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Report on the in-depth review of the first and second national communications
of Belgium

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. In Belgium, the in-depth review team had the unique task of reviewing both the first and second national communications (NC1 and NC2). Due to the complex distribution of competences between the different levels of federal, regional and local government in Belgium, the UNFCCC was only ratified at the beginning of 1996. Subsequently, Belgium submitted its NC1 in January 1997 and the NC2, which represents an update of the information included in the NC1, in August 1997. An in-depth review of the NC1 and NC2 was carried out between January 1999 and December 1999, including a visit to Brussels from 1 to 5 February 1999. The review team consisted of Prof. Ayete-Lo Nohende Ajavon (Togo), Dr. Olga Pilifosova (Kazakhstan), Ms. Serena Adler (Romania), Mr. Michel Raquet (European Community) (EC) and Dr. Katia Simeonova (UNFCCC secretariat, coordinator).

2. Belgium is located on the south-east coast of the North Sea. Its territory covers 30,750 km², of which 21 per cent or around 6,460 km² was forest in 1997. The climate is maritime, with moderate temperature changes and an average temperature of 9.8°C. Winds are predominantly westerly and there is regular precipitation. The population has been increasing by 0.18 per cent annually since 1982, reaching 10.14 million in 1996, 97 per cent of which lived in urban areas. The Belgian economy is small and open, and the country ranks ninth among world exporters. The major export goods are iron and steel products, cars, primary plastics and organic chemicals. The gross domestic product (GDP) grew by an average of 1.6 per cent annually between 1990 and 1995, though in 1993 it fell by 1.4 per cent as a result of a recession. In 1997, GDP reached BF 8,370 billion (US\$ 269 billion), having grown by 1.5 and 2.9 per cent in 1996 and 1997, respectively.¹ In 1997, the Government launched an austerity programme to push its budget deficit below 3 per cent in order to qualify for European Monetary Union. It was expected that economic growth would accelerate in 1998 and 1999, with inflation remaining below 1.5 per cent and unemployment continuing to fall. Services were by far the most significant sector of economy. In 1997, they contributed more than two thirds of the GDP, followed by industry and finally by agriculture, which made up only a few per cent of GDP.

3. Historically, coal was the only important indigenous energy resource in Belgium, but coal mining and coal use have been declining gradually during the last two decades. In the same period, Belgium has developed both its nuclear industry and its natural gas network. This network supplies gas to domestic consumers and transports natural gas in transit to neighbouring countries. These changes partly offset the impact of growing use of oil products in transport and residential heating on the carbon intensity of the total primary energy supply (TPES). TPES grew by 8.2 per cent, from 48.4 million tonnes oil equivalent (Mtoe) in 1990 to 52.4 Mtoe in 1995, primarily because of the growth of gas and oil supply by 29 and 12 per cent, while the supply of coal dropped by 11 per cent and that of nuclear energy remained broadly the same for the entire period. In 1995, oil and oil products accounted for the bulk of TPES (40.1 per cent), followed by nuclear power and natural gas with almost equal shares (20.6 and 20.3 per cent),

¹ In 1997, the exchange rate was around BF 31.11 to the United States dollar.

coal (17.3 per cent) and a small share of renewables, including large hydro and waste incineration (1.8 per cent). As for final energy consumption, growth in the residential, commercial and public sectors reached 20 per cent in the same period. In the transport sector the increase was around 10 per cent, while in industry it was only 3 per cent.

4. The team gained the impression that climate change policy-making in Belgium can only be understood in the context of the 1988 institutional reform. This reform was a milestone in the process of the devolution of power from the central government to the regions, initiated in the early seventies. It was triggered by the 1988 Institutional Reform Act, under which Belgium became a federal state with significant delegation of powers to the regional governments of Flanders, Wallonia and Brussels. The implications of the reform for climate change are briefly that there is an extremely complex system of distribution of competences, in which different aspects of climate-related policies, such as policies on the environment, energy, transport, agriculture, science and forestry are handled by different levels of the government. Price and taxation policy, and education policy are the only two exceptions in this regard, competence for the former lying with the federal Government only and for the latter with the Communities. Other issues dealt with by the federal Government include national equipment programmes, large infrastructure for energy storage, transport and distribution, nuclear fuel cycle, and research and development. The regions are responsible for transport and distribution of energy (up to 70 kV), distribution of natural gas, renewable energy and energy efficiency. Municipalities have a monopoly over the electricity and gas distribution and many local authorities have been involved in the preparation of local transport plans.

5. Belgian climate policy is formulated through an extensive consultative process, with involvement of all the key agents through the mechanism of inter-ministerial conferences and working groups. In particular, the inter-ministerial conferences on the environment, economy and energy, serve as forums to discuss different aspects of climate policy and to reach consensus. The opinion of the major stakeholders, e.g. industry, academic institutions, trade unions and green non-governmental organizations, is sounded mainly through the Federal Council for Sustainable Development, set up by law in 1997. The council works by providing the Government with advice on specific issues upon request by the federal Government or on its own initiative. The NC1 and NC2 were prepared by the Greenhouse Effect Coordination Group, which is one of the working groups of the Inter-Ministerial Conference on the Environment. At the beginning of 1997, a decision was taken to streamline the work of the group, stressing the role of regions by giving them the political mandate to negotiate. The team felt that while the institutional arrangement on climate change seems adequate, given the complex distribution of competences, further strengthening of the institutional framework and enhanced coordination and cooperation are needed, among regions on the one hand and between regions and the federal Government on the other, along with the allocation of more resources.

6. The evolution of the greenhouse gas (GHG) emission reduction target is one of the key characteristics of climate policy in Belgium. In 1991, the federal Government took a decision to adopt as the national target a 5 per cent reduction in energy-related carbon dioxide (CO₂) emissions between 1990 and 2000. In 1994, this target was reiterated by the federal and regional

governments and the National Programme for Reducing CO₂ Emissions (NPRE) was prepared by a number of working groups, including a Transport group, an Energy group, a CO₂ Tax Policy group and a CO₂ Science Policy group with the aim of achieving this target.² Finally, under the EC burden-sharing agreement, the target agreed for Belgium calls for a 7.5 per cent reduction in the total of all six gases covered by the Kyoto Protocol for the first commitment period of 2008-2012.³

7. The NC1 clearly indicated that the implementation of the NPRE alone will not be sufficient to reach the national target, as almost half of the necessary reduction in emissions was expected to come from the combined carbon/energy tax.⁴ However, this tax has never materialized in Belgium. Furthermore, other measures envisaged in the NPRE have not been implemented, while those implemented have failed to deliver the effect expected (renewables, energy efficiency and natural gas). As a result, emissions have continued to grow. In 1996, they reached 128,550 Gg CO₂ according to the recent inventory, against 115,800 Gg in 1990 (121,100 Gg adjusted emissions) given in the NC1, which indicates that it would be unrealistic to expect the 5 per cent reduction target to be reached before 2000. The team noted that the attention of policy-makers was geared to the post-2000 period and that a new Policy Plan for Reduction of GHG Emissions, due by the end of 1999, was expected to lay down in a single framework all the policies necessary to achieve the target under the Kyoto Protocol. Another plan under preparation in 1999 was the Sustainable Development Policy Plan, in which climate change was expected to be one of the key issues.

8. In the international context, Belgian officials underscored the role of climate policy coordination within the EC, given that Belgium has a small and open economy. Issues related to carbon/energy taxation, minimum energy efficiency standards, modal shift in transport and an agreement on fuel economy with the automobile industries were seen as priorities for such coordination. In this context, it will remain of the utmost importance for Belgium to find the right balance between national policies and international cooperation in achieving its emission targets.

9. After a week of meetings with host country officials, the team concluded that the information in both the NC1 and NC2 is consistent. The team learned also about a great number of new activities that had taken place in the country, especially after the Kyoto Protocol was adopted. The present report therefore presents an analysis of the information included in the NC1 and NC2, together with the new information made available thereafter. Finally, the team

² The 5 per cent reduction target refers to temperature-corrected baseline emissions, i.e. it is set at 115,100 Gg CO₂.

³ The 7.5 per cent reduction target (not temperature-corrected) was agreed on the condition that both national and EC-wide policies are implemented.

⁴ The combined energy/carbon tax assumed introduction of an EC-wide tax at the level of US\$3 per barrel of oil equivalent (boe) in 1996 and US\$10 per boe in 2000.

concluded that, in presenting information in the NC1 and NC2, Belgium had adequately adhered to the reporting guidelines. Due to the short time between the publication of the NC1 and NC2, the latter did not follow the guidelines strictly, but rather updated information on the GHG inventory using the Intergovernmental Panel on Climate Change (IPCC) Revised 1996 Guidelines for National Greenhouse Gas Inventories, and added projections of methane (CH₄) and nitrous oxide (N₂O) to those of CO₂ given in the NC1. The most important deviations from these guidelines were: lack of emission estimates following the IPCC reference approach and the worksheets on energy, and land-use change and forestry, lack of information on the effect of individual policies and measures, and indicators of progress, and lack of the tables with information on financial assistance and technology transfer.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

10. The Belgian inventory presented in the NC1 for the period 1990-1994 comprehensively covered emissions by source and removals by sinks. It included emission estimates of the direct GHGs: CO₂, CH₄ and N₂O; of indirect GHGs, or precursors, such as nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs); and initial estimates of hydrofluorocarbons (HFCs). Historical emission estimates for the 1990-1994 period were updated in the NC2 and emission data for 1995 were added. The 1998 report *Inventory of Greenhouse Gas Emissions in Belgium, 1990-1995/1996* (referred to below as the “recent inventory submission”) contained the most recent inventory data. This report extends the coverage of the GHG inventory to industrial gases such as perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) as well as HFCs.

