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Report on the in-depth review of the third national communication of Hungary

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## I. INTRODUCTION AND NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

1. Hungary ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 24 February 1994 and the Kyoto Protocol on 21 August 2002 (accession). Hungary is thereby bound to limit its emission of greenhouse gases (GHGs) to 6 per cent below its base period level during the first commitment period (2008–2012) once the Kyoto Protocol enters into force. According to decision 9/CP.2 of the Conference of the Parties to the UNFCCC, Hungary chose the average of GHG emissions in the period 1985–1987 as its base level.

2. The UNFCCC secretariat received the third national communication (NC3) of Hungary on 2 July 2002. An in-depth review (IDR) of Hungary's NC3 was carried out from July to October 2003, including a country visit by a review team on 25–29 August 2003. The review team consisted of Mr. Francis D. Yamba (Zambia), Mr. Noam Gressel (Israel), Mr. Terry Carrington (United Kingdom of Great Britain and Northern Ireland) and Ms. Xin Ren (UNFCCC secretariat, coordinator). During the visit the review team met the national experts who participated in the preparation of the NC3 and representatives from the government, ministries, research institutes, and environmental and business non-governmental organizations (NGOs).

3. Compared with the second national communication (NC2), the presentation of national circumstances in the NC3 was much improved and more in conformity with the *Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention, Part II* (hereinafter referred to as the UNFCCC guidelines). The NC3 provided information about demographic, geographic and climatic patterns, in addition to the economic and energy profiles. Sector profiles were expanded to include waste, agriculture and forestry. Information regarding government, industry, the transport sector and housing was provided during the visit.

4. Hungary is a land-locked country located in central Europe. The total land area is 93,033 $km^2$, of which about 63 per cent is agricultural land. This is higher than the European Community (EC) average of 40 per cent, thanks partly to Hungary's rather flat topography. Nearly 19 per cent of the total land area is forest, lower than in most Parties included in Annex I to the Convention (Annex I Parties). The climate is temperate, continental in most parts and Mediterranean in the south. Hungary has suffered from drought and water shortage since the 1990s.

5. The economic and political transition to a market economy in Hungary began around 1990, resulting in a decline in the GDP. After 1993, the economy began to recover with an average annual growth rate of 3.5 per cent. Full economic development came a few years later. The restructuring of the economy resulted in a decline in agriculture, and by 2000 agriculture represented only 4 per cent of GDP, the average level among Annex I Parties. The GDP shares for the major sectors are: services (46 per cent in 1990 and 63 per cent in 2000); industry (39 per cent and 33 per cent); and agriculture (15 per cent and 4 per cent).[1]

6. The population of Hungary declined during the 1990s; it was 10.12 million in 2000. The population density (108 persons/$km^2$) is moderate, with two thirds living in urban areas. The average number of rooms per capita increased from 0.85 in 1991 to 0.98 in 2000,[1] indicating a rise in living standards, which has implications for energy use in households.

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[1] Hungarian Commission on Sustainable Development, *Hungary: Basic Features and Indicators of Social, Environmental and Economic Changes and Planning for Sustainability*, 2002 (national information for the 2002 World Summit on Sustainable Development in Johannesburg, South Africa).

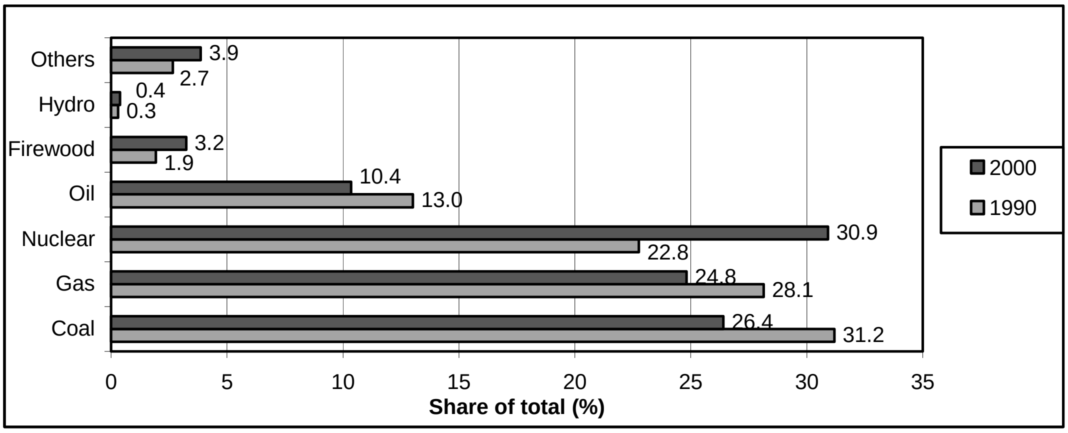
7. The energy supply in Hungary comprises domestic coal, hydropower, wood biomass, and imported fuels (mainly gaseous and liquid fuels). Figure 1 shows the energy structure in Hungary. State-owned power plants used to produce most of the electricity. As a result of privatization, a significant share of power plants came into private ownership. There is only one nuclear power plant, which generates 40–42 per cent of the total electricity needed in Hungary and remains state owned. The country relies on imports to meet up to two thirds of its energy demand. This dependence will continue to increase as domestic reserves are being depleted. One third of the domestic demand for gas is met by indigenous production, but this is forecast to decline to a quarter by 2005. The share of electricity imports has been rising since 1999.

**Table 1. Main macroeconomic indicators: base period (1985–1987), 1990 and 2000**

| | 1985–1987 (average) | 1990 | 2000 | Change from base level (%) |
|---|---|---|---|---|
| Gross domestic product – GDP (billions USD of 1995 PPP [a]) | 102.97 | 104.51 | 112.93 | 9.7 |
| Total primary energy supply – TPES (Mt oil equivalent, Mtoe) | 30.35 | 28.44 | 24.93 | –17.8 |
| Population (millions) | 10.53 | 10.37 | 10.21 | –3.1 |
| $CO_2$ emissions (Tg[b] $CO_2$ from fuel combustion) | 81.79 | 70.53 | 55.44 | –32.2 |
| $CO_2$ emissions per capita (1000 kg $CO_2$ ) | 7.76 | 6.80 | 5.43 | –30.1 |
| $CO_2$ emissions per GDP unit (kg $CO_2$ per US$ of 1995 PPP) | 0.79 | 0.67 | 0.49 | –38.2 |

*Source:* The data are from the International Energy Agency (IEA) database, 2003 edition.
[a] GDP is based on the price in 1995 adjusted by purchasing power parity.
[b] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes (Mt).

**Figure 1. Structure of total primary energy production**




*Source*: *Energy Statistical Yearbook of Hungary*, 2001.

8. Hungary is a parliamentary democracy with a National Assembly. At regional level there are 19 counties, which may be consolidated according to EC requirements following Hungary's accession to the EC. At the local level there are several hundred municipalities. The overall climate change policies are set by the parliament and implemented by the government. The municipalities are responsible for implementation at the local level, such as district heating, public transport and waste management.

9. The Ministry of Environment and Water (MoEW) has overall responsibility for the implementation of UNFCCC commitments and preparation of the national communications (NCs) in cooperation with the Ministry of Economic Affairs and Transport (MoEAT), the Ministry of Agriculture (MoA) and the Ministry of Education (MoE). The change of government during the reporting period for the NC3 and the lack of continuous provision of resources are regarded as the main reasons for the delay in submitting Hungary's NC3.

10. Hungary's Commission on Sustainable Development, set up in 1993, is headed by the MoEW with representatives from government, industry and commerce, academia and NGOs, serving as an advisory body for the negotiation and implementation of the Rio conventions, including the UNFCCC. In 2003, the Inter-ministerial Committee for Kyoto Mechanisms was set up as the national authority for Joint Implementation (JI) and emissions trading. It is chaired by the state secretary and represents the ministries mentioned above. Neither of these two bodies assumed the role of a formal platform for discussion and coordination of climate-change-related policies, nor for the preparation of the NCs. However, the NC3 was sent to each major ministry and the Commission on Sustainable Development for comments before final submission.

## II. GREENHOUSE GAS INVENTORY INFORMATION

### A. Preparation and methodology

11. Planning, coordination and submission of the GHG inventory to the UNFCCC is the responsibility of the MoEW. The ministry contracts the preparation of the GHG inventory to outside organizations. Before 1998, Systemexperts Ltd prepared the GHG inventory. From 1998 to date, the Institute of Environmental Management (IEM) under the Directorate for Environmental Protection has been contracted by the MoEW on an annual basis and is responsible for the preparation of the GHG inventory. This change of institutional arrangement, together with the publication of the 1996 IPCC guidelines,[2] ensured that from 1998 onwards the inventory has been produced using these revised guidelines. Input in the form of data and information was also provided by the MoEAT, the MoA, the Institute for Traffic Science, the Hungarian Central Statistical Office, the Hungarian Customs and Finance Guard, the Energy Centre, the Emission Information Centre and the Hungarian Energy Office, as well as by industrial associations and individual plants. The Hungarian statistical system completed its change to the international practice only in 2000. The data structure was quite different from the IPCC categories when the NC3 was prepared, which caused certain difficulties in the estimation of inventories.

12. Before 2003, there was no long-standing institutional arrangement for preparing the GHG inventory. The main reason was the lack of financial resources and continuity of financial support. In addition, Hungary had not yet introduced a centralized archiving system. However, there were plans to establish such a system, if funds could be made available. At the beginning of 2003, new financial resources were granted for inventory preparation. A new unit was specially created within the IEM to coordinate and prepare the GHG inventory, and in particular to start the recalculation over the whole time series.

13. The base period for Hungary was an average of emissions between 1985 and 1987, according to decision 9/CP.2. Hungary's NC3 covers the GHG inventory for the years 1990 to 1999 and the average of 1985 to 1987, but the inventories for the years 2000 and 2001 were made available during the review team's visit. The latest year considered in this in-depth review is therefore 2001.

14. Developments between the NC2 and the NC3 for the GHG inventory included the addition of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride ($SF_6$) for the years 1998–2001, and precursors nitrogen oxides ($NO_X$), carbon monoxide (CO), sulphur dioxide ($SO_2$) and non-methane volatile organic compounds (NMVOC). The consideration of key source analysis reported by Hungary was based on level 1 assessment, which does not take the fuel split into account. The review team learnt during the visit that this gap was being addressed and in future, the key source analysis will be based on Tier 1 level assessment as described in the IPCC Good Practice Guidance.[3] The difference

[2] *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories.*
[3] *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories,* IPCC, 2000.

in carbon dioxide ($CO_2$) emissions calculated using the reference approach compared to the sectoral approach was assessed to be relatively small, around 0.3 per cent.

