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Report on the in-depth review of the second national communication of Estonia

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I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. Estonia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in July 1994. The first national communication (NC1) was submitted in March 1995. In March 1998, the country submitted its second national communication (NC2), which was in turn reviewed between December 1998 and September 1999 and included a country visit by a review team from 2 to 5 February 1999. The review team consisted of Dr Francis Yamba (Zambia), Ms Anna Violova (Slovakia), Mr. Thomas von Stokar (Switzerland) and Ms Amrita Narayan Achanta (UNFCCC secretariat, coordinator).

2. Located on the eastern coast of the Baltic Sea, Estonia has a total area of 45,227 km^2 and a generally low terrain (its highest point being 318 m above sea level). The country has a moderate continental climate. The population in 1995 was estimated at about 1.5 million, with urban areas accounting for two thirds of the total population. Of the country's land area, forests and wooded areas comprise 47 per cent, agricultural land 25 per cent, and wetlands 20 per cent. Urban areas and towns cover 2.4 per cent and roads and infrastructure 0.9 per cent of the land area. Of the designated forest area, 46 per cent is managed forest and is categorized under the Forest Act as protection forests and commercial forests; the Act also regulates felling. Estonia has one of the world's largest exploited deposits of oil shale on its northern coast and in addition has peat resources.

3. The team gathered that the process of economic reform in Estonia preceded independence from the former Soviet Union, which was regained in 1991. The subsequent transition process from a centrally planned economy to a market economy led to a significant decrease in the gross domestic product (GDP) growth rate, in both 1991 and 1992, relative to the previous year (-14 per cent and -15 per cent respectively). The structural change in GDP that accompanied this transition, was marked by a decline in the share of the forestry and agricultural sector (from 21.5 per cent in 1989 to 6.7 per cent in 1995) and an expansion of industry (from 7 per cent in 1989 to 16.4 per cent in 1995), trade, transportation and services. Since 1995, however, the GDP growth rate has been positive, reaching 11 per cent in 1997, but falling to 4 per cent in 1998. Economic growth is expected to continue up to 2002 according to the Ministry of Finance, with privatization identified as the factor most influencing growth. By 1998, most of agriculture, housing and production had been privatized, the only exceptions being infrastructure (such as water supply and sewerage, urban public transport, and railways) and energy supply. In late 1998, the Government approved a restructuring and privatization plan due for completion by 2000, for Eesti Energia, the company which dominates the power sector, and for Eesti Polevkivi, the only oil shale mining company. At present, though all the shares of Eesti Energia are state-owned, the plan includes the involvement of a strategic investor to whom 49 per cent of the shares will be sold, the rest staying with the company.

4. Total primary energy supply, which currently has a 65 per cent share of domestic fuels (oil shale, wood and peat), declined sharply from 417 PJ in 1990 to 232 PJ in 1997. There was also a steep decline in imports of fuels and electricity. For the same period, final energy consumption fell from 213 PJ to 114 PJ, due to the economic recession, ongoing privatization and economic restructuring, some stabilization being apparent from 1993 onwards. Of the final

energy consumed in 1996, households accounted for 45 per cent, industry 29 per cent, transport 16 per cent, other consumption 7 per cent and agriculture 3 per cent.

5. Administratively, the country is divided into 15 counties, 198 municipalities and 46 towns. At the central level, in 1995, an inter-ministerial "Commission on the Implementation of the UN Framework Convention on Climate Change" was constituted, chaired by the Minister for the Environment, and responsible for the coordination and implementation of climate change activities. The municipality and town governments assume responsibility for the regulation of environmental protection, public transport and sanitation, all of which have potential climate change implications. The team also learned of the creation of an environmental fund in 1983, based on revenue arising from the levy of emission charges and targeted at providing additional funding for environmental protection, but no details specifically relating to climate change protection were provided. Climate change related policy is expected to be also influenced by the screening of national legislation vis-a-vis that of the European Community (EC) necessitated by the country's inclusion in the first round of accession talks with the EC.

