declared October Energy Saving Month. This campaign spotlights all energy efficiency initiatives through study moments, media and press coverage, entertaining activities, etc.

Professionals and businesses

Various professionals are directly concerned with climate change, its causes and possible solutions: architects, car manufacturers, insulation experts, mobility managers, engineers, installers, heating experts, etc. In training provided for these specific target groups, the necessary attention should be given to the climate change issue. Another specific field of action for training and awareness raising is the daily functioning of all public sector administrations, private sector businesses and small and medium enterprises. Here again, the climate impact of this functioning should be underlined in awareness-raising actions for employees, usually carried out by the energy or mobility manager concerned. This section out-

[102] http://www.plan2004.be
[103] The manual can be downloaded at http://www.negawatt.be/fond_documentaire/viequotidienne_vieaubureau/manuelchassegaspi.pdf
[104] http://www.komimo.be (Flanders); http://www.dimanchesansvoiture.irisnet.be (Brussels); http://semaine.mobilite.wallonie.be/wasemo_2005/login.do (Walloon Region)
[105] www.bondbeterleefmilieu.be
[106] http://www.bblv.be/fnk/
[107] http://www.energiesparen.be

lines different initiatives that focus on both of these spheres of action.

- The Walloon Region organises several training programmes to improve the quality of thermal insulation in buildings. The target group consists of architects, energy managers in public buildings and teachers in vocational schools training carpenters and bricklayers. The following list of sectors shows the training actions or tools offered:
  - Architects: training on solar water heating, training in the framework of the Building with Energy initiative, practical guides, CD-ROMs (on the climate and construction, DENIBE, Energie+[108]).
  - Construction firms: practical guides, training provided by the FVB/FFC, the Foundation for Professional Training in Construction[109].
  - Suppliers and installers of solar water heating equipment: training and consent to guarantee the quality of supplies.
  - Study materials: information seminars and tools such as technical publications, tools specific for CHP and large solar water heating systems.
- The quarterly 'Le Reactif' ('The Active Energy Manager) is published by the Walloon Region and targets first and foremost a specialised public from the industrial and tertiary sectors: energy managers, architects, engineers, installers, etc. This public has been enlarged to include all private and public decision makers involved with energy management in one way or another. The magazine consists of two separate parts: a general section on the strategic questions of the day and a second, more technical part containing specific and technical information for all those intervening in industries or on tertiary sector premises, or using renewable energy sources or CHP (Combined Heat & Power). In 2004, around 34 000 copies of 'Le Reactif' were distributed.
- The Brussels Institute for Environmental Management (IBGE/BIM) develops tools to be used by professionals or in certain economic sectors. An example is the IBGEBIM-K software tool for architects, used to estimate the overall insulation picture of a building. Another example is the energy consulting procedure that can be used to execute an energy audit in half a day. Specific training is also organised, including the 'energy management' course for energy managers in private or public sector buildings. Other training subjects include energy accounting, mobility management of an enterprise and environmental management of a company's car fleet.
- The Walloon Region helps enterprises to reduce their energy consumption in a number of ways. First, a handbook entitled 'Why and how to initiate energy management in my business', is disseminated, matched with financial incentives such as subsidies and grants. Second, facilitators specialised in the industrial, tertiary, CHP, biomethanisation, hydro-electricity and other sectors can be consulted. Finally, specific workshops are organised to promote the rational use of energy in industry and tertiary sector firms and in small and medium-sized enterprises. In 2004 for example, the following information sessions for enterprises were held:
  - Energy price, CO_2 market and Green Certificates – How to invest in RUE (Rational Use of Energy) in a context of uncertainty? (13 February 2004)
  - Assessment and perspectives for the liberalisation of gas and electricity markets in the Walloon Region. (28 April 2004)
  - Optimising heat flux management. (04 June 2004)
  - Renewable energy in industries – How to respond to challenges to reduce CO_2 emissions? (05 October 2004)
- The diffuSER programme was a support service for key Walloon consultants in the energy field (Energy Department of the government and the 12 energy information stands) that ran from January 2002 to December 2004. These agents were trained for their task of disseminating information on renewable energy sources. An assessment of the outcome of the programme was made for 2004:
  - Answers to 800 questions.
  - The drafting of 25 information sheets presented on the APERe website[110] (consulted at a rate of 3 000 downloads per month).
  - The preparation of 24 sheets commenting on existing case studies in the Walloon Region (consulted at a rate of 600 downloads per month).
  - The preparation of three files: 'Renewable energy in the Walloon Region', 'Heating with wood' and 'Wood-energy'.
  - The organization of five training sessions (solar heating for swimming pools, heat pump, biomethanisation, hydro-energy and wood-energy).
  - Participation in 21 activities covering the entire Walloon Region.
- The Eco-dynamic Enterprise label was initiated by the Brussels Institute for Environmental Management (IBGE/BIM) in collaboration with 13 other partners. The label offers public, regional-level recognition and is awarded for three years to enterprises implementing an environmental management scheme based on the continuous improvement principle, in all environmental fields, including energy and mobility. Amongst other things, the selection criteria include the existence of energy accounting, technology choices for air conditioning and energy consumption, encouragement of energy-saving behaviour, alternatives to the use of individual passenger cars, etc.