15. The methodology used to estimate GHG emissions was in conformity with the 1996 IPCC guidelines for the years 1998–2001, but not for the previous years, including the base period, where the *IPCC Guidelines for National Greenhouse Gas Inventories* (1995) were used. Recalculations for the base period and the period 1990–1997 were not possible because of a lack of financial resources. Complete common reporting format (CRF) tables for the entire time series were submitted only for the years 1998–2001. This inconsistency in the time series caused difficulty in identifying the real emission trends in all sectors, as detailed in the next section.

16. The NC3 inventory accounted for anthropogenic emissions of GHGs required to be reported, namely $CO_2$, methane ($CH_4$), nitrous oxide ($N_2O$), HFCs, PFCs and $SF_6$, as well as precursors ($NO_X$, CO, NMVOC, and $SO_2$), and GHG removal, for all sectors, i.e. energy, industrial processes, agriculture, waste and land-use change and forestry (LUCF). The inventory included HFCs, PFCs and $SF_6$ for the years 1998–2001. Estimates of emission from biomass combustion and international bunker fuels were also presented.

17. For the energy sector, Hungary used IPCC Tier 1 methodology and IPCC default carbon emission factors (CEF) to estimate $CO_2$, different factors were used for $CH_4$, and $N_2O$ emissions for the years 1998–2001. In particular, the emission factor for $N_2O$ was reported to be lower than the average used by most European countries, based on the CORINAIR[4] emission factor. Hungarian experts explained that because of the lack of domestic measurements, the $N_2O$ emission factors were extracted from the literature. In Hungary, a hybrid of fluidized bed combustion and pulverized combustion technology has been applied in coal-fired power plants. The Research Institute for Electrical Energy (VEIKI) measured the $N_2O$ emissions from these plants. The results were used in the estimate of country-specific emission factors for $N_2O$ from the energy sector.

18. For the energy sector, most of the activity data was obtained from the *Energy Statistical Yearbook 2001*, the Energy Centre, *Environmental Statistics Data of Hungary 2000*, yearly reports of the Hungarian Central Statistical Office and industrial sites. The data were assessed to be of good quality. Energy data used for the inventory were found to be consistent with those reported by the International Energy Agency (IEA).

19. In the case of fugitive emissions, regional emission factors (for countries with economies in transition (EIT)) for processing, distribution, and transmission of natural gas were applied for the gas produced in Hungary. To improve the accuracy of data on fugitive emissions from this source, the review team felt it desirable to include and determine the country-specific CEF for gas production. According to Hungarian experts, in the preparation of future NCs the emission factors for fugitive emissions will be corrected on the basis of data from MOL, the Hungarian Oil Company. Moreover, before 1992, Hungary used domestic coking coal. But since 1992, this type of coal has no longer been mined in Hungary and imported coking coal has been used instead. As a result, the Hungarian experts saw the need to modify the calculation of these fugitive emissions before 1992 in future NCs.

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[4] CORINE (COoRdination d'INformation Environnementale) was a work programme set up in 1985, aimed at gathering and ensuring the consistency of information about the state of the environment in the EC. One of its components was CORINAIR – the CORINe AIR emissions inventory under the European Monitoring and Evaluation Programme (EMEP) for the long-range transmission of air pollutants in Europe.

20. For agriculture, all methodologies used to estimate emissions followed the IPCC Tier 1 method in the guidelines, except for manure management for which a Tier 2 method was used. Hungary used mainly default parameters and emission factors, and country-specific figures where available, for rice cultivation, animal waste management and enteric fermentation. Most of the activity data came from national agriculture statistical yearbooks, and the rest from expert judgment, such as in the case of manure management.

21. For LUCF, Hungary used the IPCC methodology to estimate all GHG emissions and removals. For waste, a country-specific methodology was used. The activity data are available only for waste generation per year and not for total waste in place in landfill sites. In spite of this, continuous decomposition of waste over the years was taken into account, as detailed in Hungary's 2001 national inventory report. The emission factor is an estimate of annual biogas per unit of waste disposed of. The methodology for waste-water handling is in accordance with the 1996 IPCC guidelines, but data on sludge are not available. The country-specific biological oxygen demand (BOD) and chemical oxygen demand (COD) values and output amounts were used with default $CH_4$ correction factors.

## B. Emission profile and trends by gas

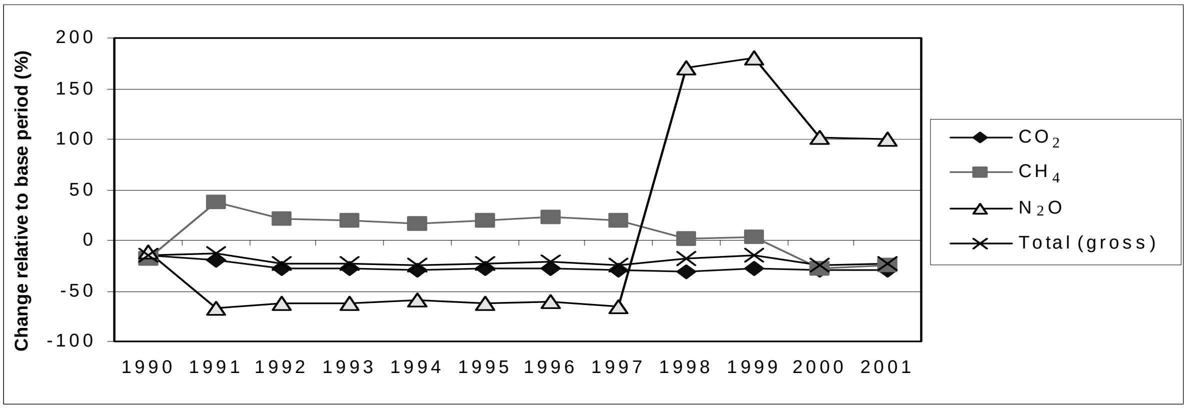
22. In 2001, the largest contributor to Hungary's total GHG emissions by gas was $CO_2$, which amounted to 75.6 per cent of the total GHG emissions expressed in $CO_2$ equivalent, followed by $CH_4$ (13.4 per cent) and $N_2O$ (10.3 per cent). The fluorinated gases (HFCs, PFCs and $SF_6$) contributed 0.3 per cent, 0.3 per cent and 0.2 per cent respectively. The figures for the base period were 82 per cent $CO_2$, 14 per cent $CH_4$ and 4 per cent $N_2O$. No emissions of HFCs, PFCs, and $SF_6$ were reported for the period 1990–1997 owing to lack of data (see table 2 and figure 2). There is no domestic production of fluorinated gases.

**Table 2. Hungary's GHGs emission by gas (Gg $CO_2$ equivalent)**

| | Base period | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | Change (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ | 83 676 | 71 673 | 67 391 | 60 557 | 60 826 | 59 196 | 59 758 | 60 475 | 58 893 | 57 601 | 60 117 | 58 555 | 58 728 | –30 |
| $CH_4$ | 13 952 | 11 437 | 19 197 | 16 978 | 16 633 | 16 300 | 16 625 | 17 125 | 16 600 | 14 272 | 14 343 | 10 097 | 10 415 | –25 |
| $N_2O$ | 4 005 | 3 519 | 1 318 | 1 543 | 1 515 | 1 665 | 1 533 | 1 583 | 1 360 | 10 863 | 11 258 | 8 105 | 8 008 | 100 |
| HFCs | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | 154 | 154 | 157 | 210 | 36 |
| PFCs | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | 597 | 574 | 215 | 199 | –67 |
| $SF_6$ | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | 201 | 101 | 87 | 131 | –35 |
| **GHG** | **101 633** | **86 629** | **87 905** | **79 078** | **78 974** | **7 7161** | **7 7916** | **79 183** | **76 853** | **83 688** | **86 547** | **77 215** | **77 691** | **–24** |

*Note:* N.A. means not available.

**Figure 2. Hungary's GHG emissions trend by gas, 1990–2001**



23. Emissions of $CO_2$ declined by 30 per cent between the base period and 2001. Energy remains the main source of $CO_2$ emissions (about 95 per cent throughout the inventory time series). The shares of subsectors within energy are: energy industry (44 per cent in the base period and 36 per cent in 2001); public and residential sectors (also called "other sectors", 28 and 26 per cent); energy use in manufacturing (13 and 18 per cent); and transport (9 and 15 per cent). During this period, the coal consumption began to decrease in different sectors, except for power generation where it remained the same.

24. Around half of the $CH_4$ emissions in Hungary were from fugitive emission from fuels, both in the base period and in 1990. Since 1991, $CH_4$ emissions from waste handling have been included in the inventory. In 2001, emissions from waste became the largest source of $CH_4$ (50 per cent), followed by agriculture (22 per cent) and fugitive emissions (21 per cent). Within waste, the main source is solid waste disposal, which accounts for four fifths of $CH_4$ emissions from the waste sector.

25. However, the trend analysis for all gases for the time series between the base period and 2001 should be viewed with caution because of the change to the 1996 IPCC guidelines for the years 1998-2001. This is especially true for $N_2O$. The main source of $N_2O$ was agriculture (66 per cent in 2001), predominately agricultural soil. The review team was informed that $N_2O$ from agricultural soil had been estimated only since 1998, which explains a sharp leap observed in the trend (figure 2). Before 1998, in the absence of estimation of $N_2O$ from agricultural soil, the largest source of $N_2O$ was reported under "Others", which represents extraction of geothermal water.

26. Emissions of PFCs and $SF_6$ also declined, by 67 per cent and 35 per cent respectively. The decrease in PFCs was attributed to the decline in aluminium production. Hungarian experts attributed the uncertainty in $SF_6$ emissions estimates to the lack of research. The rise in $SF_6$ emissions from 2000 to 2001 is mainly due to increases in the use of electrical insulation devices and in equipment manufacture. Emissions of HFCs increased by 36 per cent as a result of their increased use in cooling and freezing devices in households and in cars as substitutes for ozone-depleting substances.

### C. Emission trends by sector

27. In 2001, the energy category contributed 79 per cent of the total GHG emissions, followed by agriculture (10 per cent); waste (7 per cent) and industrial processes (4 per cent). The distribution structure for the base period was: energy 91 per cent; agriculture 6 per cent; and industrial processes 4 per cent. GHG emissions from waste were not reported for the base period and 1990. Table 3 and figure 3 show the GHG emissions distribution and relative change by sector.