11. In 1994, a special emission inventories group was set up by the CO₂ Science Policy group, with the main task of estimating GHG emissions and compiling the inventory for the NC1. The group was composed of representatives from the following federal and regional authorities: Federal Office of Scientific, Technical and Cultural Affairs, Federal Department of the Environment, Flemish Environment Agency (VMM), Walloon Directorate-General for Natural Resources and the Environment (DGRNE), the Brussels Environmental Management Institute (IBGE/BIM), the Interregional Cell for the Environment (IRCEL/CELINE), Federal Planning Bureau, Federal Ministry of Economic Affairs, Institut Wallon and Flemish Institute for Technological Research (VITO). Individual experts also participated in the group. For the NC2 and the recent inventory submission, the assessment was done by a smaller Emissions group of the Coordination Committee for International Environmental Policy (CCIEP) with the active participation of VITO and experts from VMM, DGRNE, IGBE/BIM, IRCEL/CELINE and the Federal Department of the Environment. The review of inventory data and results was done by a number of CCIEP working groups, in particular by the Greenhouse Effect Coordination Group. Final approval of inventory results was given at ministerial level by the Inter-Ministerial Conference on the Environment.

12. The GHG inventory results reported in the NC1 conform with the UNFCCC guidelines, based on the IPCC Guidelines. For reporting in the NC2 and in the recent inventory submission, the 1996 Revised IPCC Guidelines were used. The team noted that the NC1 and NC2 contained

only summary tables with inventory results, which were provided together with selected emission factors and activity data (energy balances). In the recent inventory submission, the overview tables with uncertainty estimates of the inventory data were missing, due to the lack of such estimates at national level. Indeed, the team found that the very complex approach to compiling the GHG inventory in Belgium makes it difficult to come up with reliable estimates of uncertainties at the national level. Nonetheless, the NC1, NC2 and the recent inventory submission contain a great deal of information on methodology used, and procedures for data collection and for selecting emission factors, which contribute to the transparency of the inventory. Moreover, the team acknowledged the effort of the Brussels region to produce and publish a GHG inventory containing all the primary information following CORINAIR methodology.

13. At the national level, estimates of CO₂ emissions from the energy sector were produced using the national energy balances, IPCC default emission factors and national methodology, which is close to the IPCC top-down methodology. The team was informed of an approach and associated activities to prepare CO₂ emission estimates by region based on existing energy balances of the Walloon and Brussels regions and the outcome of a project in the Flemish region to draw up its own energy balance. According to this approach, after the inventory is prepared by region, the national inventory is based completely on regional inventories; for the 1999 annual inventory, such an entirely regional-based approach was followed. It was planned also to use country-specific emission factors, where possible. Estimates of non-energy related GHG emissions and energy-related non-CO₂ emissions were provided by all three regions using CORINAIR methodology, and compiled thereafter at national level. The team acknowledged that different approaches to estimating the GHG inventory by regions and at national level made the task of compiling the national inventory and recalculating the time-series difficult.

14. Most of the activity data used for the national GHG inventory were taken from the national energy balances prepared by the National Statistics Institute and published by the Ministry of Economic Affairs. However, the national balances contain limited information on energy balances at the regional level, necessary to calculate the inventory of the regions. Hence, the regions prepared their own energy balances, with sometimes slightly different end-use sectoral structure and fuel type. In this exercise, VITO ensured the consistency of data among regions necessary to obtain the national totals, and improved quality of these data. Activity data on non-energy CO₂ emissions and ozone precursors are compiled by the regions employing their CORINAIR databases. Activity data to estimate emissions and sinks from agriculture, and from land-use change and forestry came from the national statistics prepared by the Federal Agricultural Economics Institute. The forest inventory is carried out once every 10 years, the most recent one dating from 1990. Forestry statistics were available also at the regional level but not for all regions.

15. Different sources and approaches have been used to obtain the emission factors. Broadly, emission factors used for energy-related CO₂ emissions were taken from the IPCC, while factors used for non-energy CO₂ and other GHGs were taken from CORINAIR. For some emission sources, such as the iron and steel industry, emission estimates were taken directly from industry.

For other sources, such as emissions from waste, estimates were obtained by measurements. The team noted that, in cases where country-specific emission factors are used, they need to be published and peer-reviewed. The team also noted that the emission factors used by regions sometimes varied widely and hence the emission factors need to be consistent across regions. For instance, to estimate CH₄ emissions from waste incineration, the Flemish region used an emission factor of 3 g per tonne, while the Walloon and Brussels regions used 665 g per tonne. This occurrence was attributed to the fact that the former factor was taken from CORINAIR, while the latter was obtained by measurement.

16. A national method has been used to estimate emissions from transport. It fits the available statistics, takes into account national studies on emissions from transport, and accounts for vehicle type, mileage, type of road and specific fuel consumption. Recently, the COPERT method (of CORINAIR) was used to assess transport emissions by region. Such estimates are available for the Flemish region for the 1990-1997 period and the Brussels region for the 1995-1996 period.

17. Emissions from international aviation and marine bunkers have been estimated annually and reported separately, according to the IPCC Guidelines. To obtain activity data for marine bunkers, fuel use was split between national and international navigation by fuel type, i.e. consumption of light and heavy oil was allocated to domestic and international navigation respectively. For aviation bunkers, given the ratio between domestic and international flights, fuel consumption was exclusively attributed to international aviation. The team noted the high share of bunker fuel emissions compared to total emissions.

18. To estimate non-CO₂ emissions, a kinetic model consistent with the IPCC tier 3 approach was used for emissions from waste and the CORINAIR method was used for emissions from agriculture. Two different methods were employed to estimate forest sink capacity, the IPCC method and a country-specific method elaborated by the VITO. The latter, calibrated by remote sensing data, estimates carbon fixation from all vegetation. In contrast, the IPCC method requires reliable statistics, average growth and expansion factors, and calculates carbon fixation in forests only. A comparison shows that the estimates using the IPCC method are around 10 per cent higher, due to differences in data and uncertainty about growth and expansion factors used in the IPCC method. According to the IPCC method, the forest sink was estimated at 2,057 Gg CO₂ stored, which corresponds to around 1.8 per cent of the total CO₂ emissions between 1990 and 1996.

19. Both the NC1 and the NC2 contained estimates of potential emissions of the new gases, while the recent inventory submission contains also estimates of actual emissions of these gases, including emissions of HFCs, PFCs and SF₆. Although the coverage of sources of these gases seems comprehensive, the estimates are still preliminary due to lack of reliable primary information. Before 1993, such information was available, because there were customs statistics on the import and export of such gases and products which contained them. After 1993, such information was not available any more from customs, and manufacturers were asked to provide the necessary data. To estimate the potential emissions, the total amount of substances and

products containing these gases available on the Belgian market was used. To calculate actual emissions, different methods were applied for different gases, but broadly these methods were based on estimates of leakages and surveys.

20. The total GHG emissions of Belgium for 1990 were estimated at 136,895 Gg of CO₂ equivalent in the recent inventory submission, which is equal to the figure reported in the NC2 and is approximately 2 per cent higher than the estimates in the NC1. The difference stems from revisions of CO₂ estimates only. CO₂ is by far the most important gas in Belgium, with emissions estimated at 114,033 Gg in 1990, or 83 per cent of the total emissions. This was followed by CH₄, which made up 9.7 per cent, and N₂O, which accounted for the rest. Between 1990 and 1996, total emissions grew by 7.2 per cent to reach 146,820 Gg, a growth primarily attributed to the growth of CO₂ emissions by 9.2 per cent and N₂O emissions by 14 per cent, while CH₄ emissions declined by 7.3 per cent.