6. The host officials indicated that the country was still in a state of economic transition. There was no specific climate change policy but there were long-term plans at various stages of development and implementation in ministries, with the Ministry of the Environment incorporating environmental concerns in such plans. The team observed that the use of programmes, strategies and national plans, for the implementation of international agreements was stipulated in the 1995 Sustainable Development Act. Among such plans and other documents, the team received copies of the 1997 National Environment Strategy, the 1998 National Environmental Action Plan (NEAP), the 1998 Global Environment Facility (GEF)/United Nations Environment Programme (UNEP) publication 'Economics of Greenhouse Gas Limitations - phase I: Establishment of Methodological Framework for Climate Change Mitigation Assessment - Estonian Case Study', the 1998 Climate Change Studies in Estonia, and the 1998 country case study on climate change impacts and adaptation assessments in Estonia. The team was specifically informed that since some of these documents were still in draft form at the time of the compilation of the NC2, the information contained therein was additional to that provided in the NC2.

7. The team learned that the coordination and compilation of the NC2 had been subcontracted by the Ministry of the Environment to the Estonian Institute of Ecology. The host officials referred to the involvement of various ministries, non-governmental organizations and academia in its preparation. The team formed the impression that a strengthening of the current level of inter-ministerial cooperation would be useful with regard to future related work. The team's attention was specifically drawn by the host officials to the limited financial support available for the construction of the annual inventory, a fact which had led to its non-submission in 1998.

II. INVENTORY OF ANTHROPOGENIC EMISSIONS AND REMOVALS

8. The Estonian Institute of Ecology, in conjunction with the Ministry of the Environment, coordinated the preparation of the national inventory of emissions and removals of greenhouse gases (GHGs). The active contribution of the Estonian Energy Research Institute and the work done within the 1994 United States Country Studies Programme (USCSP) was mentioned to the team. Among the documents provided during and after the visit were the publications on the USCSP inventory work and energy balances for various years.

9. The team noted that in accordance with the UNFCCC reporting guidelines, information was provided on carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), but was lacking for PFCs (perfluorocarbons), HFCs (hydrofluorocarbons) and SF_6 (sulphur hexafluoride). In accordance with the guidelines, international bunker fuels were not included in the national totals. In a deviation from the guideline requirement, the NC2 lacked data tables and worksheets on the energy, agriculture, and land-use change categories, lessening the transparency of the exercise, though worksheets were provided during the visit. The review team did note the presence of significant data gaps as well as some discrepancies between figures contained in the NC2 tables. No adjustments of the inventory data were carried out.

10. The NC2 included inventory data for the period 1990-1996, for CO_2, CH_4 and N_2O, estimated on the basis of the 1994 Draft Intergovernmental Panel on Climate Change (IPCC) Guidelines and 1995 IPCC Guidelines. In 1998, no official submission of national inventory data was made to the UNFCCC secretariat, due to financial constraints; however in 1999, subsequent to the review team's visit, an official submission containing the 1997 and 1998 national GHG inventories constructed on the basis of the IPCC 1996 Revised Guidelines was made. As a consequence of this submission, the review team was able to include data for 1990-1998 in the tables of this report. However, it limited the analysis and graphical representation to the 1990-1996 period (with the exception of the overall GHG emission trend for 1990-1998), due to the presence of marked deviations in sectoral trends for 1997 and 1998 and the absence of methodological homogeneity, no single IPCC methodology having been used for the entire data set. Limited estimates of emission data for nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs) from the energy sector for the period 1990-1994, were partially included in the NC2 and also provided during the visit. The team gathered that HFCs, which had not been reported in the NC2 and were currently not produced in Estonia, were imported in 1990 (199 tonnes) and 1995 (63 tonnes). Some estimates of CH_4 and CO_2 emissions from wetlands were also included in the NC2. Subsequent to the visit the review team learnt that the host team was revising their earlier inventory estimates for the period 1990-1996, using the IPCC Guidelines and the Good Practice Guidance, apart from expert consultation in the areas of land-use change and forestry and fugitive emissions.

11. In terms of methodological changes between the NC1 and the NC2, both opted for a similar approach in using the 1994 IPCC Draft Guidelines and the 1995 IPCC Guidelines. The host team stated that the recalculated base year (1990) estimates contained in the NC2, differed from those in the NC1 primarily on account of a change in activity data, in spite of the fact that the same energy balance database was used. These recalculated estimates for 1990 in the NC2

were for CO_2 emissions from fossil fuel combustion: 37,184 Gg (the NC1 estimate having been 37,170 Gg) and from industrial processes: 613 Gg (compared to 627 Gg in the NC1). The team observed a marked difference between the communications in the 1990 estimate for the land-use change and forestry sector, which was a net sink of 11,317 Gg CO_2 in the NC2, in contrast to the NC1 estimate, which indicated a net sink of 7,947 Gg. Though the host officials referred to the altered activity data, and the inclusion of emissions from the paper and pulp industry in the NC2, unlike the NC1, the review team felt that more details should have been provided by the country on the reasons for the differences in the recalculated base year estimates, particularly in the forestry sector where they were significant. Table 1 lists the emission factors and activity data used in the construction of the inventory.