28. Within energy, the contribution to total GHG emissions from each subsector (in the base period and in 2001 respectively) was: energy industries (36 and 28 per cent); public and residential sector (23 and 21 per cent); manufacturing (11 and 14 per cent); transport (8 and 12 per cent); and others (4 and 0.5 per cent). Overall, the data indicate that GHG emissions from energy in 2001 decreased by 34 per cent compared to the base period.

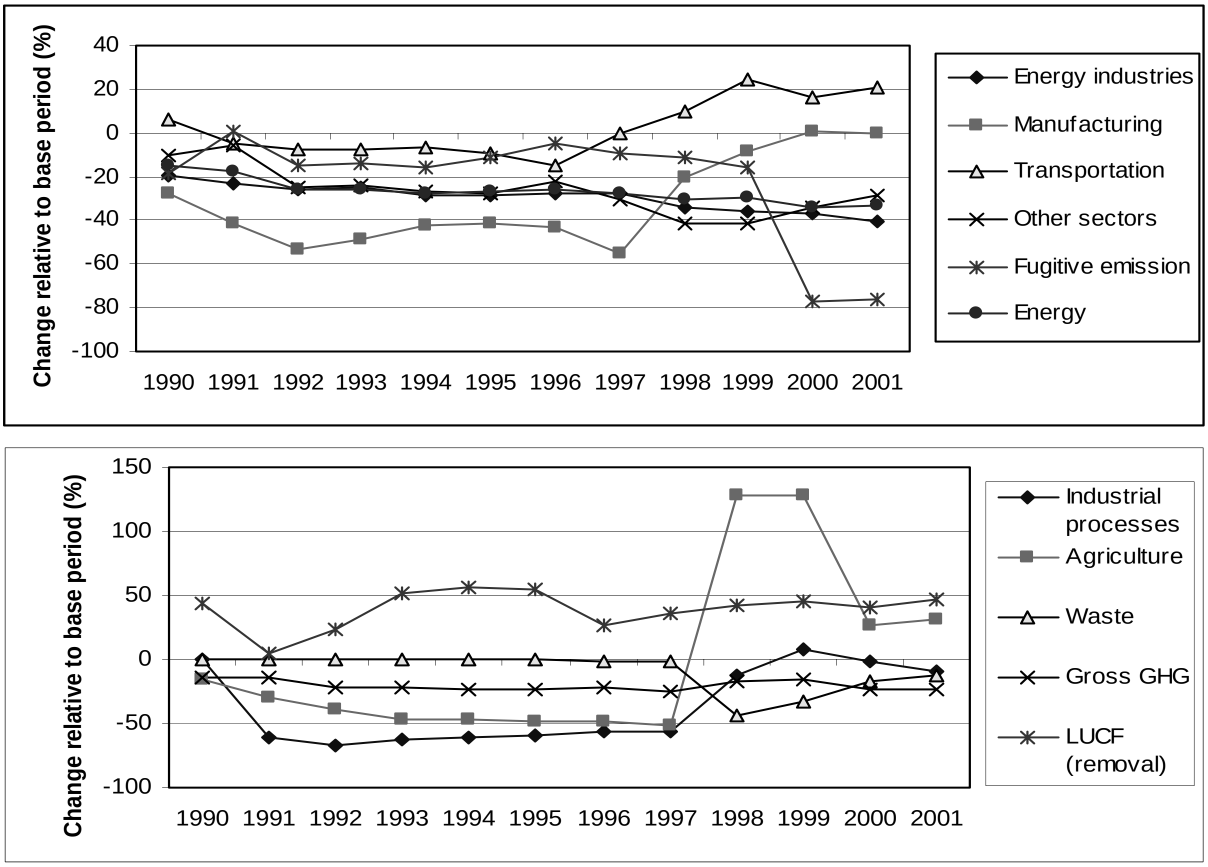
**Table 3. Hungary's GHG emissions by sector, base period and 1990–2001 (Gg $CO_2$ equivalent)**

| | Base period | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | Change (%)[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Energy | 92 256 | 78 156 | 76 331 | 68 232 | 68 414 | 66 550 | 67 399 | 68 588 | 66 343 | 63 848 | 65 268 | 61 110 | 61 286 | –34 |
| *A1. Energy industries* | 36 928 | 29 746 | 28 520 | 27 476 | 27 575 | 26 290 | 26 431 | 26 610 | 26 537 | 24 239 | 23 677 | 23 233 | 21 872 | –41 |
| *A2 .Manufacturing* | 10 893 | 7 893 | 6 380 | 5 131 | 5 548 | 6 306 | 6 352 | 6 199 | 4 905 | 8 660 | 9 957 | 10 989 | 10 874 | 0 |
| *A3. Transport* | 7 741 | 8 208 | 7 383 | 7 189 | 7 141 | 7 212 | 7 001 | 6 612 | 7 741 | 8 474 | 9 666 | 9 024 | 9 378 | 21 |
| *A4 Other sectors* | 23 174 | 20 877 | 21 749 | 17 306 | 17 591 | 16 960 | 16 762 | 18 091 | 16 221 | 13 660 | 13 596 | 15 292 | 16 542 | –29 |
| *A5 Others* | 4 106 | 3 746 | 2 791 | 3 078 | 2 471 | 1 820 | 2 489 | 2 149 | 2 385 | 425 | 420 | 420 | 420 | –90 |
| *B. Fugitive emissions* | 9 414 | 7 686 | 9 508 | 8 052 | 8 089 | 7 962 | 8 366 | 8 927 | 8 555 | 8 390 | 7 952 | 2 152 | 2 200 | –77 |
| 2. Industrial processes | 3 587 | 3 568 | 1 383 | 1 169 | 1 319 | 1 398 | 1 439 | 1 549 | 1 588 | 3 126 | 3 893 | 3 517 | 3 234 | –10 |
| 3. Solvents | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | N.A. | 27.89 | 32.01 | 167.13 | 184.94 | 563 |
| 4. Agriculture | 5 790 | 4 904 | 4 043 | 3 536 | 3 111 | 3 096 | 2 973 | 2 954 | 2 843 | 13 184 | 13 200 | 7 329 | 7 562 | 31 |
| 5. LUCF | –3 097 | –4 467 | –3 239 | –3 823 | –4 697 | –4 820 | –4 797 | –3 931 | –4 205 | –4 411 | –4 500 | –4 370 | –4 540 | 47 |
| 6. Waste | N.A. | N.A. | 6 142 | 6 135 | 6 125 | 6 112 | 6 101 | 6 088 | 6 073 | 3 496 | 4 147 | 5 081 | 5 396 | –12 |
| **Total GHG excl. LUCF** | **101 633** | **86 628** | **87 899** | **79 072** | **78 969** | **77 156** | **77 910** | **79 178** | **76 847** | **83 682** | **86 541** | **77 206** | **77 663** | **–24** |

*Note:* Discrepancies in totals between table 2 and table 3 are caused mainly by rounding errors and need to be checked in future recalculations.

[a] The change is calculated as: [(2001 – base period)/base period] x 100. In case of solvents and waste the base period in the formula was replaced by 1998 and 1991 respectively.

**Figure 3. GHG emission trend by sector and subsector, 1990–2001**



29. ***GHG emissions from energy industries*** decreased by 41 per cent from the base period to 2001. Although the figures are only indicative, because of a lack of consistency over the whole time series, a number of reasons were found to underlie the decrease in addition to the economic decline during transition. Deep mining of lignite is declining and will be stopped in future, as it is not economic. More gas will be used in the place of lignite. Another reason for the decrease in emissions from this sector is the nuclear power plant coming into full service in 1988, coinciding with the decline in energy consumption caused by economic transition and the complete collapse of the earlier market for fuel imports. These factors made a substantial impact on GHG emissions from the energy industry. Consequently, the demand for fossil fuel decreased, contributing to the decrease in emissions.

30. ***GHG emissions from energy use in manufacturing*** decreased in the first half of the 1990s. This was due to a decline in economic activities and the structural change from heavy industry to light industry, and towards a service-oriented consumer society. Hungary used to have three aluminium factories, but only one is still in operation. Metallurgical plants with high energy consumption have been replaced by privatized facilities with more efficient technologies. Together with restructuring in industry, this has decreased energy consumption and related GHG emissions. However, an upturn in the economy beginning in 1993–1994 was responsible for a slight increase in GHG emissions, which is particularly obvious for the recalculated period 1998–2001. This seems to indicate that there is little reduction potential left through structural change, and there is a recovery of industrial activities.

31. ***GHG emissions from transport*** registered a large increase (21 per cent) over the last decade, largely due to an increase in numbers of passenger cars and trucks resulting from economic growth. However, the Hungarian data show that the total petrol consumption remains fairly stable because of improvements in the efficiency of cars. The share of cars of western origin with low specific fuel consumption increased and the age of the car fleet decreased. As a result, the fuel economy of transport has improved. The main reason for the increase in transport emissions seems to be the increase in freight road transport and associated diesel consumption.

32. ***GHG emissions from public and residential sectors*** decreased by 29 per cent in the period. About 90 per cent of the fuel used in these sectors is natural gas or liquefied petroleum gas. Since 1998, no heating oil has been used in these sectors. Coal consumption in the residential and public sectors decreased to one fifth of its previous value because of the intensive programme of fuel switching to natural gas. Hungarian experts estimated that although insulation has improved, the energy demand increased by 40 per cent because of an increase in the number of detached houses, larger living areas and more household appliances, notably air conditioning. As a result, the overall energy consumption, and therefore the GHG emissions, has increased in the last few years.

33. ***The estimate of fugitive emissions*** indicated a decrease by 77 per cent overall, mostly in the last two years. This is mainly because of the recalculation for 2000 and 2001, after the in-country review of the 2002 inventory pointed out the double-counting problem in $CH_4$ emissions from fugitive sources. Better piping and pumping systems accounted for only a small part of the decrease, as the Hungary Oil and Gas Company has now largely adopted modern technology. Lower emission factors were therefore applied for the recalculation, instead of the IPCC default CEF for Eastern Europe.

34. ***GHG emissions from industrial processes*** showed an increase after 1998. This is partly due to the inconsistency of different methodologies, i.e. application of the 1996 guidelines after 1998, and partly due to growth of industrial production. The wider use of HFCs (as the main substitutes for the chlorofluorocarbons (CFCs) being phased out under the Montreal Protocol), together with the spread of cooling and freezing devices, also contributed to this increase. The levelling off of emissions from industrial processes after the year 2000 might be explained by improvement in production technologies and the closing down of most of the aluminium production facilities.