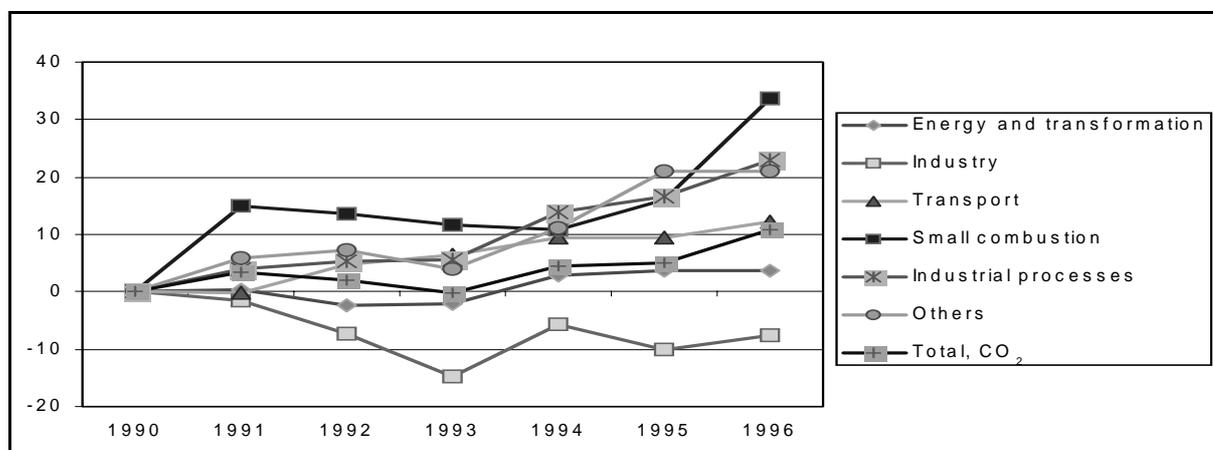
21. The growth of emissions from the residential, commercial and institutional sectors (small combustion) and also from transport contributed the most to the upward trend of CO₂ emissions, while emissions from the energy and transformation industries increased only slightly and those from industry decreased. The relatively high and growing share of emissions from small combustion was attributed to the large and growing number of houses not connected to district heating and the inadequacy of incentives to improve energy efficiency. Moreover, only 20 per cent of the existing building stock complied with the new building codes and fuel oil remained the fuel of choice for space and water heating due to the higher prices of natural gas. As to the emissions from transport, almost 95 per cent of them originated from cars and trucks, the number of which has been growing constantly, as has engine power. In the industrial sector, two opposite tendencies contributed to the drop in emissions. Industrial output and emissions from the iron and steel industries declined as a result of the recession in the early 1990s, whilst investment in new chemical plants and increased productivity of existing ones spurred emission growth from the chemical industry. Mainly due to the low rate of boiler replacement and lack of maintenance, small combustion remained the single most important source of emissions in 1996 with a share of 28 per cent, followed by both energy and transformation, and industry, with equal shares of 22 per cent, and other sources (table 1 and figure I).

Table 1. Carbon dioxide emissions, by source, 1990-1996 (Gg)

	1990	1991	1992	1993	1994	1995	1996
Energy and transformation	28 140	28 232	27 504	27 519	28 953	29 141	29 195
Industry	31 027	30 557	28 746	26 436	29 236	27 908	28 681
Transport	19 964	19 921	20 911	21 238	21 877	21 834	22 390
Small combustion	26 788	30 794	30 424	29 908	29 682	31 053	35 804
Industrial processes	9 188	9 546	9 665	9 706	10 456	10 706	11 287
Other	983	1 042	1 053	1 022	1 093	1 190	1 190
Total CO₂	116 090	120 092	118 303	115 829	121 297	121 832	128 547
Land-use change and forestry	-2 057	-2 057	-2 057	-2 057	-2 057	-2 057	-2 057

Note: "Other" includes emissions from waste incineration.

Figure I. Carbon dioxide emissions, percentage change from 1990, by source



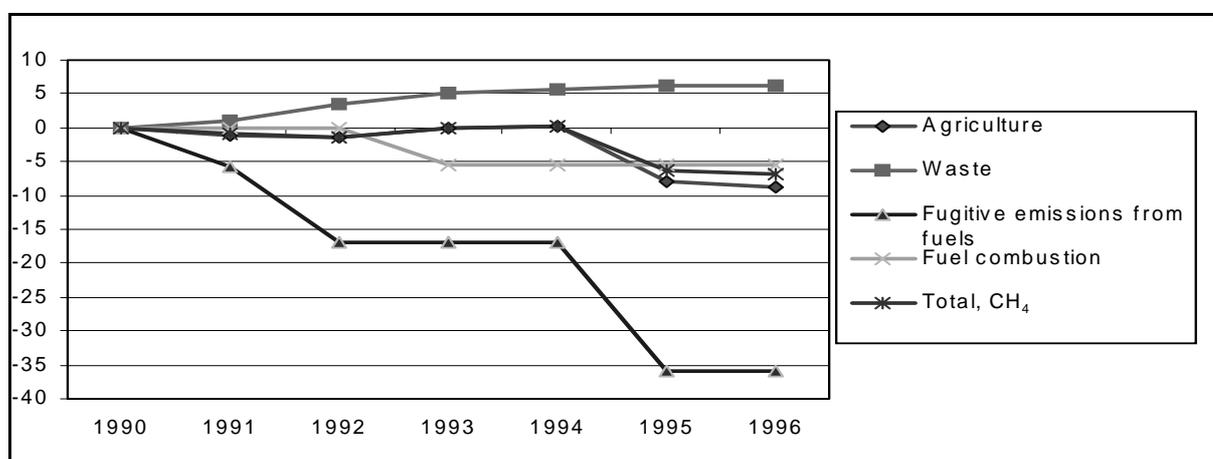
22. The upward trend in CH₄ emissions was mainly a result of an increase in emissions from waste; emissions from agriculture decreased as an indirect consequence of implementation of the EC Common Agricultural Policy and changes in agricultural practice. Agriculture was the main source of CH₄ emissions in 1996, accounting for 60 per cent of the emissions, followed by waste with 31 per cent, and energy and other sectors with 9 per cent (table 2 and figure II).

Table 2. Methane emissions, by source, 1990-1996 (Gg)

	1990	1991	1992	1993	1994	1995	1996
Agriculture	388	384	382	388	389	357	354
Waste	174	176	180	183	184	185	185
Fugitive emissions from fuels	53	50	44	44	44	34	34
Other	18	18	18	17	17	17	17
Total CH₄	634	629	625	633	635	594	591

Note: "Other" includes emissions from fuel combustion and industrial processes.

Figure II. Methane emissions, percentage change from 1990, by source

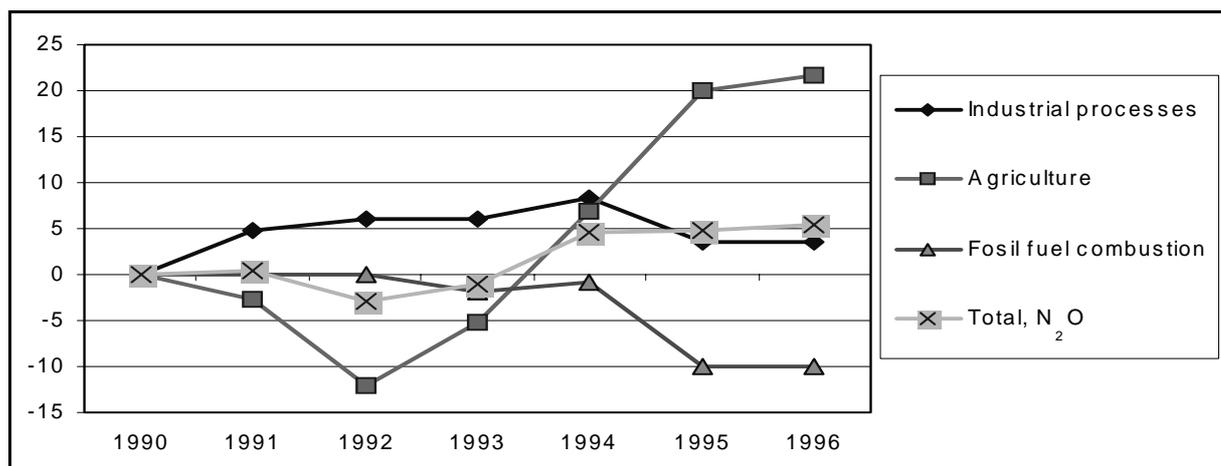


23. The increase in N₂O emissions from 1990 to 1996 resulted mainly from the 22 per cent growth of emissions from industry, while other sectors maintained their emissions broadly constant. Industry was the main emission source with a share of 40 per cent, followed by agriculture 29 per cent, energy 24 per cent, and waste and other sources 7 per cent (table 3 and figure III).

Table 3. Nitrous oxide emissions, by source, 1990-1996 (Gg)

	1990	1991	1992	1993	1994	1995	1996
Energy	8.3	8.7	8.8	8.8	9.0	8.6	8.6
Industrial processes	11.5	11.2	10.1	10.9	12.3	13.8	14
Agriculture	10.9	10.9	10.9	10.7	10.8	9.8	9.8
Waste	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total N₂O	30.8	30.9	29.9	30.5	32.2	32.3	32.5

Figure III. Nitrous oxide emissions, percentage change from 1990, by source



24. The recent submission contained estimates of actual and potential emissions of the new gases only for 1990 and 1996, because activity data were not available for the years in between. Belgium is not a producer of these gases, hence emissions were associated only with their use in the following sectors: HFCs in refrigeration and air-conditioning, foam plastics and aerosol products, PFCs in solvents and SF₆ in sound and electrical insulation. For 1990, actual emissions of these gases on a CO₂ equivalent basis amounted to 533 Gg for HFCs, 73 Gg for PFCs and 333 Gg for SF₆.