[108] http://energie.wallonie.be/energieplus
[109] http://www.laconstruction.be
[110] http://www.apere.org

- In the Brussels and Walloon Regions, training for mobility advisers has been put in place for a professional public (municipality mobility managers, traffic technicians, public transport actors, etc.). It aims to develop awareness of mobility, to stimulate a multi-modal approach to transport and to create a 'common language' between the different players in the field. In parallel with these activities, a documentation centre and information dissemination activities have been initiated.
- The Flemish government is organising large-scale training projects in 5 provinces for architects, engineers and professionals from the construction sector on the energy performance regulations entering into force on 1/1/2006. So far, the training has been followed by more than 1000 people. The training provides further explanations on the use of the energy performance software (beta 0.3 version). The training package consists of 5 modules. A first module outlines the general framework of the energy performance regulations, a second module relates to the ventilation systems in residential buildings and non-residential buildings. The third module deals in greater depth with the energy performance calculation for residential buildings, the fourth module does the same for offices and schools. The fifth module finally is specifically devoted to transmission losses.
- The Flemish government and the sectoral federations organise a number of information meetings for companies wishing to sign up to the audit covenant for companies. Flemish companies can still sign up to 10 December 2005.
- As regards the application of sustainable energy in Flanders, the Flemish government is working on drawing up a quality charter for the installation of solar boilers, heat pumps and photovoltaic solar panels.
- In Flanders, study days and training are organised continually by the government and by employers' organisations, training centres and associations on a variety of topics, such as CHPs, sustainable energy, process optimisation in industry, lighting, ecology premium, etc.
- The Flemish government has issued publications for the target group of professionals:
  - building with photovoltaic solar panels (for architects)
  - energy saving in the laundry sector
  - energy saving in catering
  - energy saving in horticulture
- In Flanders, companies are eligible for an ecology premium if investments are made in certain energy-efficient technologies. The Flemish distribution network managers also have an extensive subsidisation programme.

A premium tool has been developed on the website www.energiesparen.be for all energy premiums for which companies are eligible.

The way forward: Decade of education on SD

In December 2002, Resolution 57/254 on the United Nations Decade of Education for Sustainable Development 2005-2014 (DESD) was adopted by the United Nations General Assembly. UNESCO was designated as lead agency for the promotion of this major initiative, launched on 1 March 2005[111]. The overall goal of the DESD is to integrate the values inherent to sustainable development into all aspects of learning and to encourage changes in behaviour that allow for a more sustainable and fairer society for all. Its agenda addresses the complexity of today's world, places itself at the crossroads of many disciplines and of course comprises education and training on climate change. The specific skills the DESD seeks to enhance, moreover, all are highly valuable in the drive to alter citizens' behaviour in the transport and energy fields: critical and creative thinking; oral, written and graphic communication; collaboration and cooperation; conflict management and resolution; participation in civic activities, etc.

There is no universal model of education for sustainable development. Within the DESD framework, each country has to define its own priorities, actions, goals, emphases and processes, in order to respond to the local environmental, social and economic conditions in culturally appropriate ways. In Belgium, the first steps to draw up national and/or regional strategies have been taken.

In the Flemish Region, a discussion platform focusing on the DESD and closely linked to the existing EE network is being put into operation. Among its initial tasks are the development of indicators for education and of an inventory of existing educational projects. A first concrete field exercise for the DESD was the 'Verdraai De Wereld' project[112], coordinated by the Globelink organisation[113] and launched in August 2005. For one year, sustainable development is the overarching theme for 10 Flemish youth movements, and will thus reach some 250 000 children and young people. This central theme will be the focus of the daily action of each youth network and will serve as the starting point of certain common events and actions.