Table 1. Methodology, activity data and emission factor sources used

IPCC category	Methodology	Activity data	Emission factor
Fuel combustion	1994[a], 1995 IPCC (reference/sectoral approach)	Energy balance	IPCC default emission factors, with country emission factor used for oil shale. A Swedish emission factor was selected for gasoline and diesel. For CH_4 emissions from oil shale mining the Russian emission factor for lignite mining was selected.
Fugitive emissions	1994, 1995 IPCC	Not indicated	IPCC default
Industrial processes	1994, 1995 IPCC	Not indicated	Not indicated
Agriculture	1994, 1995 IPCC	Statistical Year books	IPCC default
Land-use change and forestry	1994, 1995 IPCC	Forestry Year book	IPCC
Waste	1995	Statistical Yearbooks	IPCC default used for solid waste disposal and waste water handling.
Wetlands	1995	Not indicated	IPCC default

a: This refers to the IPCC Draft Guidelines, 1994.

12. A noticeable decrease in CO_2, CH_4 and N_2O emissions for all source categories was attributed primarily to an economic decline during the 1990-1996 period. Bearing in mind that different IPCC methodologies were used, the figures show that total CO_2 emissions in 1998 declined by around 52 per cent with respect to emissions in 1990; CH_4 emissions declined by 22 per cent (excluding emissions from the land-use change and forestry sector, which were not available) and N_2O by around 56 per cent.

A. Carbon dioxide

13. In estimating CO_2 emissions from the energy sector, Estonia used both a top-down IPCC reference approach (tier 1) and a sectoral approach (table 2). In 1996, of the CO_2 emissions from fuel combustion, the dominant share of 88 per cent was from the energy and transformation sector (75 per cent in 1990). This contribution was predominantly due to the combustion of oil shale, which constitutes 68 per cent of the fuel used for electricity and heat generation. The related CO_2 emissions are formed due to the combustion of a product containing organic carbon and also as a decomposition product of the carbonate in the shale. The other fuels being used for electricity and heat generation and contributing to CO_2 emissions include heavy and light fuel oil, shale oil, firewood, peat and coal.

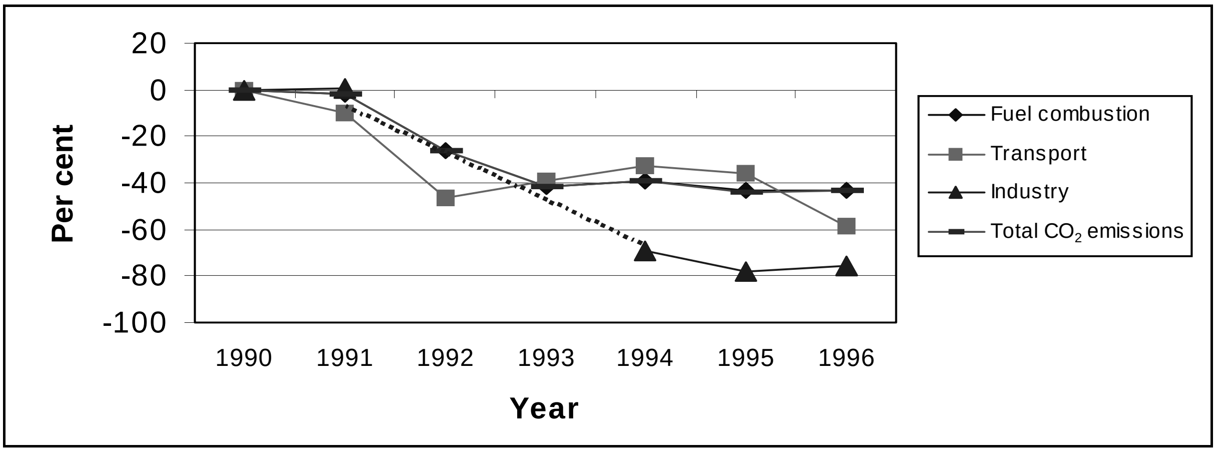
Table 2. Carbon dioxide emissions and removals, by source and sink, 1990-1998 (Gg)