III. POLICIES AND MEASURES

25. The NC1 presents an overview of policies and measures envisaged by the NPRES to meet the national CO₂ reduction target. This programme consists of 14 sets of new measures in addition to a number of existing measures, which had already been taken for purposes other than CO₂ emission abatement, i.e. fiscal measures, research and development measures, and measures in electricity and steel production sectors. The approach in preparing the programme was to compile climate-relevant measures at federal and regional levels in a single programme. The NPRES dealt with CO₂ emissions only and had two pillars: energy efficiency and natural gas. The effect expected from the NPRES was estimated at 13,735 Gg CO₂ saved in 2000, split almost equally between the complementary and the existing measures. Detailed information on each of the policies and measures of the NPRES provided in the NC1 explained the objective, responsibilities for implementation and the type of policy instruments. Quantitative estimates of the effect of existing measures were missing and the tables required by the UNFCCC guidelines were not used. The team stressed the importance of monitoring and evaluating implementation and effects achieved, which would help to strengthen the implementation of existing measures or would guide a decision on new measures if and when it appears necessary.

26. Apart from action at the national level, the Flemish region developed its first CO₂ plan in 1994 and subsequently updated it in 1996 in an attempt to rank measures according to their reduction potential and ease of implementation. Another planning tool for climate policy was the Environmental Policy Plans of the Flemish Region. In 1997, the second such plan, called MINA2, was adopted. It envisaged a portfolio of mitigation measures together with financial support, including BF 100 million for CO₂ measures and BF 40 million for CH₄ and N₂O measures. The team was also informed about two ongoing studies on assessing the existing measures and on the impact of the Kyoto Protocol on the Flemish economy. The Walloon region has adopted strategies to support the NPRES implementation, which were aimed primarily at energy efficiency, education and public awareness. Climate change issues were addressed in part in the Environmental Plan for Sustainable Development of the same region. Similarly, the 1995 Regional Development Plan of Brussels streamlined the efforts to address energy efficiency and transport, and hence associated GHG emissions.

A. Carbon dioxide

1. Energy supply and transformation

27. Competence in different aspects of energy policy in Belgium was distributed among the federal Government, the regions and municipalities. The role of the federal Government was to stimulate the dialogue between all these levels of government and to coordinate views in order to adopt decisions by consensus. In this context, a formal body, the Energy Concerting Group (ENOVER/CONCERE) was set up in 1991 under the Inter-Ministerial Conference on Economy and Energy, to enhance the exchange of information, to discuss positions of different levels of government and to coordinate the national position for international negotiations. On climate change, the role of ENOVER/CONCERE was significant as it has served as the national focal

point for joint implementation projects and facilitated voluntary agreements with industry. It has also participated in co-funding some regional initiatives, such as energy certification for buildings, and a seminar on reducing CO₂ emissions from households heating. The group comprised representatives of federal and regional authorities dealing with energy, Belgian representatives to the EC and OECD, and officials from other policy areas.

28. The National Equipment Programme for Electricity Production and Transmission for the period between 1995 and 2005, adopted in 1996 and referred to below as the National Equipment Programme, has been the major tool to plan and direct investment in the energy sector. It envisaged decommissioning 24 units, mainly coal-fired, and replacing them with 1,160 MW of new combined cycle plants within the 1997-1998 period and with 2,250 MW of new plants shared almost equally between combined cycle and coal technology within the 2000-2005 period. No new nuclear plants were envisaged for the period of the plan, but an ownership share of 750 MW in a French plant was foreseen. Additionally, new capacity of 1,000 MW was planned from decentralized plants, mainly from combined heat and power (CHP) and renewables. The team learned that the share of CHP in electric power production was expected to reach 6 per cent in 2005; the future of the new capacity planned for 2000-2005 was however unclear, given the uncertainties with electricity market liberalization.

29. The main electricity generator in Belgium, the private company Electrabel, accounted in 1995 for 88 per cent of electricity generation, with the public generating company, Société Coopérative de Production d'Electricité /Samenwerkende vennootschap voor de Productie van Elektriciteit (SPE), and autoproducers making up the rest. In 1995, Electrabel and the public generating company set up a new company to coordinate and manage the activities of both companies in the field of electricity production, transmission and distribution to large end users. The Belgian electricity sector can thus be characterized as a horizontally and vertically integrated one, the reason for the latter being that both Electrabel and SPE participate in the so-called "mixed intercommunal" distribution utilities, together with the municipalities, which in turn have a legal monopoly for electricity distribution. In the natural gas sector, Distrigas, a private company has a monopoly over supply. Shares in both Electrabel and Distrigas have been acquired by Tractebel, the premier energy group in Belgium.

30. With regard to electricity market liberalization, Belgium obtained a one-year derogation in implementing the EC directive on this matter. Nonetheless, Belgian officials stressed that a legislative framework for this process was likely to be ready by mid-1999. Indeed, by the end of 1998, the regions had reached an agreed position on different aspects of energy market liberalization, which was communicated to the federal Government. At the beginning of 1999, the federal Government prepared an advice on the electricity market liberalization bill, which was subsequently discussed in the federal parliament. The bill envisaged the model of "third party access" and gradual opening of the market, with 2007 set as the deadline for small users to gain access to it. It also aimed at establishing a balance between incentives to invest in new plants and in energy efficiency, and in this sense, it was seen as an opportunity to reinforce energy efficiency policies. Finally, the bill required the current planning tool, the National Equipment Programme, to be replaced by an indicative plan for electricity production.

31. According to the bill, the preparation of the indicative plan for electricity production would be a responsibility of the Commission for Electricity and Gas Regulation, the new regulatory body for the liberalized segment of the electricity market. The indicative plan should be prepared in consultation with the transmission grid manager, regional authorities, the Federal Planning Bureau, Control Committee and the Interdepartmental Commission for Sustainable Development. The indicative plan is seen as a tool to ensure that the issues of energy supply diversification, renewable energy and other environmental objectives such as promoting technologies with low CO₂ emissions receive due attention and the relevant targets are met. In addition, a commission was created with representatives of academic institutions dealing with issues of global warming, nuclear energy, renewables, thermodynamics, fossil fuels, waste incineration, environmental sciences and law, and energy economics to develop a vision of the future of electricity production in Belgium as several nuclear units approach the end of their technical lifetime. The output of this commission was expected to help the Government in taking a decision on the future of nuclear energy in Belgium.

32. The promotion of natural gas was one of the pillars of the NPRE. Together with boiler improvement, it was expected to save around 1,900 Gg CO₂ in 2000. Indeed, the role of natural gas in the Belgian energy sector has become increasingly important over the last decade for two main reasons. Firstly, its contribution to electricity generation was expected to almost double between 1993 and 2000. Secondly, Belgium has a significant gas transmission role within Europe, as over half of the gas passing through the Belgian grid goes to other European markets. Still, consumption of gas by households was at a very modest level. The main reason was the relatively high price of natural gas for households; in 1996, expressed per unit of energy, it was around twice as high as the price of heating oil and was comparable to the price of electricity. Moreover, the connection of private households to the gas grid was expensive. To overcome some of the barriers hindering natural gas penetration in households, the NPRE included a bonus scheme to encourage the shift to natural gas. Although such a bonus scheme has never been implemented at national level, some gas utilities have provided their customers with incentives to promote switching to natural gas.

33. With regard to CHP, the objective set in the National Equipment Programme was to have in place 1,000 MW of installed capacity, which is likely to be achieved by 2000. At federal level, a national system was set up to provide businesses with a 10 per cent tax deduction for CHP investment. As a result, between 1995 and 1998, new CHP capacity of 645 MW was commissioned. In 1998, new capacity of 294 MW was under construction and additional capacity of 200 MW was planned. Virtually all new CHP were industrial; the potential in the residential sector has yet to be studied.

34. At the regional level, the Flemish region set a goal to put in operation 1,200 MW of high quality CHP, i.e. with an efficiency at least 5 per cent higher than the combined cycle plants. The goal seems to be a realistic one, given that in 1995 the installed capacity of CHP in the Flemish region reached 350 MW, which made up around 80 per cent of CHP capacity in Belgium. Moreover, preferential tariffs were set for natural gas used in CHP, in order to stimulate interest towards building new plants. The Flemish region also has in place an energy

demonstration programme to support innovative energy projects, typically CHP projects, by providing investment support up to 35 per cent of the project cost. Some implementation barriers still remained. For example, the tariffs for back-up supply from the grid in emergency cases were set too high. The installed capacity of CHP in the Walloon region amounted to 250 MW in 1998, which corresponded to more than half of the estimated potential for the region of 380 MW.

35. Deregulation of the electricity supply industry was expected to give added impetus to the development of the CHP market. In this context, the incentives were seen to result from removing barriers in front of the independent power producers, setting a guaranteed minimum price for electricity from CHP and liberalizing the gas market, with a consequent drop in gas prices. Furthermore, the new CHP plants were to be exempted from the public service obligation.