35. ***GHG emissions from agriculture*** decreased gradually until 1997, mainly for economic reasons. The steep rise after 1998 is due to a change in methodology that has not yet been applied to the whole time series. The problem lies with $N_2O$ from agricultural soil, in particular what should be included in organic soils, i.e. Histols. Using the new methodology, 7 million ha of cultivated soil has been defined as Histol. After the 2002 in-country inventory review, it was clarified by both international and Hungarian experts that most of the Histols in Hungary were peat and swampland, not cultivated agricultural soil. This explains the halving of emissions from agriculture for the year 2000 and 2001. The recalculation has been completed for the base period and is in process for 1998 and 1999. In future it will be applied to the whole time series.

36. ***GHG emissions from wastes*** almost halved from 1997 to 1998 when the 1996 IPCC guidelines were applied, even though $CO_2$ emissions from waste incineration began to be included from 1998 onwards. The third major problem identified by the 2002 inventory review is $CO_2$ from waste incineration. The biogenic and non-biogenic solid waste input material should be separated, as only the emissions from the incineration of fossil-origin wastes should be counted in the inventory. This correction has been made for 2000 and 2001, but not yet for 1998 and 1999. Hungary is striving to address these problems and the recalculation of the whole time series.

37. ***LUCF*** in Hungary constitutes a net sink throughout the time series. Removal of $CO_2$ by LUCF sinks has grown steadily over the last decade but fluctuated over the last few years. Around 40 per cent of forests in Hungary were privatized in 1990–1991, leading to an increase in timber felling in these parts of the forest and a decrease of felling in state-owned forests. In 1996, the felling increased once again, as a result of a colder winter when more wood was harvested and used for heating purposes. The fluctuation over the years is mainly determined by the demand for wood and the rate of afforestation. Wood export has increased, but domestic consumption actually decreased in the first half of the 1990s.

## III. POLICIES AND MEASURES

### A. General

38. The NC3 reported policies and measures in the energy sector and in agriculture, but not in waste, industrial processes, transport and LUCF. The public and residential sectors were mentioned only in the context of the energy efficiency programme. There was no information on fluorinated gases. It would have been helpful to have a summary table of policies and measures, their GHG reduction potential and types of instrument applied.

39. The MoEW has the overall responsibility for climate change policy in Hungary. It works closely with other key departments such as the MoEAT and the MoA. As an accession country to the EC (and an EC Member State since May 2004), Hungary is obliged to harmonize its legislation with that of the EC, encoded in the *acquis communautaire*.[5] This has proved to be the key driving force behind policy development that has direct or indirect implications for climate-change-related activities in Hungary.

40. Since the publication of the NC3 there has been a change of government, with subsequent changes to the portfolio of policies and measures and their funding. The mid-term economic development programme, the Széchenyi Plan, published in February 2001, has been modified and the focus shifted to EC integration. However, the subprogramme on energy efficiency remains essentially the same, although the funding scheme has been adjusted. This new National Development Plan, which is important for EC accession, was submitted to the parliament in early 2003. It was devised as a

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5 The principal document for accession to the European Union.

multi-year programme for Hungary as a full EC Member State, counting on both national and EC financial resources for implementation.

41. The main elements of climate change policies and measures are set out in the Climate Change Action Programme of the second National Environmental Program (NEP). The detailed second NEP covering the next six years was adopted by the government in 2003 and sent to the parliament in September 2003. The Climate Change Action Programme specified operational goals in energy, transport and renewable energy. As the review team understood, this Action Programme did not set up quantitative targets or a time frame for achieving these goals.

42. The review team found that the Environmental Protection Product Charge was another policy instrument that might contribute to GHG mitigation. This charge was introduced by an act in 1995 but has only recently come into force. The purpose of the charge is to generate a fund to finance efforts to prevent and mitigate potential damage to the environment caused, directly or indirectly, by products over their life cycle. The revenue collected will be transferred to the State Treasury and form the Environmental Protection Fund. Products subject to such a charge are fuels and other crude oil products, tyres, cooling equipment and refrigerants, packaging, batteries, thinners and solvents, and regular printing papers. Partial or full exemption is offered to environmentally friendly and recycled products, or products for export. The coverage of this charge has a direct impact on GHGs from the use of fuels and emission of fluorinated gases, and an indirect impact on GHG emissions from wastes and manufacturing. However, the implementation and effectiveness of this charge were not presented.

## B. Cross-cutting issues

43. Climate change is a cross-cutting issue affecting the responsibilities of a number of ministries and other stakeholders. Coordination amongst the different ministries could be improved. The government is undertaking considerable work on climate change, in order to meet Hungary’s commitments. However, the review team was made aware that the government does not currently have the necessary capacity to undertake all of this work, the burden of which is expected to increase with the accession to the EC.

44. From the information provided to the review team, it seems that as well as concern over capacity there is a related concern over the amount of funding available for the proposed plans and programmes. A number of programmes are in place, for example on energy efficiency, or are currently about to be implemented, such as the National Waste Management Plan, but these plans do not appear to have all the necessary funding allocated to them.

45. Hungary’s accession to the EC raises a number of new issues. The National Programme on Adoption of the EC *acquis communautaire* covers climate change objectives. In the environmental area, Hungary has already incorporated a number of EC requirements into its policies and therefore few difficulties are anticipated. However, accession to the EC will impose new targets, regulations and requirements. The European Climate Change Programme contains a number of measures that are being or will be introduced; for example, the EC Emissions Trading Scheme, which requires a considerable amount of work in order to prepare a draft National Allocation Plan by 31 March 2004. A linking directive to other Kyoto mechanisms, a directive on fluorinated gases and a monitoring mechanism were also proposed at the EC level. It is not clear whether there is sufficient capacity and funding available to meet all these requirements.

46. In order to ensure the effective implementation of policies and measures, it is necessary to assess their impact through monitoring and evaluation schemes. These appear to be in place in some areas, but there is no procedure for ensuring their use across all climate-change-related policies. Economic, social

or political concerns, rather than climate change policy, are usually the key drivers for policies and measures. Nevertheless, it is important that climate change policy is taken into account and is therefore as fully integrated as possible into other policy areas.

## C. Energy

47. As showed by inventory data, the energy sector is the major source of Hungary's GHG emissions. Domestic energy production provides approximately one third of the total primary energy supply (TPES) and imports provide the remaining 69 per cent. Hungary's electricity requirements have been met through a mix of nuclear power (40–42 per cent), coal-fired (by lignite, hard coal and brown coal) power generation (20–25 per cent), gas-fired power generation (30–36 per cent) and renewable sources since 1990. Renewable energy comprises mainly hydropower (total annual production 180–200 GWh) and biomass. Not much change is expected to this mix in the foreseeable future, apart from some opportunities for fuel switching and an increase in renewable sources of energy.

48. The government policies in the energy sector focus on energy efficiency and renewable sources of energy. The Energy Centre, which has been enlarged from 12 to 70 staff, is mainly responsible for the implementation of the National Energy Saving and Energy Efficiency Action Programme and managing other national, bilateral and EC funding. This programme provided grants to cover 30 per cent of the capital investment of projects eligible for this funding. It granted 1 billion HUF (EUR 4 million) for 2000 (the first year), and 3.5, 5.5 and 3.5 billion HUF for 2001, 2002 and 2003 respectively, all in the form of grants to industry as well as households. In 2003, the Energy Centre received more than 6,000 applications, mainly from small and medium-sized enterprises and municipalities. The main national targets supported by this funding remain the same, i.e. to reduce the energy intensity by 3.5 per cent per year under the projection of a 1.5 per cent annual increase in energy consumption and 1.5 per cent annual growth in GDP. The target is deemed feasible and necessary, as the current energy intensity in Hungary is about 2–3 times of that of the EC.

49. Some elements of this programme and its funding have, however, been reduced since the change of government. So far little has been done to evaluate progress towards the targets of 75 PJ of energy saving per year and 5 Mt $CO_2$ reductions per year. In general, the effort to attain energy efficiency is believed to be more effective in industry than in the public and residential sectors because of the more straightforward linkage with cost and the possibility of reclaiming value added tax (VAT) in the industrial sector.

50. The Electricity Act entered into force in 1 January 2003 and transposed the relevant EC directive into national legislation. As a result, 35 per cent of the electricity market in Hungary will be open by 2004. As experienced elsewhere, the open market in the electricity sector caused severe problems in terms of supply security and stability of the grid. The Hungarian experts considered the complete opening of this market a distant and uncertain prospect. By the time of the review team's visit about 15 per cent of the market had been liberalized. The price of electricity is 20 HUF (about EUR 0.08)/kWh for residential users and 15–20 HUF/kWh for industrial consumers. These are prices in the publicly controlled electricity market, kept intact mainly by the long-term (10–15 years) purchasing agreement between the government and the large power producers during the privatization period in the mid 1990s. In the free market, accounting for 15–20 per cent of total electricity use in Hungary, the price is lower – 10 HUF/kWh. So far only large consumers are eligible to buy electricity in this open market. Hungary does not have much surplus power generation capacity. Supply and demand are well balanced, so there has not been real competition in the domestic electricity market so far.

51. With market liberalization and entry into the EC, the energy price will probably increase for small consumers but decrease for large users. This will encourage energy efficiency and energy

conservation for small consumers, but also stimulate profit-driven energy production, as already observed by Hungarian experts. The review team felt that fuel poverty in low-income households might become a social concern too. There is a proposal that VAT on electricity could be increased from 12 per cent to 23 per cent in January 2004. The VAT rate for most commodities in Hungary is currently 25 per cent.

52. The Soviet-designed Paks nuclear power plant is the only one in Hungary. It has been in operation since 1983 and in full service with its four reactors since 1988. The decision on whether to extend the plant's lifetime beyond the scheduled date of 2015 has been postponed because of public and economic concerns. This may not have an impact on the first commitment period, as the scheduled lifetime of the plant ends after 2012, but after that the phase-out of nuclear power could pose a challenge for Hungary.

53. In 2000, renewable energy represented 1.6 per cent of Hungary's TPES, 3.5 per cent of primary energy consumption and 0.5 per cent of electricity consumption. The government aims to double the share of renewable energy to 6–7 per cent of total consumption by 2010. In negotiation with the EC on implementing the directive on electricity from renewable sources, a national indicative target for Hungary similar to the domestic target has recently been agreed: 6 per cent of energy consumption and 3.5 per cent of electricity consumption should come from renewables by 2010. This means that Hungary needs to increase the share of electricity from renewables by a factor of 7 within 10 years. The funding needed was estimated as 400 billion HUF each year. The government's main measures include grant aid and a special electricity tariff. It also intends to explore the options of a renewable energy obligation and tradable green certificates. Currently, electricity distributors and suppliers legally cannot refuse to purchase electricity from renewable sources when the producer's capacity is larger than 0.1 MW.