In the Walloon Region, a first major event was the DESD launch forum, held in June 2005[114]. The event brought together the different actors involved in the educational process (organisations, education, media, museums, cultural institutions, government, etc.) and to encourage the development of synergy and partnerships across disciplines and sectors. About

[111] http://portal.unesco.org/education
[112] http://www.verdraaidewereld.be
[113] http://www.globelink.be
[114] http://www.educa21.net/custom/forum-juin

200 participants from almost 100 organisations attended some of the 30 workshops. A second initiative in the DESD framework, called 'My dish - my planet'[115] was held in autumn 2005. During two weeks, a wide range of projects or tools (educational tools, inter-school activities, etc.) were offered by some 25 organisations, all of which can be used in primary and secondary schools to raise young people's awareness of sustainable development topics. In addition to these initiatives, a DESD steering committee has been established by the French Community government.

Internet information resources

Several government agencies and administrations share responsibilities for information on climate change, often clearly linked to their own sector, and focusing for example on energy or mobility issues. A number of other societal actors also play an important role in the climate change issue and in efforts to disseminate information to their target groups and members. Many of these resource entities have been mentioned in the previous sections. In this section, we present a non-exhaustive list of the main information websites in Belgium for matters concerning the environment, climate change, energy and mobility.

Environment in general and climate change

http://www.environment.fgov.be

The portal site of the Federal Public Service Health, Food Chain Safety and Environment contains a section on climate change, including general information, relevant legislation and links.

http://www.mina.be

This is the website of AMINAL, the environmental administration of the Flemish government. A special Air unit is responsible for the subject of climate change and has a separate website:

http://www.vlaanderen.be/lucht

This is the official website on the air policy of the Flemish environmental administration, with an extensive section on its climate policy, including all the documents of the Flemish Climate Conference.

http://www.vmm.be

The VMM (Flemish Environment Society) is one of the public administrations in the Flemish Region responsible for preparing and adapting environment policy. One of VMM's tasks is to report on the quality of the environment in general and on air and water quality in particular.

http://www.milieuinfo.be

Portal website and guide to all environment-related official information and public administrations in the Flemish Region.

http://www.ibgebim.be

The Brussels Institute for Environmental Management (IBGE/BIM) is the administration for environmental and energy matters in the Brussels-Capital Region. This institute plans, provides advice and information, issues licenses and carries out controls in different policy fields (among which air quality). The website offers information on all environment related subjects. An information line is also available. Since 2005, energy facilitators have been selected by the Brussels-Capital Region and can be consulted by individuals or institutions seeking to improve the energy performance of their buildings and activities.

http://environnement.wallonie.be

Portal website for environmental matters in the Walloon Region, managed by the DGRNE (Directorate-General Natural Resources and the Environment).

http://www.irceline.be

The Belgian Interregional Unit for the Environment (IRCEL-CELINE) provides information on ambient air quality in the Belgian regions. The website contains a daily ozone-bulletin based upon information collected at different measurement points, as well as archives (since 1998) of this data. Every half an hour, the air quality (O_3, NO_2, CO, SO_2, PM10 and PM2.5) is measured and published on the site).

http://www.climat.be &
http://www.klimaat.be

This website of the Federal Environment Administration presents information on federal initiatives in the field of climate policy, as well as an overview of recent data on greenhouse gas emissions and general information on global warming.

Energy

http://www.energie.mineco.fgov.be

This website of the Federal Energy Administration presents information on its energy-related responsibilities, including renewable energy (technologies, actors, financial regulations, legislation, statistics, links, etc.)

http://www.energiesparen.be

The Flemish government's Natural Resources and Energy Department has a website which abundantly documents all aspects of the energy question: Flemish energy policy, RUE, statistics, subsidies, environmentally friendly energy production, etc. Different sections offer diversified information for specific target groups (households, government, businesses, architects, schools and associations). Brochures on RUE (insulation, ventilation, energy audits, heating, practical tips, etc.) and sustainable energy (biomass, CHP, solar energy, heat pump, etc.) can be downloaded. Every year, the website has about 200 000 visitors.

http://www.energie.wallonie.be

In the Walloon Region, the website of the DGTRE, the Walloon Region Energy Department, offers abundant information on all issues related to energy. Twelve en-

[115] http://www.monassiettemaplanete.be

ergy information stands also provide practical information and audits to individuals willing to use energy in a more efficient and rational way. The stands are scattered across Walloon territory and offer a free and independent service to all private individuals. The Walloon Region Energy Department manages the development of the network and provides continuing theoretical and technical-commercial training for the 28 consultants. The themes dealt with are heating, the preparation of sanitary hot water, the insulation of the building exterior, ventilation needs, rational use of electrical household equipment and renewable energy sources, bio-climatic renovation, etc. A wide range of tools can be consulted by the public: brochures, specialised manuals, quantitative and qualitative audits, articles in local press, etc.