36. Promotion of renewables was an issue on the policy agenda of the regions, while competence at federal level was limited to applying fiscal policies designed to enhance their penetration. Support for renewables has been provided in the form of investment and production subsidies. At federal level, renewable energy was supported by the same national system as the system for CHP, i.e. by granting businesses a 10 per cent tax deduction for investment in renewables. In 1995, a decision was taken by the Government to provide BF 1 per kWh for electricity produced from renewables, which resulted in a subsidy of BF 20 million in 1997. Furthermore, in 1998 another decision was taken to provide an additional BF 1 per kWh for electricity produced from wind and small hydro, while buy-back rates for electricity from small-scale photovoltaics (less than 3 kW) had to be negotiated between the producer and the grid. In the latter case, the subsidy in the Flemish region may reach up to 50 per cent of the production cost. In the same year, an agreement was reached on simplifying the technical conditions for connecting renewable sources to the grid. Despite the incentives, renewable capacity has not grown as fast as anticipated; in 1999, only one per cent of electricity was produced from renewables, of which 90 per cent was from biomass. This is mainly the result of a lack of follow-up at regional level, where urban planning and other administrative procedures hinder increased use of renewables.

37. At regional level, the Flemish region has in place a target-oriented policy to promote renewables, the target being to increase the share of renewables within the TPES from 0.35 per cent in 1996 to 0.7 per cent in 2000, 3 per cent in 2004 and 5 per cent in 2010. Since 1991, this policy has been backed by a 20 per cent investment subsidy for small enterprises and 10 per cent for medium and large enterprises. In the Walloon region, renewables were promoted by conducting surveys on the potential for small hydro, by installing eight boilers using biomass with a total capacity of 6.3 kW and by planning another eight boilers. The effect of the existing boilers was estimated at 3 Gg CO₂ saved.

38. For the future, Belgium expects to have an installed capacity of 100 MW of wind power by 2005, while the economically proven potential is estimated at 1,000 MW. To support further renewables, the electricity market liberalization bill obliged electricity distribution companies to

achieve a certain minimum share of renewables in their sales of electricity. To check on the implementation of this provision, green certificates will be issued to companies which comply with it and a fine will be paid by those that fail to comply, at least in the Flemish Region. The bill provided a legal framework for offshore wind-farm concessions. It also established a legal framework for setting minimum buy-back tariffs for electricity generated from renewables and for creating a funding mechanism for this purpose by using the revenue from the energy levy, explained below, from the electricity transmission fee and from the fines for non-compliance. Federal government officials were of the opinion that the feed-in tariffs for small hydro and wind power were sufficient to make investment in these technologies attractive. The team felt that the immediate plans to scale down the value added tax (VAT) on renewables from 21 to 6 per cent, if materialized, would further enhance the penetration of renewables.

39. During the 1990s, average electricity prices decreased for both households and industry. With prices around \$0.18 per kWh, electricity supply for households remained relatively expensive, in fact one of the most expensive in Europe, while prices for industry of around \$0.07 per kWh were in line with the average for the EC countries. It was anticipated that liberalization of the electricity market would bring about a further drop in electricity prices, but the future trend would be strongly influenced by the decommissioning of the oldest nuclear power plants. In the context of taxation policy, an energy levy was introduced in 1993 for energy supplied to households, e.g. light heating oil, natural gas and electricity, with a view to raising revenue to support employment. Some energy types, such as diesel fuel, coal, some uses of natural gas in industry and social tariffs for electricity were exempted from this tax. In addition to the energy levy, a VAT of 19.5 per cent was imposed on electricity and natural gas used by households. Subsequently, the level of the tax has been raised two times to reach 21 per cent in 1996. The coal taxes remained low compared to the other fuels: as of 1997, there were no taxes on coking and steam coal, for industry and for electricity generation, and a reduced 12 per cent VAT rate was applied to coal used by households, all of which did not stimulate fuel switching.

2. Industrial, residential, commercial and public sectors

40. The industrial, residential, commercial and public sectors together accounted for 54 per cent of the energy-related CO₂ emissions in 1990, and 50 per cent in 1996. These high percentages were due to the relatively high contribution of industry to GDP, to the high energy consumption in households and services, and to the scant improvements in energy efficiency in these sectors. Even though emissions from industry marked a decline between 1990 and 1996, this occurrence was attributed to a fall in industrial output rather than to some measures applied. Moreover, after a sharp drop in the period between 1980 and 1990, primary energy intensity rose again thereafter mainly due to the economic recession of the early nineties and some downscaling of energy conservation measures.

41. The NC1 provided information on several measures to promote energy efficiency in these sectors, *inter alia*, strengthening of the minimum efficiency standards, conducting energy audits, support for energy efficiency projects and concluding voluntary agreements with industry. Whereas mitigation measures aimed primarily at enhancing energy efficiency, some measures

were geared at improving generic manufacturing technologies. In particular, one of the measures with significant effect in the Walloon region was the shift towards electric steel production. This was one of the two existing measures included in the NPRE, with savings estimated at 4,000 Gg CO₂ annually. Among other instruments to promote energy efficiency at regional level were tighter thermal insulation standards for buildings, financial support provided for energy efficiency equipment in industry, information and public awareness, and new technology development and promotion. In addition, involving both federal and regional levels, an investment allowance was given for environmental and energy saving projects, which allowed to deduct from the tax base the amount of investments in such projects. In 1997, the allowance covered around 13.5 per cent of the total investment made in such projects.

42. Building codes, which set mandatory minimum energy efficiency and thermal insulation standards, were introduced for new and renovated dwellings and have been revised several times in different regions in the last decade. In turn, the tightening of thermal insulation standards was stressed by Belgian officials as an important measure envisaged in the NPRE, which was expected to reduce the energy losses in buildings by 20 per cent according to the estimates given in the NPRE. Indeed, both Flemish and Walloon regions enforced the K55⁵ standard for new residential dwellings in place of the previous K65 standard, and various heat loss coefficients for the walls of renovated residential buildings. Broadly, the same K55 standard was applied to buildings in the services sector, but in some cases K65 and heat loss coefficients for walls were also used for new offices and school buildings in the Walloon region. The Brussels region has been preparing new thermal insulation standards similar to those of the Walloon region.

43. Monitoring of the implementation of these new standards indicated that around 80 per cent of new buildings failed to comply with them; savings delivered were therefore far below the estimates. To address this issue, a programme of monthly checks of around 30 residential buildings was launched in the Flemish Region. Moreover, there was an ongoing effort to move from insulation standards to energy performance standards. Further strengthening of insulation standards was not envisaged in the Walloon region as this was considered a very costly measure. The team felt that, apart from problems related to enforcing the new standards, lack of harmonization among the three regions and the existence of old building stock not affected by the new standards might hamper the efficiency of this approach.

44. Along with strengthening of insulation standards, the Flemish region has been providing a subsidy of 20 per cent of investment in energy efficiency projects in small enterprises and 10 per cent for medium and large enterprises since 1991. The same region has in place a system for mandatory annual inspection of heating installations fired by liquid fuel. The Walloon region spent around BF 50 million annually for subsidies for energy efficiency improvement in industry, for launching pilot projects on the rational use of energy and for raising public awareness on energy efficiency.

⁵ The K value is an indication of the heat loss value of the building as a whole, while the wall system of the building can have different heat loss coefficients. A lower K value indicates more stringent standards.

45. Voluntary agreements with industry, although envisaged in the NPRE, seem to have a limited scope of implementation in Belgium due to its particular political and institutional structure. Still, some agreements were recently concluded with utilities to increase the amount of electricity produced by CHP plants, which, together with the subsidies provided for this purpose, might help boost the number of such plants. Other agreements were concluded between the Flemish regional government and the electricity distribution companies, gas distribution companies and consumer organizations to subsidize heat pumps and to support installation of solar water heaters, energy efficiency, energy auditing and lighting projects. The plans and subsidy schemes were specified in each agreement and a secretariat specially appointed by the government followed the implementation. The team was also informed of an ongoing effort in the Walloon region to negotiate an agreement with the glass industry for better combustion control, improved furnace efficiency and other technical solutions, which were expected to improve energy efficiency and hence save CO₂ emissions.

46. With respect to appliances, voluntary standards and labelling of light bulbs were under consideration as of the time of the visit and energy labelling was enforced for refrigerators, air-conditioners, washing machines and dryers in line with the EC regulation on this matter.

3. Transport

47. As in many other EC countries transport was an important and growing source of emissions in Belgium, and virtually half of the measures envisaged in the NPRE, including economic instruments, regulations and physical planning, targeted emissions originating from this sector. These measures were implemented by different levels of government, with the primary objective of solving some urgent problems of the local environment, such as traffic congestion, air pollution, and noise. They were applied only partly and the effect achieved was lower than expected, but apart from that, as of 1993, Belgium has seen a slight decrease in transport energy intensity. Even so, Belgium has one of the highest road densities in the EC and road transport continued to grow in absolute terms, with almost unit elasticity between the GDP and the number of cars. At the same time, rail transport declined.

48. Measures targeting passenger transport in the NPRE mainly aimed at promoting public transport and at reducing the traffic in city centres and commuting by car. Measures concerning freight attempted to stimulate combined transport schemes in cooperation with France and Luxemburg, but they were at a very initial stage of implementation, as it was difficult to overcome economic and institutional barriers. By imposing strict monitoring of speed limits and by changing price and tariff policy, the NPRE planned to influence both the overall efficiency of transportation and the consumption patterns.