54. A similar requirement is also stipulated to encourage co-generation of heat and power (CHP) when the CHP producer's capacity is larger than 20 MW. In addition, Hungary has distributed generation (DG) of electricity and heat mainly by gas turbine. The total capacity of DG is about 300 MW. If the annual thermal efficiency of DG exceeds 65 per cent, the electricity produced will be bought at the subsidized price. This functions as a way of encouraging CHP, as only when DG is operated in the form of CHP can it reach this level of thermal efficiency.

55. According to Hungarian experts, wind energy potential in Hungary is small, as the wind speed is about one third of that in coastal countries. As a result, the annual capacity factor of the 250 kW Inota wind turbine in 2002 was about 11 per cent, and that of the 600 kW Kulcs wind turbine was about 20 per cent, rather low by prevailing standards.

56. Hungary is rich in geothermal resources, mainly in the form of hot water (70–90°C), which can be used directly in district heating. However, there are few high-temperature steam geysers, such as those in the USA or Iceland, which could be harnessed for power generation. The Hungarian experts did not see a lot of potential even for heating, because of water management requirements (the salt content is very high, 40–60 kg/m$^3$). When there is large-scale extraction of geothermal water, the aquifer must be sufficiently refilled in order to sustain underground water. This is energy consuming and technically difficult, especially in the sandy soil of eastern Hungary where most of the geothermal resources are located. Contamination of aquifers by refill is another unsolved challenge.

57. The biggest and most feasible renewable energy potential lies in biomass, mainly wood and agricultural wastes. The total capacity in Hungary at present is about 500 MW per year, including a 330 MW/year biomass-fired power plant and a 160 MW plant converted from coal firing. The government plans to increase the use of biomass as energy, and the share of renewable energy, by subsidising their production. Compared to the cost of existing hydropower and woodchips as fuel, tapping solar energy to supply low-temperature heat is competitive in Hungary.

### D. Public and residential sector

58. In Hungary today, about 20 per cent of households are connected to district heating. The figure is lower than it used to be because of the increase in the number of detached houses, for which district heating is uneconomic. Since it is impossible to meter individual consumption in the district heating system, municipalities pay collectively. This gives little incentive to end users to improve energy efficiency. Gas and electric heating are much easier to meter, and the direct link between energy use and cost at individual level is therefore more visible. Another difficulty for district heating is that upgrading the piping system is not cost-effective under the current circumstances. In this sense, introducing the new building code on energy performance is believed to be more cost-effective in terms of energy efficiency.

59. The EC Directive on Energy Performance of Buildings of 2002 was adopted by Hungary and is expected to improve energy efficiency in this sector. The requirements of the Directive are enforced through a licence system. The local authorities check the energy performance and review it after improvement is finished, then issue the licence. The Hungarian experts thought the implementation of the building code was less effective than expected so far. The EC laws on the energy performance of appliances have mostly been harmonized with Hungarian legislation, although their effectiveness and implementation have not been evaluated.

### E. Transport

60. The NC3 contains only limited discussion of transport issues. It was not possible to discuss this sector during the visit, as the relevant officials and experts were unable to attend. In the NC3, expected changes to the car fleet have been taken into account but not other changes, some of which are expected to arise from the EC accession. For example, Hungary is obtaining substantial EC funds for its road-building programme. Some concerns were expressed about the implications of this for rail transport, which is generally favoured because of its lower GHG emissions. In addition, the European railway system is not fully compatible, especially between western and eastern European countries, and this has also affected the use of railways. Reversing the decline of rail transport in Hungary will require international cooperation, according to Hungarian experts.

61. Accession to the EC is expected to increase car ownership and car mileage, while the use of public transport decreases. Transport energy consumption shows a 3.9 per cent annual growth rate between 1995 and 2000. The government expects a continuing growth in GHG emissions from transport, but has not developed a clear strategy for dealing with the situation. The price of motor fuel has increased, while the share of cars with high specific fuel consumption has decreased significantly.

62. In 2003, a new Sustainable Development Transportation Programme for Hungary was drafted. It did not foresee decreasing emissions from transport, but outlined targets including modernizing the car fleet, stabilizing the share of public transport and promoting environmentally friendly modes of transport. This programme was approved by the MoEAT shortly before the review team's visit, but has not yet been approved by the government and was not discussed during the visit.

### F. Industry

63. Hungary's industrial sector declined during the 1990s but has experienced some growth in recent years. The industrial sector will be subject to the EC Integrated Pollution Prevention and Control (IPPC) Directive, which provides the regulatory basis for reducing emissions of $CH_4$, $N_2O$, HFCs and PFCs but indirectly also affects $CO_2$ emissions. Its implementation in the cement, iron and steel, and aluminium industries is ongoing. Other EC directives influencing industrial GHG emissions have also been harmonized into national legislation, such as the Directive on Large Combustion Plants. The European

Commission has recently proposed a draft directive on fluorinated gases. The Hungarian government will need to consider what future action is needed for these gases.

64. The MoEW prepared the draft legislation for the Environmental Load Fee in cooperation with the Ministry of Finance, as a measure to implement the IPPC Directive. This fee will cover pollution of air, water and soil. The initiation and the structure of this fee are in line with the establishment of a new tax system in Hungary, required by the integration with the EC. In the first five years, this fee will focus on $SO_2$, CO and dusts, and therefore affect $CO_2$ only indirectly. If the parliament accepts the bill, the fee is planned to be effective soon.

65. The EC has also recently agreed to the introduction of an energy tax. The Hungarian government is expected to introduce this tax, to conform to EC requirements. In Hungarian industries energy cost represents a relatively high proportion of total production cost, unlike Western Europe where wages are more important. The energy tax is therefore expected to have a positive effect on GHG mitigation. The NC3 outlines a number of measures agreed in 1990 for promoting energy conservation in the industrial sector. However, the government currently seems to have the implementation of the IPPC Directive as the main measure for this sector.

## G. Agriculture

66. The responsibility for the agriculture sector lies with the MoA. The government's environmental policy in this area is set out in the National Agri-Environmental Programme for 2000–2006. A midterm (2003) evaluation of its socio-economic and environmental impacts is being undertaken. A final assessment will be made in 2006 to decide whether to continue or to modify the programme.

67. The numbers of livestock and levels of emissions from the agriculture sector have decreased from earlier levels, although livestock numbers are now expected to increase until they reach EC quota levels. Thereafter the overall level of emissions from livestock is expected to remain at the same level for the next few years, according to the EC quotas. The NEP does not list measures in this area. Research is under way to improve the GHG inventory from agriculture.

68. The MoA has a policy for manure management, and this is also covered in the National Waste Management Plan prepared by the MoEW. No $N_2O$ reduction measures were listed or discussed in such areas as crop irrigation and fertilizer use.

## H. Forestry

69. About 60 per cent of the forests in Hungary are still state-owned; the rest have been privatized. The National Forestry Service under the MoA is responsible for preparing the management plan, while the 20 state-owned share holding companies manage the state forests. Each year a forest survey is conducted on a rotation basis for about one tenth of all stands, using a sampling method to produce a yearly inventory of forests. The privately owned forests are not as well managed as the state forests. The average size is about 1.5 ha per private owner, which is rather small, making the collection and assessment of inventory data for private forests difficult.

70. It is expected that afforestation will increase as a result of EC policy. The EC provides funding for afforestation of abandoned cropland, because the quota system under the Common Agricultural Policy (CAP) does not encourage the maintenance of farmland in Hungary. Such funding is channelled mainly through private owners. The EC subsidies are substantial, about EUR 1,000 per hectare depending on species, accounting for 50 per cent of the cost of afforestation. The Hungarian experts reported a current annual increase in forest stock of 12 million $m^3$. In the last few years about 8,000 ha per year on average has been converted to woodland. However, only about 70 per cent of the annual

increment has been utilized each year. This creates a potential for renewable energy projects utilizing wood biomass.

71. A further driver for the increase in afforestation around the turn of the century is the potential of wood biomass as renewable energy revealed by JI projects under investigation. Despite the government plan to increase the use of wood biomass as fuel, the export of wood has increased while domestic consumption has decreased in recent years. Hungarian experts clarified that before becoming a Member State of the EC on 1 May 2004, Hungary had not received financial support from the EC for afforestation.

### I. Waste management

72. The Hungarian government's waste policy is set out in the Waste Management Act of 2000, and in a 1995 Act on Environmental Protection Product Charges. The Waste Management Act incorporates a number of EC-related regulations and objectives. As a result, no major changes in waste policy are anticipated following the country's accession to the EC. The main challenge will be implementation, as pointed out by Hungarian experts.

73. In 2002 the government also published a National Waste Management Plan 2003–2008 and is in the process of implementing the plan through separate programmes, including waste separation and treatment of biodegradable waste. The review team was informed that there was a need for further elaborating operational regulations for implementation of the plan. The funding will come mainly from international sources (55 per cent) including the EC, the national budget (35 per cent) and local government (10 per cent).

74. In 2000, 83 per cent of municipal waste was landfilled, 3 per cent was recovered and the rest was mainly incinerated. Today Hungary has only one municipal waste incinerator, located in Budapest, with a capacity of 300,000 tonnes per year. There are more than 20 small incinerators for hazardous waste categories such as medical and industrial wastes.

75. The Waste Management Plan set a target of reducing the landfilled waste to 60 per cent by 2010 in order to meet the EC Landfill Directive. Other measures to meet the EC requirements include expanding municipal waste incineration to build or upgrade three or four large-scale incinerators at regional level. This plan to expand incineration has met opposition from the local governments and the public. No targets were specified for recycling. The review team was of the opinion that better wastewater handling would reduce $CH_4$ emissions and such a policy could be integrated into any revised drought management strategy.

## IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

### A. Preparation and reporting

76. The NC3 contains sector-specific projections for energy, forestry and agriculture. Systemexperts Ltd, a Hungarian consulting and engineering firm that was involved in the process and trained through the US Country Studies Program and many other similar projects mainly with the Argonne National Laboratory (USA) and the EC's 5th Framework Programme, coordinated the projections of the NC3. In addition, Systemexperts Ltd prepared the projections for the energy sector and the aggregate projection, subcontracting the projections for agriculture and forestry to specialized research institutions. The Research Institute for Animal Breeding and Nutrition (ATK) prepared the projections for agriculture and the Forestry Research Institute prepared the projections for forestry.