http://www.curbain.be

In the Brussels-Capital Region, an information desk is run by the Urban Centre. It provides advice to the general public on energy saving possibilities and renewable energy use. Residential energy audits are offered for free.

http://www.emis.vito.be

EMIS, the Energy and Environment Information System, is a project of the Flemish Region. The system collects and treats a broad spectrum of energy and environment related information, structured in four parts: energy numbers, business guide, environmental technology and legislation.

http://www.ode.be

The Organisation for Sustainable Energy (ODE) is the central source of information on renewable energy in Flanders, for households as well as enterprises. The ODE has a permanent secretariat for the general public. Other activities include the publication of quality brochures and the monitoring of the proportion of renewable energy in energy consumption in Flanders.

http://www.bbri.be/webcontrole

This nation-wide website gives information on legislation, regulations, subsidies and procedures related to thermal insulation and ventilation of buildings.

Mobility

http://www.mobilit.fgov.be

This website of the Federal Government Administration for Mobility and Traffic explains how the mobility issue is framed in the federal sustainable development policy. It also publishes the level of carbon dioxide emissions of different vehicle models.

http://statbel.fgov.be/port/mob_fr.asp

This is the National Institute for Statistics' portal site for all traffic and mobility related studies, numbers and statistics. Sections on mobility and environment and on climate and greenhouse effect are accessible.

http://www.mobielvlaanderen.be

The Flemish Region has set up this website to inform the public on different aspects of mobility: abundant information is to be found on public transport possibilities, freight-traffic, home-work traffic, the mobility policy at different political levels, statistics, etc.

http://mobilite.wallonie.be

This is the website used by the Walloon Region to communicate its mobility policy and to disseminate information on all mobility issues. Links are provided to the Network of Mobility Advisors, the Mobility Week campaign, the Mobility Documentation and Diffusion Centre, alternative forms of mobility (cycling organisations, car sharing groups, etc.) and the accessibility sheets.

http://www.bruxelles.irisnet.be/nl/citoyens/home/mobilite_a_bruxelles.shtml

The website of the Brussels-Capital Region has a special section on mobility, informing citizens on different ways to get around in the city-region.

http://www.bondbeterleefmilieu.be/wijsopweg/index.php

'Wijs op Weg' (Wise on the Way) is the sustainable mobility website of the Bond Beter Leefmilieu, the umbrella organisation of some 125 environmental groups in Flanders. Abundant information, tips and links are provided to demonstrate that comfortable and inventive mobility can be reconciled with environmentally friendly behaviour.

http://www.uwe.be/mobilite

This website is administered by the mobility unit of the UWE, the Walloon Union of Enterprises. The unit advises and assists companies in their analysis and practices in the field of sustainable mobility of persons and goods. Information is provided on Business Mobility Plans (integrated schemes to optimise mobility), different modes of transport (walking, cycling, car sharing, public transport), the role of mobility coordinators in enterprises, teleworking, etc.

BELGIUM'S FOURTH NATIONAL COMMUNICATION

Under the United Nations Framework Convention on Climate Change

This report was prepared in collaboration with :

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Edited by the National Climate Commission
- January 2006

Published and distributed by the Federal
Public Service Health, Food Chain Safety
and Environment

Place Victor Horta 40 Box 10,
B-1060 Brussels, Belgium

Legal Deposit: D/2006/2196/4

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and Dutch.

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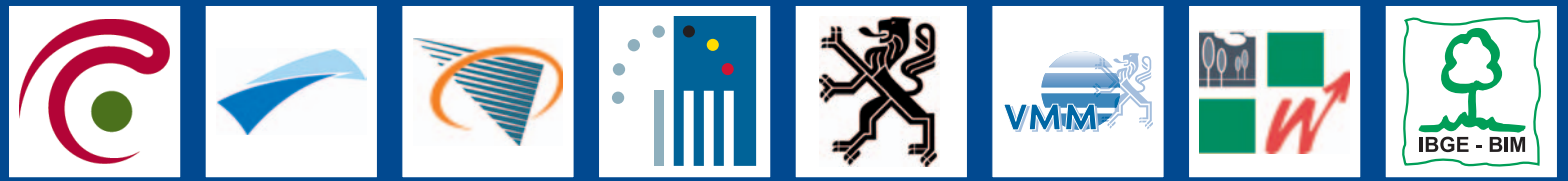
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