49. In the context of the price and taxation policy, in order to discourage the use of cars for professional purposes, limits were set on the deduction of transport costs from professional income and higher taxation was imposed on private use of company cars. The use of public transport was also encouraged by giving exemptions to employer-paid public transport costs. Moreover, as of 1998 the use of bicycles for commuting was stimulated. To counterbalance the

drastic reduction in VAT on car sales from 33 per cent to 19.5 per cent, a new tax on new cars was introduced in 1992, and in 1993 it was extended to second-hand cars. The tax level depends on the car age and engine power, and was believed to be an effective tool to push consumer choice towards smaller and less polluting cars. Finally, in 1995 the Eurosticker (Eurovignette) was introduced, as a levy on the use of the road network by heavy goods vehicles (12 tonnes upwards).

50. Taxes on gasoline and diesel oil in Belgium have risen steadily during the 1990s, virtually offsetting the impact on consumers of declining world oil prices. In 1996, additional excise taxes were imposed on gasoline, which brought Belgium into the group of EC countries having the highest level of motor fuel taxation. Simultaneously, an excise compensation tax was levied on diesel cars, which countervailed the lack of a similar increase in the excise taxes on diesel fuel. As a result, in 1999, taxes made up 78 per cent of gasoline prices and 66 per cent of diesel fuel prices.

51. At regional level, the planning aspects of transport policy were given great importance. Among the three plans dealing with different facets of transport policy in the Flemish region and in line with measures envisaged in the NPRE, the Spatial Structure Plan is worth mentioning. The overall objective of this plan was to modify the demand for car transport by setting clear goals to link functions and supplies in city development, to link living and working in regional centres and to optimize the transport infrastructure. The team was informed of an approach to handling transport problems in Flemish cities by concluding mobility contracts between the Flemish region, the cities and the public transport companies, which in turn entailed preparation of mobility plans by the cities. These mobility plans had to identify problems, to evaluate scenarios and to stimulate policy implementation. The team noted that around two out of three Flemish cities were partners in such plans, including Bruges, where the plan was launched in 1996. The team found the approach innovative, as it provided a framework for tackling transport problems in a consistent way and for enhancing the exchange of experience. Other examples of measures at regional level include the experience in the Walloon region of a company which offers car-pooling employees an allowance equal to the cost of public transport.

4. Land-use change and forestry

52. Around a fifth of the total area of Belgium is covered by forest but the coverage is unevenly distributed. It makes up 21, 20 and 8 per cent of the areas of the Walloon, Brussels and Flemish regions, respectively, and around 80 per cent of the productive forest is in the Walloon Region. Total expenditure by the three regional governments on nature conservation and forestry was about BF 3,800 million in 1996, representing 5 per cent of overall public expenditure on the environment.

53. At federal level, in 1995, a ministerial decree based on an EC directive (2080/92) provided for subsidies to farmers for conversion of agricultural land to forest in order to compensate for loss of revenue. Subsidies for production of biofuels were also available. In the Flemish Region, both the Environmental Policy Plan (MINA2) and the Structure Plan for Forest

envisaged creating 10,000 ha of new forest and converting another 10,000 ha of agricultural land into forest by 2007, pursuant to the same EC regulation. To achieve the first objective, the Flemish government spent BF 2,269 million between 1991 and 1998 in establishing 3,830 ha of new forest. Apart from that, the federal Government provided 50 per cent co-financing to EC subsidies for the acquisition of new sites for nature development, afforestation and reforestation, which amounted to BF 190 million between 1991 and 1998. Notwithstanding the efforts made, it was likely that the targets set would not be achieved as the annual afforestation under different schemes amounted to only 360 ha annually. Some of the reasons for the slow pace of afforestation included problems linked with planning, the little involvement of and lack of significant financial contribution from the local authorities, and high land prices; there was also a lack of interest on the part of farmers, as the compensation for the revenue lost was low. Although the forest policy of the Walloon region was geared towards maintaining forest biodiversity and productivity, there was no explicit policy to increase the forest area as no land was available for this purpose.

B. Methane

54. Belgium has no policy specifically targeting CH₄ emission, but several measures launched since 1990 have indirect implications for these emissions, including the EC Common Agricultural Policy and the waste management policy implemented at regional level.

55. In the Flemish region, the MINA2 plan centred on action to reduce CH₄ emissions within the period 1997-2001. It set a 10 per cent reduction target for CH₄ emissions by 2002 compared to 1990 and envisaged achieving this target by recovering waste gas from landfills and reducing CH₄ emissions from agriculture, from gas distribution leakages and from anaerobic waste-water treatment. As of 1998, the depositing of separately collected waste (organic waste, paper and packaging waste, including, glass, metal and plastic waste) in landfills was banned. Separate collection of household and garden waste was encouraged as of 1995 and the Flemish region concluded voluntary agreements with 171 out of the 208 municipalities for such separate collection. Collection of landfill gas was made obligatory and was carried out in 9 out of the existing 16 biologically active landfills. In 4 of the controlled landfills the recovered gas is used for electricity production. Finally, the 1997 Plan for Household Waste set new targets to reduce the amount of household waste per capita from 325 kg in 1995 to 240 kg in 2001 with a long term objective to reduce it to 150 kg.

56. In the Walloon region, the first and second waste plans, adopted in 1995 and 1998 respectively, set objectives for waste minimization and reduction of the quantity of waste going to landfills. In particular, the targets for municipal waste called for a 29 per cent reduction in waste generated over the period of 1995-2010 and for a reduction of landfilled waste from 40 per cent of the total municipal waste in 1995 to 8 per cent in 2010. The percentage achieved for landfilled waste in 1995 was 56 per cent. Moreover, a waste regulation imposing a ban on organic waste disposal was planned for 2000.

57. In Brussels, the first and second waste prevention and management plans covering the periods 1992-1997 and 1998-2003 also aimed at reducing the quantity of waste generated and landfilled. The targets set for municipal waste were to reduce the quantity of waste generated over the 1998-2003 period by 10 per cent and to eliminate the waste going to landfills by 2000. Indeed, since 1995 all waste has been incinerated.

C. Nitrous oxide

58. As in the case of CH₄, Belgium has no policy exclusively targeting N₂O emissions, but some policies geared at emissions from the nitric acid industry, anaerobic storage of manure and the use of fertilizers were expected to have an impact on the emissions level. In the Flemish region, for example, a more detailed inventory of N₂O emissions, the introduction of measures to reduce emissions and the preparation of more robust projections were the three points stressed in its MINA2 plan. Moreover, a stabilization target at the 1990 level was adopted for 2002.

59. The team was informed that, while the Flemish region was one of intensive agriculture, agriculture in the Walloon region was extensive, hence measures launched in the Flemish region were likely to deliver higher reductions. A phased approach to tightening the standards for fertilizer application was envisaged in the Flemish region. In the Walloon region, the EC Nitrate Directive was implemented in 1994 and a Code of Good Agricultural Practices was designed to impose some restrictions on fertilizer and manure application, primarily to prevent groundwater contamination.

D. New gases

60. Before launching any policies to reduce emissions of HFCs, PFCs and SF₆, Belgium gave priority to improving the inventory methodology for them, the results being expected in 1999. This would, *inter alia*, provide an estimate of the effects of policies, with a view to preparing input for the Policy Plan for Reduction of GHG Emissions. In parallel with a series of ongoing studies on policies concerning the new gases, in 1999 the Flemish region planned to strengthen its environmental legislation by imposing limits on leakages of HFCs, PFCs and ozone-depleting substances in the refrigeration sector and to promote alternatives to these gases.

IV. PROJECTIONS AND ESTIMATES OF THE EFFECTS OF MEASURES

61. The NC1 and NC2 contained a detailed description of GHG emission projections and methodologies used for the projection exercise. Whereas the NC1 gave projections of CO₂ emissions only, the NC2 added estimates for the future trends of CH₄ and N₂O. Projections indicated the possible emission trends in the medium and long term (2005 and 2020), using 1990 as a base year. Information on projections was presented by gas and for CO₂ emission it was disaggregated by sector as required by the guidelines. Estimates of the effects of individual policies and measures in the NC1 and NC2 were limited to estimates by sector, and within each sector by two types of policy instrument, namely, fiscal and non-fiscal. Separate projections were not provided for emissions from bunker fuel and for the new gases. For sinks, an assumption was

made that in the mid-term the CO₂ sequestration of the Belgian forest will remain broadly the same as in 1990, i.e. 2,100 Gg CO₂.

62. The Federal Planning Bureau had a key role in coordinating the scientific input of several research institutions involved in the preparation of emission projections in a modelling working group. This group was set up as an ad hoc subgroup to the CO₂ Science Policy group mentioned above. The approach in the projection exercise was to set up a process to stimulate dialogue among modellers to come up with a consistent set of projection assumptions, models and results. In this process, the Federal Planning Bureau and the Econotec consultancy made the short- and medium-term CO₂ projections, and VITO and the Centre for Economic Studies (CES) to the Catholic University of Leuven developed the long-term ones.