77. The current projections covered $CO_2$ emissions from the energy sector and removal from LUCF, and $CH_4$ emissions from agriculture. No projections were provided for $N_2O$ or fluorinated gases, and the GHG emissions from industrial processes and waste sectors were missing. By the criteria of key source categories as indicated in Annex 2 of the NC3, the projections were undertaken on key sources representing approximately 67 per cent of the 1999 emissions inventory of Hungary. The key sources that were not included were $N_2O$ from agricultural soil (12 per cent of total GHG emissions in 1999), $CH_4$ from fugitive emission sources (9 per cent), $CH_4$ from waste (3 per cent) and $CO_2$ from industrial processes (2 per cent).

78. The review team noted that, within energy (79 per cent of total GHG emissions), omission of fugitive $CH_4$ emissions was likely to introduce an error in calculating the reduction in this category, given that a key measure in the energy sector is to increase the share of natural gas in the total mix of fossil fuel at the expense of solid fuels. Such measures typically reduce $CO_2$ emissions but increase fugitive $CH_4$ emissions that have to be deducted from the $CO_2$-related savings. The review team was also informed that country-specific methodologies were being developed, which will improve the preparation of projections as well as the overall NCs in future.

79. The review team was informed that reductions in $CH_4$ emissions from the energy sector were counted in the aggregate model, despite the fact that such reductions were not reported in the sector-specific model. Under the aggregate model, $CH_4$ emissions from the energy sector were calculated as achieving net reductions of 870 and 1,189 Gg $CO_2$ equivalent by 2010 for the "with measures" and "with additional measures" scenarios, respectively. The source of this data and the underlying assumptions remain unclear both to the review team and to the Hungarian experts.

80. Similarly, in agriculture, a rather limited investigation was conducted, including only $CH_4$ emissions from activities related to animal husbandry. However, the overwhelming primary source of agricultural emissions is $N_2O$ from agricultural soils (78 per cent of agricultural emissions, 12 per cent of total GHG emissions). This area was not examined, despite the potential for effective policies. It should be noted that Hungary is currently preparing a National Drought Management Strategy. The review team thought that reduction of $N_2O$ from agricultural soils could well be integrated into drought mitigation strategy and activities, such as efficient irrigation systems, liquid injection of fertilization into irrigation systems ("fertigation") and other optimization techniques. Emissions of $N_2O$ from agricultural soils are currently being recalculated. Their actual amount is expected to decrease, although according to the Hungarian experts it may still account for more than 9 per cent of the total GHG emissions after recalculation.

81. Other key sources that were not covered by the projections in the NC3 are GHG emissions from waste and industrial processes. Projections may be even more necessary for the industrial sector than for the waste sector, given the economic recovery and a trend of increasing emissions from this sector in recent years. Overall, omissions in the projections mainly concern non-$CO_2$ GHG emissions. The review team expressed the view that these omitted emissions could have been modelled effectively using relatively simple IPCC methodology and a spreadsheet method, a common and generally acceptable practice for projections.

82. Comparison of the projections of the NC3 with the NC2 is difficult, since the NC2 did not include a quantitative aggregated projection or a projection for the agricultural sector. In the NC2, a bottom-up spreadsheet method was applied for the projections of $CO_2$ emissions from the energy sector. The result, as graphed in the NC2, exceeded 60,000 Gg by 1999, while the actual figure reported in the NC3 for 1999 was 56,490 Gg. In the area of forestry, scenarios examined in the NC2 were either far below the reasonable afforestation rate for the period (the "business as usual" (BAU) scenario) or far above (all the other three scenarios in the NC2). This suggests that the projections in the NC2 may not

have been effective decision-making tools. The tools used for projections in the NC3 were much improved.

## B. Assumptions, scenarios and methodology

83. Three scenarios are defined in the NC3, in accordance with the UNFCCC guidelines: the base case scenario, representing the BAU or "without measures" scenario; "with measures"; and "with additional measures". Given that the aggregate projection was built using a top-down approach, whereby emission reductions in various sectors were subtracted from a "without measures" scenario, it is extremely important that the projections define the "without measures" scenario for each sector. Hungarian experts expressed the need for more coordination in the next phase of projection preparation.

84. The overall macro-economic assumptions include: a continuing decrease in population at the current rate; GDP continuing its trend of rapid growth at current recovery rates (3–6 per cent), energy intensity continuing to decrease at 1 per cent a year. The life of the current nuclear power station will extend beyond the commitment period (2008–2012). Power generation would become more efficient by using the most up-to-date technologies available. Other primary assumptions, policies and measures used in each sector under different scenarios are summarized in table 4.

**Table 4. Summary of sectoral assumptions under three scenarios**

| | "Without measures" scenario | "With measures" scenario | "With additional measures" scenario |
|---|---|---|---|
| **Energy** | Peak electricity load 0.9%, demand 1% growth/yr | Same as "without measures" but greater share of gas | Not presented in NC3; double renewable energy to meet targets agreed with EC (6–7% of total energy consumption by 2010) |
| **Agriculture** | Hungarian claims for EC quota for dairy cattle and sheep number (highest) | Midway between EC quota and Hungary's claim. The actual outcome of EC negotiations was reportedly very near this level | Original EC proposed quota for Hungary (lowest) |
| **LUCF** | Lowest afforestation rate in the past 20 years | Recent average afforestation rate, i.e. 8,000 ha/year | Maximum rate of afforestation potential until 2050, i.e. 15,000 ha/year |

85. According to the projection experts, the demand for energy by the household and services sectors is expected to remain stable, as a result of declining population and modernization of appliances, building insulation, etc. These will counter any increases in the use of new appliances. The review team noted, however, that future patterns of consumption and use might change radically as a result of synchronization with western European consumption patterns following accession to the EC. For example, rapid increases in peak electricity demand may follow consumption of high-energy-demand appliances, such as air-conditioning systems, dishwashers and clothes dryers. More importantly, pricing of energy and growth in GDP are key factors in determining demand. It is therefore recommendable that future NCs should include a sensitivity analysis of the demand curve and its flexibility within foreseeable price ranges.

86. It was clarified during the visit that the difference between "with measures" and "with additional measures" scenarios for the energy sector was that in the latter, the share of renewable energy in the total energy consumption would be doubled. However, Hungarian experts estimated that even if the maximum potential for renewable energy in Hungary were to be realized, it would be impossible to achieve an additional reduction of 2,000 Gg $CO_2$ equivalent, projected by the aggregate model for the "with additional measures" scenario in the energy sector. No further details were given, so it was impossible for the review team to determine sources other than renewables contributing to such reduction. Three subscenarios based on "with measures" scenario examined different levels of fuel imports in the energy sector. Results for these were not reported in the NC3 or during the review.

87. In agriculture, the base case scenario is currently being examined by Hungarian experts to see if this quota is equivalent to the current livestock numbers in Hungary, i.e. the “without measures” level. Emissions of $N_2O$ from manure management, making up 1 per cent of the total GHG emissions, should change in accordance with $CH_4$ emissions in the various scenarios and quotas. Reductions in $CH_4$ have a close and direct correlation with reductions in $N_2O$ from manure management, so the latter could have been easily included in the NC3 projections and the review team would suggest including it in future NCs.

88. In LUCF, the current base case level may be deemed unrealistically low. The definition of the current “with measures” scenario seems actually to represent a “without measures” scenario, given the economic recovery and the ongoing EC commitment and support for afforestation. This EC policy is likely to remain intact well beyond the first commitment period. Therefore, for the sake of the aggregate projection, the review team considered it advisable to define the current “with measures” scenario in the NC3 (with afforestation rate 8,000 ha/year) as the “without measures” scenario, given that this afforestation rate has already been maintained for the past 7–9 years. Hungarian experts agreed with this opinion and suggested that a value higher than the current “with measures” (about 8,000 ha/year) and closer to “with additional measures” (15,000 ha/year) scenarios in the NC3 could be roughly regarded as “with measures” instead. Hungarian experts explained the difficulty in defining any scenario based on policies, as the domestic policies for LUCF had not been developed at the time the projections were prepared.

89. No detailed breakdown of GHG reduction or economic cost or saving is listed for the various policies and measures, nor is it clear which measures are assigned for each scenario. The latter point was clarified during the review team’s visit. Such an explicit classification and breakdown would be valuable in the energy sector, where a broad selection of measures was compounded for each scenario.

90. In the energy sector, projections were devised using the Energy Power Evaluation Programme (ENPEP) modelling system package. This model is being used for energy planning in Hungary, including various cost-benefit analyses of projects, fuel supply and pricing. Two important modules of ENPEP are the key to sufficient analysis of GHG emissions: The IMPACT module is designed to model emissions resulting from various scenarios and the BALANCE module is designed to determine the point of equilibrium for supply and demand in complex energy systems. The review team is of the opinion that ENPEP is a robust tool, well suited for the purpose of sectoral projection in the energy sector.

91. The projections for agriculture focus on $CH_4$ emissions from enteric fermentation in animal production. The projections were carried out using IPCC methodology, and in most cases using IPCC default emission factors judged by Hungarian expert experience, based on the similarity of management practices. Emission factors for Western Europe, Eastern Europe or developed countries were used. Three levels of potential production (numbers of livestock) were examined, according to the three scenarios of possible EC quotas for Hungary, as indicated in table 4. Quotas are applicable for dairy cattle and sheep. The same three levels were also constructed for non-dairy cattle, on the basis of the existing relationship in Hungary between the numbers of dairy and non-dairy cattle. These levels are based on expert opinion and consultation with additional experts at the MoA.

92. By the time of the visit, the final outcome of the negotiations with the EC on agricultural quotas had been decided and was very close to the middle range, namely the “with measures” scenario, which is called Scenario C in the NC3. The various scenarios defined in agriculture do not include actual policies and measures other than these EC quotas. Technical measures for reduction of $CH_4$ emissions in agriculture were thought by Hungarian experts to be unlikely to achieve substantial reductions, as optimal dietary practices are already in use in Hungary.

93. The CASMOFOR model was used for the projection of sinks in the forestry sector. This model was adapted from a previous one (CASFOR) that was introduced as part of the US Country Study Program. Versions of this family of models are commonly used for GHG projections for both research and reporting purposes. Leading Hungarian experts in the field of LUCF introduced country-specific factors and developed the model for their own purposes. The review team felt that this tool is state-of-the-art for Hungarian LUCF projection purposes.

94. Besides the three main afforestation scenarios based on the assumptions listed above, the species composition of the afforestation programme was examined, especially in relation to short-rotation species and slow-growing indigenous species. Short-rotation species sequester approximately half of the carbon pool. The EC subsidies are two-tiered: approximately EUR 1,000 per hectare for indigenous oak and EUR 500 for short-rotation poplar. Despite this difference in subsidy rate, almost all afforestation (over 90 per cent) utilizes short-rotation species. However, given the form of presentation in the NC3, the type of species composition that was selected for incorporation into the aggregate projections remains unclear. This was clarified after the review team's visit. A more updated run of the CASMOFOR model for LUCF produced a set of outcomes that are similar to those presented in table v22 of the NC3 but more realistic, according to Hungarian experts. It is based on the assumption of mixed species, i.e. 30 per cent indigenous slow-growing species, with 50 per cent as the upper limit.

95. After the visit, Hungarian experts provided the complete outcome of the updated projections for LUCF (table 5). The year 2000 was chosen as the base year when the carbon fixed is assumed as zero. Therefore, the actual inventory data for the year 2000 (–4,370 Gg $CO_2$ equivalent) should be added when calculating the total $CO_2$ removal in future under the "without measures" scenario. For example, by 2010, the total $CO_2$ removal would be 6,212 Gg $CO_2$ equivalent. This result corresponds well with the review team's estimate based on the inventory data. On this basis, the review team found out that the results presented in the NC3 are the projected increase in $CO_2$ removal from 2008 to 2012, not the amount of carbon that will be fixed by a certain year.

**Table 5. Comparison of projections results of $CO_2$ removal by LUCF**

| | NC3 | Updated and clarified projections | | | |
|---|---|---|---|---|---|
| | Increase 2008–2012 | Increase 2008–2012 | Carbon fixed by 2010 | | Total removal by 2010 |
| | Mt C | Mt C | Mt C | Gg $CO_2$ equivalent | Gg $CO_2$ equivalent (plus removal in 2000) |
| "Without measures" (Kyoto III) | 0.4 | 0.5 | 0.5 | 1 833 | 6 212 |
| "With measures" (Kyoto II) | 0.9 | 1.0 | 1.0 | 3 667 | 8 046 |
| "With additional measures" (Kyoto I) | 1.7 | 1.9 | 2.0 | 7 334 | 11 712 |

96. In parallel to the sector-specific projections discussed above, the NC3 provided an aggregate projection. It utilized a top-down approach to obtain the "without measures" emissions projections, and then deducted the projected reduction from energy and agriculture under "with measures" and "with additional measures" scenarios so as to obtain the final projected GHG emissions in future under "with measures" and "with additional measures" scenarios. A linear regression was calculated for the trend during the years of economic recovery (1994–1999) in which GHG emissions began to rise as well. This regression was then used for extrapolation until the commitment period (2008–2012) to obtain emission projections under the "without measures" scenario.

97. In the NC3, removal of $CO_2$ by LUCF was included in the projected total GHG emissions, not reported separately. Reductions from waste management, listed vaguely in the NC3, turned out to be a typing error and not projected. A clear list of reductions would have been of great help to the Hungarian experts preparing the NC3, as well as for the in-depth review. The lack of transparency might limit the

ability to form a realistic picture of future GHG emissions. During the visit, the Hungarian experts clarified most of the quantitative information regarding individual policies and measures, potential reduction of GHGs by sector, and the definition of various scenarios that were not clearly reported in the NC3. These are summarized in table 6.

**Table 6. Reductions in the NC3 projections, clarified and confirmed by Hungarian experts**

| Reductions (Gg $CO_2$ equivalent) from: | "With measures" | "With additional measures" | Remarks |
|---|---|---|---|
| 1. Energy | | | |
| $CO_2$ | 4 500 | 6 500 | Source of data for "with additional measures" unclear |
| $CH_4$ | 870 | 1 189 | Source of data unclear |
| 2. Industrial processes | | | Not included in projections |
| 3. $N_2O$ and fluorinated gases | | | Not included in projections |
| 4. Agriculture $CH_4$ | 309 | 620 | From EC CAP quotas |
| 5. Land use change | –1 100 | –3 000 | From COSMOFOR model |
| 6. Waste | | | Not included in projections |
| **Total reduction** | **5 679** | **8 309** | |

## C. Results of the projections

98. On the basis of clarifications during and after the review, as detailed in the above section, the outcomes of the current projections in the NC3 are as follows. In the "without measures" scenario, the linear regression approach adopted by the NC3 resulted in a total emission level of 100,621 Gg $CO_2$ equivalent (including LUCF) in 2010 (see page 80 of the NC3). The extrapolated removal by the LUCF in future under the "without measures" scenario was not reported in the NC3. Therefore, a projection without LUCF cannot be obtained directly from the NC3. Instead, the review team repeated the extrapolation exercise from the 1994–1999 data using the same simple linear regression as adopted by the NC3. The outcome from this extrapolation is that the GHG emissions without LUCF would be 104,104 Gg $CO_2$ equivalent in 2010 under the "without measures" scenario.

99. In viewing the few data points (1994–1999) comprising the reported emissions for the trend period, it was noticed that a single data point (for the year 1997) biased the regression towards a relatively optimistic "without measures" outcome, which gave a lower emission level in 1999 than the actual inventory (see figure 4). This means that the simple regression should be corrected by adding that gap (about 1,900 Gg $CO_2$ equivalent) between extrapolation and the actual inventory data for 1999. The final outcome of such a corrected regression is presented in table 7. The result of an incremental approach used by the review team as a double check is also reported in table 7, and is close to that of the corrected linear regression.

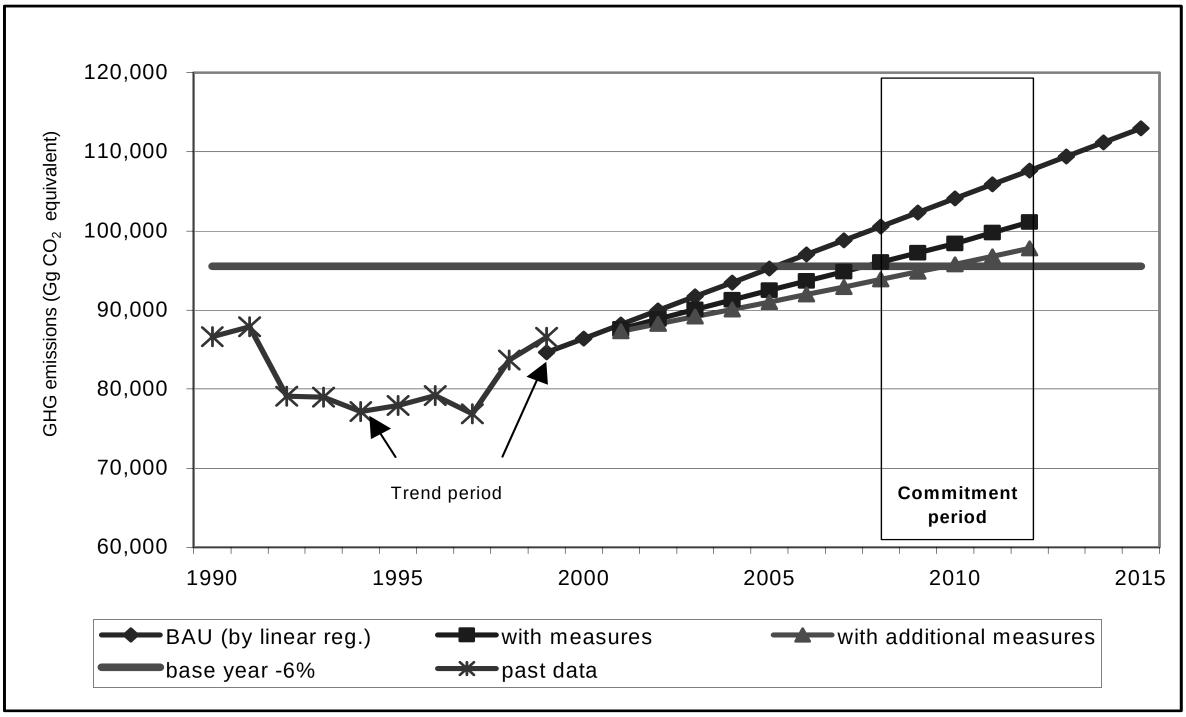
**Table 7. Results of clarified projections for 2010, excluding LUCF (Gg $CO_2$ equivalent)**

| | Extrapolation methods | | |
|---|---|---|---|
| | Linear regression (by NC3) | Corrected regression | Incremental method |
| "without measures" (BAU – base case) | 104 104 | 106 003 | 107 194 |
| "with measures" | 98 425 | 100 325 | 101 515 |
| "with additional measures" | 95 795 | 97 695 | 98 885 |

100. Figure 4 presents the historical inventory data, the Kyoto target, and an extrapolation for the years 1994–1999 as the "without measures" (BAU) scenario, and the projections for "with measures" and "with additional measures" scenarios. Projected reductions under "with measures" and "with additional measures" scenarios (shown in table 6) are taken from the NC3, clarified by the review team

and confirmed by the Hungarian experts. In figure 4 a gap of approximately 1,900 Gg $CO_2$ equivalent is evident between the historical data and the extrapolation (see the 1999 data point). This is because that the uncorrected simple regression is presented in this chart, for the sake of clarity. Sinks from LUCF were not included in this analysis, in accordance with current practice.

**Figure 4. Clarified projections for GHG emissions in Hungary**




101. Hungary's Kyoto target is 95,535 Gg $CO_2$ equivalent, i.e. 6 per cent below its base period level (101,633 Gg $CO_2$ equivalent) during the first commitment period (2008–2012). The final outcome of projections for GHG emissions without LUCF in 2010, clarified jointly by the review team and Hungarian experts, suggests the following: with the relatively optimistic approach adopted by the NC3 for aggregated GHG emissions, the GHG emissions in 2010 would be 98,425 Gg $CO_2$ equivalent with implemented and adopted policies and measures. With additional measures, the GHG emissions would be 95,795 Gg $CO_2$ equivalent, still slightly (0.3 per cent) higher than the Kyoto target. Stricter and more conservative extrapolation methods (a corrected linear regression or an incremental approach) suggest that Hungary may surpass its Kyoto target by an even greater margin, even with additional measures.

102. Improvements in Hungary's inventory and projection tools have enabled an improved set of projections compared to those in the NC2. However, current projections, as reported in the NC3, do not completely conform to the UNFCCC guidelines for the NCs. More effort is needed in this regard. The value of the projection exercise for policy formulation would thereby be increased, and uncertainties associated with the various scenarios reduced.