63. The NC1 and NC2 described three scenarios: a baseline or “without measures” scenario, a “with measures” scenario and a “with measures committed to” scenario. The team found the approach to scenario definition to be broadly in line with the guidelines. While the underlying assumption behind the baseline scenario was that no mitigation measures have been implemented since 1990, in fact it incorporated some measures included in the National Equipment Programme and the NPRE (enhanced penetration of natural gas and improved productivity of nuclear plants). Both the “with measures” and the “with measures committed to” scenarios were prepared primarily to estimate how the national target could be achieved. To that end, the former scenario included implemented measures and measures under implementation from the NPRE together with a set of fiscal measures (increase of VAT on energy use, excise duty on fuel and an energy levy on fuel used by households), while the latter accounted additionally for the effect of a carbon/energy tax (not implemented). Projections for each of the three scenarios were made for the medium term to 2005 and for the long term to 2020.⁶

64. The description of the projection methodology in the NC1 was accompanied by an elaborate discussion of the key features, strengths and weaknesses of the models used. Four models were employed for projections. The HERMES (Harmonized European Research for Macrosectoral and Energy Systems) and EPM (Energy/Emission Projection Model) models were used for medium-term projections, while AGE (Applied General Equilibrium) and MARKAL were used for long-term projections. The team acknowledged the methodological soundness of choosing two sets of models, each being a combination of top-down and bottom-up models. It noted however that, whereas the output from the two sets of models was broadly consistent, as a result of the consistent set of assumptions used, these outputs were not linked and the 1990 emissions used for projections differed from the NC1 and NC2 inventory values.

65. HERMES is a macroeconomic model used by many EC countries and tailored to their energy and economic circumstances. According to the modelling team, given the open character

⁶ In preparing projections and calculating the 5 per cent CO₂ reduction target in 2000, both unadjusted and adjusted data for temperature variations were used. As unadjusted and adjusted CO₂ data for the base year 1990 were 115,800 and 121,100 Gg, respectively, the 5 per cent CO₂ reduction target for 2000 was estimated with and without adjustments at 110,000 and 115,100 Gg correspondingly.

of the Belgian economy, it was very important that HERMES provided for some flexibility and could reflect the reality of the world economy. Some limitations of the model stem from the fact that the energy modelling is centred on the demand side, and therefore the future structure of the energy supply system could not be analysed. To overcome these limitations, the EPM model was used subsequently to HERMES. EPM is a bottom-up model developed by Econotec with the aim of representing in detail the emission sources, non-fiscal emission reduction measures, including the measures under the NPRE, and associated cost in several sectors, namely, industry, households, commerce and transport. For long-term projections, the AGE model, a general equilibrium model especially designed to produce future trends for analysis of energy and the environment, was used. In conjunction with the AGE model for the purposes of the technological, energy and economic analysis of mitigation options, and for estimation of the marginal cost of GHG mitigation, the MARKAL model was employed.

66. The underlying assumptions for all three scenarios were consistent as they used the same macroeconomic scenario. This scenario was defined in the NC1 as one of relatively high economic growth characterized by monetary stability and absence of price shocks. An annual GDP growth rate of 2.4 per cent was assumed in the period between 1995 and 2005, which is in line with the historic growth of the Belgian economy in the period from 1970 to 1994. In the long term between 2005 and 2020, a lower growth rate of 1.6 per cent was assumed. Oil prices were expected to increase by 2.1 and 1.5 per cent in the medium and long term, respectively, compared to 1990. The actual development for the period between 1995 and 1998 indicated that the GDP growth rate was around 0.5 per cent higher than anticipated, while the world crude oil prices were much lower. This had significant implications for the baseline emissions, as economic growth and energy prices were among the key drivers behind the GHG emissions. This conclusion is supported by the most recent 1998 projections of the Federal Planning Bureau, which assumed a GDP growth rate over the 1998-2010 period of around 2.5 per cent, which suggests a potential for an even greater increase in emissions.

67. The NC1 projected the baseline CO₂ emissions to grow from 115,800 Gg in 1990 to 129,300 Gg in 2000, an increase of 13,500 Gg. The NPRE and fiscal measures would bring emissions down to 125,200 Gg, and the carbon/energy tax was expected to bring this figure down to 116,300 Gg. These results indicated that the NPRE measures alone would bring the emissions close to, but still well above, both the 5 per cent reduction target in 2000 (115,100 Gg CO₂) and the 1990 emission level (115,800 Gg CO₂). Given that the carbon/energy tax and some measures of the NPRE were not applied and that the baseline emissions rose as a result of higher-than-expected economic growth and lower-than-expected energy prices, in the near term Belgian emissions are likely to be close to those projected in the baseline scenario. By sector, emissions were expected to increase sharply in transport even in the case of a sizeable tax increase, due to the low price elasticity of demand. Another sector with constantly growing emissions was that of electricity supply, where the increase was attributed to the fact that no new nuclear plants were envisaged by 2010 and therefore gas and coal remained the fuel of choice for electricity generation. Emissions from industry were expected to decline, because of a fall in industrial output rather than as a result of policies.

68. A sensitivity analysis of the impact on the emission trend of key assumptions, such as world demand, oil prices and GDP growth has been performed. The results obtained suggest that future emissions are highly sensitive to changes in these assumptions, but even in the case of the lowest economic growth assumed, the emissions according to the “with measures” scenario remain higher in 2000 than in 1990.

69. The team found that the NC1 did a good job in presenting the results of estimates and the effect of fiscal measures and NPRE measures for each scenario. According to the “with measures” scenario, the combined effect of these two groups of measures would be a saving of 4,100 Gg CO₂ in 2000, the effect of each being almost equal. The NPRE measures were expected to deliver their full effect only beyond 2000; in 2005, their effect was expected to be 3,800 Gg CO₂ saved. The carbon/energy tax was expected to bring an additional reduction of 8,400 Gg CO₂ saved in 2000, which would increase the overall amount of CO₂ saved to 13,000 Gg in 2000. A comparison of the effect expected from the NPRE as reported in the NC1, as against what was originally anticipated from the programme, shows that this effect has been significantly scaled down. For example, when designed in 1994 the NPRE was expected to save 13,735 Gg CO₂ in 2000 in order to fill in the gap between the then baseline and the 5 per cent target. The total reduction was made up of two measures already included in the NC1 baseline (2,000 Gg CO₂ from the shift to electric steel production and 4,000 Gg CO₂ from improved productivity of nuclear energy) and a set of measures in different sectors mainly related to energy efficiency improvement (7,735 Gg CO₂). The most significant of the latter measures were enhanced penetration of natural gas, 1,900 Gg CO₂ saved, and CHP, 2,000 Gg CO₂ saved.

70. In the longer term, emissions in all three scenarios follow the medium-term trend, though at a somewhat lower level due to the estimate of possible emission reductions being based rather on the technical than on the economic potential. Interestingly, in the “with measures committed to” scenario, a decrease of about 10,000 Gg CO₂ was projected between 1990 and 2000, in contrast to the medium-term projection for the same scenario, followed by a steady increase in emissions thereafter. MARKAL runs furnished estimates of the cost of different reduction scenarios and assessed the sequence in which the cost-effective options should be implemented.

71. As to the non-energy related CO₂ emissions, these were projected in the NC1 by using forecasts of the output of the iron and steel, chemical and non-metallic minerals (cement, chalk and glass) industries and the related emission factors. Projections of the CO₂ emissions from waste incineration were also available in the NC1. Emissions from these groups of sources were expected to increase by 11 per cent between 1990 and 2000 and remain constant thereafter.

72. The NC2 provided projections of CH₄ and N₂O emissions to 2005. The EPM model was used to project energy-related CH₄ and N₂O emissions by sector. For emissions from agriculture, the Walloon and Flemish regions used a forecast of livestock population and productivity, taking into account the implications of the EC Common Agricultural Policy. For CH₄ emissions from waste, both regions modelled the landfills with the first order kinetic model, taking into account the ban on landfilling of organic waste. The total methane emissions in Belgium were projected to decrease by about 22 per cent in 2005 compared to the 1990 level, reflecting the decrease in

emissions from agriculture and waste. In contrast, N₂O emissions were expected to increase by 16 per cent over the same period. This increase was attributed to the growth in emissions from transport, the share of which in total N₂O emissions was expected to increase from 3 per cent in 1990 to 16 per cent in 2005.

73. The review team was informed of the ongoing activities at federal level to prepare new projections incorporating changes in key assumptions and updating estimates of the effect of policies and measures, the results being expected by the end of 1999. The Flemish region presented a new transport model, to be used in developing a new transport plan. Finally, within the programme of scientific support for Belgium's policy on climate change, a project to integrate different GHG projection models in order to prepare new projections was launched in 1999, with results expected by the end of 2000.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

74. The NC1 presented the results of the climate change impact assessment of a number of ecosystems, such as forests, grasslands, hydrology and water resources, and soils, and the biotic aspects of coastal zone management. Climate research was coordinated by the Office for Scientific, Technical and Cultural Affairs (OSTC), and conducted in the framework of the Climate Change Research Programme between 1990 and 1996. Approximately BF 0.8 million have been spent annually for this programme.