103. The Hungarian team acknowledged the need for improvements in the projections and has begun to arrange for further work in this field. The review team felt that Hungary could focus on the following areas:

(a) Selection of base cases that truly reflect "business as usual", allowing their use for the purpose of a top-down approach for aggregate projection;

(b) Use of IPCC spreadsheets and default emission factors to model sectoral emissions from key sources in Hungary, particularly in the IPCC categories of agriculture, fugitive emissions from energy activities and waste, in order to have a comprehensive picture of emissions in future;

(c) Clear and systematic listing of net reductions and the policies that enabled them;

(d) Selection of extrapolation method for the aggregate “without measures” scenario.

104. The review team was informed that the recalculation of the base period and 1990–1997 inventory data was in process and would take 1–2 years because of limited resources. This might result in an increase in the base period level and for 1990–1997 data, according to the Hungarian experts. This will have double-edged effects. Given the areas requiring improvement and taking into account the recalculation (potentially upwards) for 1990–1997 data, it is the opinion of the review team that Hungary is correct to state in its NC3 that it may actually exceed its target under the Kyoto Protocol for the first commitment period. The team is also aware that the current projections are incomplete and might have omitted some reduction potentials, such as in wastes and agriculture. In addition, the recalculation of the base period may enlarge the margin for meeting the Kyoto target. Nevertheless, the margin, if any, may be much smaller than previously thought. Overall, what Hungary’s GHG emissions are likely to be remains very uncertain at the time of drafting this report.

## V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

105. The NC3 identified drought as the single important impact of climate change to hit Hungary severely; this will continue into the foreseeable future. As in many other countries in the Carpathian basin, drought has been a recurring natural phenomenon and a major source of disaster in Hungary. The last 10 years were the driest period in Hungary since 1881. The area most affected by drought was the Great Hungarian Plain, the most important agricultural area of the country. The review team also learnt that predictions for the future, based on data from long-term observations on climate, showed that there was a noticeable decreasing tendency in the amount of precipitation and average soil moisture.

106. The review team learnt that there was no formalized institutional framework in Hungary dealing with climate change in an integrated way. This has led to the fact that the impact assessment in the past was fragmented and limited to drought and agriculture. Realizing this situation, after the NC3 the MoEW funded a three-year research project headed by the Hungarian Academy of Sciences, starting in July 2003. The project is entitled “Impacts and Responses Concerning Global Climate Change in Hungary”, and one third of its work will focus on climate change. The aim of this project is to provide a synthesis of existing and ongoing research results and empirical findings in this field with emphasis on impact assessment, and to encompass other aspects such as nature conservation, forestry, water and energy supply, tourism and the human dimension, not just drought and agriculture. The output of this research is expected to lead to a national intervention strategy and action plan to reduce the undesirable impacts of climate change and to adapt to them.

107. More extreme climatic events and more frequent variation in climate present a greater challenge than a perceived permanent change. Therefore, the starting point of this synthesis project is to improve the forecasting of changes. The meteorology models will cover a 100-year range until 2100, while the response strategies will be planned for 2025. Downscaling of the modelling result was mentioned as a difficulty, as was the impact assessment at regional level. Universities in Budapest are cooperating with the Hadley Centre in the United Kingdom on this issue.

108. Some of the research work has developed into strategies for adaptation measures. The synthesis project will include research to estimate the scale of financial resources needed for the implementation of

response strategies.  The review team is of the opinion that economic costing, and particularly the assessment of adaptation options, should be included or emphasized in future.

109. As an EIT country, Hungary is not expected to provide resources for Non-Annex I countries in the area of vulnerability assessment and adaptation measures.  Instead, Hungary has been cooperating with other non-Annex I countries in various programmes.  In particular, it has been participating in the project “European Regional Work Team on Drought” on drought mitigation strategy.  In addition, Hungary as a Party to the United Nations Convention to Combat Desertification is expected to benefit from ongoing programmes such as use of a strategic planning framework for sustainable development and for drought mitigation, through preparation of national action plans.

## VI. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

110. As an EIT country, Hungary receives financial support from a number of international sources that are listed in the NC3.  The Hungarian government is aware that its economic transition is almost over.  Its status will change in the future and it anticipates the need to provide financial support to developing countries, probably through international and EC agencies.

111. The NC3 also mentions possible JI projects in the forestry sector, which are under consideration.  During the visit, the review team was informed that the Inter-ministerial Committee on Kyoto Mechanisms would be the national authority for JI and emissions trading.  A national guideline for JI has been prepared but not yet approved.  The national registry for emissions trading is being established.  A dozen projects were discussed with Japan and Netherlands, but the government has approved only about half of them.

## VII. RESEARCH AND SYSTEMATIC OBSERVATION

112. The NC3 comprehensively reflected the situation in this area until early 2002.  Most recent progress took the form of a synthesis of ongoing research activities and was provided by the Hungarian experts during the visit.  Although there is still no specific government policy or guidelines for research related to climate change, the capacity has been built up gradually.  Funding of over EUR 1 million was allocated to climate change research in 2002 from the government and the environmental fund.  However, most funding was received from international sources, mainly from the EC and also from the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF).

113. The NC3 shows that the strength of Hungarian research related to climate change lies mainly in mitigation, especially in energy efficiency.  The review team had the impression that impact assessment and adaptation studies might need to be strengthened.  The Hungarian experts also felt that more research was needed on the inventory of non-$CO_2$ GHGs.  Furthermore, the costing study of mitigation needs to be updated, as the current results were mostly obtained using information from the mid-1990s.  Overall coordination of research and education in climate change could be improved further.

114. The major player in climate-related observation in Hungary is the Hungary Meteorological Service, under the MoEW.  From 1993, Hungary joined in the carbon cycle measurement project “Carbon Europe”, chaired by the United States of America.  Eötvös Loránd University is active in the downscaling study of the Global Circulation Model.  Several Hungarian scientists have won international prizes for research related to climate change.  Hungary has not yet participated in the global climate observing system (GCOS) but is cooperating actively.  Cooperation with developing countries in capacity-building was not reported in the NC3 or during the visit, because of the limited actions so far.

## VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

115. The MoEW plans to use the NCs for the purpose of enhancing public awareness. Recently the MoEW prepared a general information paper on the impacts of climate change, how to cope with them, and the necessity for international cooperation. A web page on climate change, in Hungarian, was also launched on the MoEW's web site. More information in Hungarian is still needed on the web site. A synergy project for the three Rio conventions is being discussed, with a view to using the momentum of Hungary's presidency at the ninth session of the Conference of the Parties (COP 9) to the UNFCCC in December 2003.

116. Hungary joined Global Learning and Observation Benefiting Environment (GLOBE) activity soon after this project was launched in the USA in 1999. According to Hungarian experts and NGOs, public awareness of the climate change issue is still quite low because of the lack of perceived direct impacts on humans. Two telephone surveys conducted in 1996 and in early 2003 substantiated this. The surveys showed that over 50 per cent of those interviewed did not link $CO_2$ emissions to energy or to climate change. Consequently, the Ministry of Education and the MoEW jointly set up a programme office for environmental education and communication in 1999. As a result, the school curriculum has incorporated limited information on climate change and GHGs. Several universities have developed educational and research programmes on climate change.

## IX. CONCLUSIONS

117. The information provided in Hungary's NC3 covers the inventory of GHG emissions, policies and measures, projections and other issues required by the UNFCCC guidelines for the NCs. The inventory includes GHG emissions by sources and removal by sinks in the base period (1985–1987) and 1990–1999, with the recent years being based on the up-to-date IPCC requirements (1996 guidelines). In the NC3, the inventories of HFCs, CFCs and $SF_6$ are provided only for 1998–1999. However, the 2003 inventory submission in the common reporting format (CRF) contains inventory data until 2001. Much research is being undertaken in Hungary to improve the GHG inventory.

118. Based on the most up-to-date data and information provided during the visit to Budapest, the review team concluded that Hungary's GHG emissions in 2000 are 77,215 Gg $CO_2$ equivalent, 24 per cent below the base period level (101,633 Gg). In 2001, the GHG emissions were slightly higher, although still about 24 per cent below the base period level. However, considering the inconsistency of the inventory as discussed in chapter II of this report, such a result needs to be viewed with caution.

119. Like most EIT countries, Hungary experienced an economic decline due to political disturbances around 1990, a subsequent transition to a market economy, and structural change. These are the main reasons for the trend of GHG emissions observed in Hungary, despite the inconsistency in the inventory. A few policies directly dealing with climate change have been put in place, although their implementation has hardly been monitored. The process of accession to the EC, together with other economic and social concerns, has driven the bulk of the policies relevant to climate change.

120. The NC3 included projections for $CO_2$ emissions from the energy sector and removal from LUCF, and $CH_4$ emissions from agriculture. No projections were provided for $N_2O$ or fluorinated gases, or for GHG emissions from industrial processes and wastes. The current projections were presented in terms of net GHG emissions, i.e. including $CO_2$ removal by LUCF, not in terms of GHG emissions excluding LUCF. The overall results of projections and those by sectors are not always clear or consistent. This was largely clarified and corrected during the review.

121. Hungary's target under the Kyoto Protocol is to limit its GHG emissions to 6 per cent below its base period level during the first commitment period (2008–2012). With the policies and measures

currently implemented and adopted, the emission of GHGs (without LUCF), based on the extrapolation approach of the NC3 and clarified during the review, would reach 98,425 Gg $CO_2$ equivalent by 2010, 3.2 per cent below the base period level. With additional measures, the figure will be 95,795 Gg $CO_2$ equivalent, 5.7 per cent below the base period level. The analysis in this report reveals that even this result is more optimistic than other stricter approaches would suggest.

122. Hungary indicated that it might have to employ Kyoto mechanisms, particularly JI and emissions trading, although the latter will actually become compulsory after Hungary joins the EC. The review team is aware that the current projections are incomplete, so some reduction potentials may have been omitted. In addition, the base period inventory level is currently being recalculated. Nevertheless, the margin is likely to be much smaller than previously thought. This may have a considerable impact on Hungary's ability to meet its target under the Kyoto Protocol and to utilize the Kyoto mechanisms in future.

123. Hungarian officials and experts described the following efforts as a follow-up to the NC3: (i) There will be further improvements in the estimation of the GHG inventory and the effects of climate change policies, particularly on energy efficiency, in measures related to the Kyoto mechanisms, and in energy sector modelling and database formulation; (ii) The institutional arrangements for climate change research will be improved to ensure more effective and responsive field research and the better assessment and operation of mitigation strategies; (iii) Hungary's socio-economic vulnerability will be examined in more detail, together with potential actions; (iv) The outcomes of domestic and international research on issues relating to climate change will be integrated into education, and education will play a greater role in raising public awareness.

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