75. Most of the research centred on the assessment of biosphere sensitivity, considering one or two climate and non-climate stresses, e.g. temperature increase, doubling of the CO₂ concentration and local pollution. Studies of the socio-economic impacts of climate change and of vulnerability in terms of sensitivity and ability to adapt, have yet to be done. Consequently, the NC1 did not contain suggestions on adaptation measures although it outlined possible adaptation strategies in some sectors.

76. Climate change scenarios used for the assessment were chiefly based on the output from five general circulation models (GCM) for responses for the period of doubling of the CO₂ concentration in the atmosphere. In some cases, climatic analogues and the IPCC scenarios of transient rainfall responses were used. The Belgian team stressed that, due to the low resolution of the GCM, many uncertainties associated with the regional effects and changes in precipitation remained. To redress the situation, downscaling using a nesting approach to improve regional scenarios is planned.

77. The team was informed that, after publication of the NC1, the OSTC took steps to improve the quality of climate impact analysis and adaptation assessment, and to provide more complete, integrated data on these issues. These steps included organizing research in a multi-disciplinary network, stimulating a dialogue between scientists on a common, standardized approach, fostering decision-supporting projects, improving research integration through the integration of all related studies within a programme entitled Supporting Actions for the

Scientific Support Plan for a Sustainable Development Policy, and conducting detailed impact assessments for five priority sectors and ecosystems.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

78. The NC1 contained information on bilateral and multilateral financial assistance, the contribution to the Global Environment Facility (GEF), technology transfer and capacity-building. Tables requested by the guidelines were not used in this section, because the information was not available at such a level of detail. The Belgian Agency for Development and Cooperation was the institution responsible for coordinating activities related to the preparation of information on financial assistance and technology transfer. In the period between 1993 and 1997, Belgium's official development assistance was within the range of 0.39 to 0.31 per cent of the gross national product. Moreover, the Government has set a goal to increase this amount to 0.7 per cent in the near future.

79. The focus of Belgian climate change cooperation was on multilateral assistance. Belgium was an active participant in the GEF, having contributed 1.68 per cent of the total amount of the fund to its pilot phase, and first and second replenishments (BF 320 million for 1994-1995, BF 390 million for 1996 and BF 312 million for 1997). It co-financed with the GEF several projects in Africa, including a solar water heater project in Tunisia. Another important activity has been the support of BF 1.8 billion within 10 years to the Special Programme for Africa, which had among its objectives support for rural development, water management, afforestation, and soil protection in the regions particularly vulnerable to climate change.

80. The bilateral financial assistance went predominantly to several least developed countries in Africa, to cover basic needs such as education, advanced agricultural practices, food security and basic infrastructure. Although no estimates were available of the amount of official development aid provided exclusively for climate change projects, an interest in energy efficiency projects has been noted in recent years among recipient countries. As of 1999, Belgium was conducting activities implemented jointly with Romania and Croatia. The team noted as an example of successful climate change technology transfer the establishment of a photovoltaic production facility in India in cooperation with some universities. Several activities were carried out at regional level, including education and training programmes for developing countries on biomass use for energy, solar energy, rural energy and energy management in public buildings.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

81. Belgium has taken a comprehensive approach to global climate change research in all sectors, aimed at providing consistent information to support the policy-making process. Competence in research and development was shared between the federal Government, the regions and the communities. The OSTC was responsible for the scientific aspects of sustainable development.

82. The most important research programme was the Climate Change Research Programme, which consisted of 36 projects and focused on the key factors influencing the global environment and climate change. In 1996, the OSTC launched the Scientific Support Plan for a Sustainable Development Policy. The plan consisted of seven programmes with a total budget of 75 million euros over four years. Of the seven programmes, the Global Change and Sustainable Development Programme appeared to have a clear focus on climate change. It included, among others, two components aimed at reducing uncertainties and ensuring scientific support for national climate policy. This programme was envisaged for the 1996-2000 period and has been supported in the amount of 16 million euros. Other programmes, such as sustainable mobility, sustainable management of the North Sea, scientific research on the Antarctic, TELSAT (earth observation by satellite), and levers for sustainable development programmes also contributed in part to the research on climate change.

83. The Government also supports research and development in the energy sector. The financing of such programmes was slashed during the recession in the early nineties, but it picked up thereafter to the level of BF 2,277 billion in 1996. While a sizeable part of this was for nuclear and nuclear-supporting technologies, there has been a recent tendency to increase the support for research on energy efficiency and renewables. In the Flemish region, BF 1 billion was spent annually on energy-related research supported within the framework of a special programme (Vliet) and through the activities of the VITO.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

84. Belgian experts did not expect the country to be particularly vulnerable to climate change and for that reason it was not easy to make people aware of climate change. Moreover, in some cases climate change was perceived as a policy issue at federal level only, which did not facilitate raising awareness of climate policy. Nonetheless, some efforts were geared to disseminating information on climate change and launching education programmes. In particular, a federal campaign on climate change and its scientific understanding appeared to have been well accepted by the public. As a follow-up to the NC1, a book was published called *Climate Change: the Will and the Way*, with information on the main sources of GHGs and the approaches to tackling emissions, and an Internet page was prepared in 1999. Other activities included a seminar organized by the Federal Council for Sustainable Development, a special exhibition organized by the Royal Academy, and a symposium on developing countries and climate change organized by the Royal Academy of Overseas Sciences. On education, special information packages on climate change were prepared for schools. At university level, climate change was introduced in the economics classes in the Walloon region, while in the Flemish region the emphasis was on preparing engineers and architects on the issues of energy efficiency and renewables.

85. Raising public awareness of energy efficiency was an integral element of the policy to promote energy efficiency. In 1995 the Flemish region launched an information system on the Internet with the best available technologies and in 1996 set up two promotion offices for CHP and renewables. The Walloon region and Brussels set up energy advice points to provide small and medium enterprises, and individuals, with information on energy efficiency. They also

prepared special leaflets and information packages for teachers, spending around BF 60 million annually. The Walloon region has launched an annual multimedia campaign for energy saving in households.

IX. CONCLUSIONS

86. The team acknowledged the efforts made to improve the quality of the GHG inventory between the publication of the NC1 and the subsequent inventories, and the use of new information to obtain accurate emission estimates. The methodology used is consistent with the IPCC Guidelines. The country-specific method of estimating the carbon sink helps to produce reliable estimates and could be used also by other countries that do not have high-quality forestry statistics. The team noted the good cooperation between regions with respect to both data collection and use of the same CORINAIR methodology, which altogether appeared vital to producing an inventory of good quality. Despite the improvements made, however, strengthening of institutional capacity, and more attention to data quality and the harmonization of emission factors appeared necessary to ensure sound estimates and consistent time-series. In the recent inventory submission, for example, the estimates of CH₄, N₂O and ozone precursors were transformed to the formats of the 1996 Revised IPCC Guidelines only for recent years, while for the period 1990-1994 this task appeared very difficult, which does not enhance data consistency. Given the complex institutional setting for inventory preparation, the team suggested that the inventory data and results be reviewed by independent entities, universities for example, in order to improve transparency and the quality of data and emission estimates.

87. The NPRE was the foundation of Belgium's climate policy. It addressed emissions from the key sources, with an emphasis on the policies of natural gas, energy efficiency, CHP and renewables. Although some progress has been made in implementing the NPRE, the actual emission growth indicates that problems remain. Indeed, the qualitative analysis suggested that, while most of the measures successfully implemented have been linked in some way with the National Equipment Programme, the problematic measures seem to be mainly those requiring decentralized action, for example, transport measures, and measures to promote renewables and energy efficiency. Furthermore, the team felt that, although Belgium has in place a diversified portfolio of instruments to promote energy efficiency, further efforts are needed to harmonize building codes across the three regions, to back the application of these codes with sufficient financial incentives and to make natural gas more financially attractive. Removing distortions in the energy price and taxation system could also help change the fuel mix, increase the share of low-carbon fuels, encourage a shift away from electricity use for heating in households and hence, in combination with other measures, tap the large potential for energy and emission savings in the building sector. The NPRE focused exclusively on CO₂ emissions, which is understandable given that CO₂ is by far the most significant GHG in Belgium. Nevertheless, the team emphasized the need to turn attention to the non-CO₂ gases as well.

88. The team felt that the preparation of the new Policy Plan for the Reduction of GHG Emissions, to be completed by the end of 1999, provided an opportunity for the integration of climate change in sectoral policies at federal and regional level, for better coordination between

different levels of government, for addressing in a comprehensive way all GHGs from all sources and for ensuring sufficient financial support for the measures planned. This appears vital to ensure that a concerted effort is made at all levels of government and by all stakeholders aimed at reversing the emissions growth.

89. Belgium has taken a comprehensive approach in analysing historical and future emission trends using reliable methodologies. An analysis of these trends suggested that the measures envisaged in the NPRE, even if fully implemented, would not be sufficient to mitigate the emissions growth, and to meet both the stabilization aim of the UNFCCC and the national target. Moreover, the baseline emissions rose as a result of higher-than-expected economic growth and lower-than-expected energy prices. As a result, already in 1996 the amount of CO₂ emissions reached 128,550 Gg, a level exceeding the national target and the stabilization aim by 12 and 11 per cent, respectively.

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