Source category	1990	1991	1992	1993	1994	1995	1996[a]	1997[b]	1998[c]
Fuel combustion[d]	37 184	36 342	27 453	21 786	22 668	20 980	21 216	20 362	18 890
including transport	2 656	2 386	1 432	1 607	1 786	1 700	1 095	1 097	1 236
including industry	2 897	2 912	NA[e]	NA[e]	898	633	710	656	666
Industrial processes	613	613	313	193	215	222	206	353	342
Total CO_2 emissions	**37 797**	**36 955**	**27 766**	**21 979**	**22 883**	**21 202**	**21 422**	**20 715**	**19 232**
Land-use change and forestry	-11 317	NE	NE	NE	-11 125	-13 266	NE	7 993	-3 356

Note: NE: not estimated; NA: not available. The data contained in this table need not correspond exactly to the information contained in the NC2, due to the use of sources such as annual inventory submissions, and information submitted during and after the visit.
a: The CO_2 emission data for the period 1990-1996 were calculated using the 1994 and 1995 IPCC Guidelines;
b: The 1997 CO_2 emission data were estimated using the 1996 IPCC Revised Guidelines, and were part of the 1999 submission;
c: The 1998 CO_2 emission data were estimated using the 1996 IPCC Revised Guidelines, and were part of the 1999 submission;
d: The category of fuel combustion includes transport and manufacturing industries and construction; its separate inclusion is meant to allow an understanding of general trends;
e: The country indicated low reliability for sectoral fossil fuel use data.

14. Additionally, during the review the host officials provided some minor corrections for the entries for 1994 and 1995, for the total CO_2 emissions from fossil fuels, in table 3.2.4 of the NC2. In the same table, a 33 per cent increase during 1990-1996 in emissions from solid biomass was attributed to the substitution of relatively higher-priced imported fuels by the increased use of woodchips in boilers and an improved collection of statistical data at the household level. The team learned that the energy sector calculations also took account of emissions arising from the oil-shale-related petrochemical industry. In the manufacturing industry subsector included under reporting for the energy sector, the NC2 only contained data for 1990 and 1996 and lacked data for the intervening years. This subsector emitted 2,897 Gg CO_2 in 1990, declining to 710 Gg in 1996. Of the industries included in the manufacturing subsector, the pulp and paper industry had closed in 1993 and resumed on a small scale in 1994-1995.

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



Note: The dotted line indicates missing data for 1992-1993.

15. As regards the emission estimates from the transport sector, which were limited to road transport, the host officials indicated that in the 1990s, the vehicles used in Estonia primarily originated from the former Soviet Union as Estonia lacked emission factors. As a result for such vehicles, the calculations did not consider vehicle type and instead were based on sectoral fuel consumption using the IPCC Guidelines. For the non-CO_2 GHG emissions from transport, the calculations applied Swedish emission factors taken from the Swedish national report (1994). The host officials clarified that the abrupt decline in CO_2 transport emissions in 1996 in contrast to the earlier years was due to an abrupt reclassification of gasoline and diesel consumed by passenger cars to the residential category, and also a decline in motor fuel consumption (37.3 PJ in 1990 to 21.6 PJ in 1996) due to a reduction in public and freight transport for the same period. As regards the issue of classification, the review team suggested that in future, fuel consumed should be reclassified under the transport sector to prevent an underestimation of sectoral emissions. The hosts also corrected the 1996 emission estimate of CO_2 from the transport sector contained in table 3.3.2 of the NC2 to read 1,095 Gg instead of 1,534.1 Gg.

16. The team noted that the difference between the 1990 land-use change and forestry estimate contained in the two communications referred to earlier, was attributed to the inclusion of the state-owned forest land in the former inventory in contrast to the latter where both state-owned forest land and forest land owned by other owners was considered. The team was not informed on the implications of either selection. The hosts elaborated on the NC2 land-use change and forestry calculations, which were based on the 1994 data and had taken into account CO_2 removals due to the biomass increment in managed forests and accumulation occurring in abandoned lands and emissions based on forest conversion and harvesting activity. The team sought clarification of the reasons for the differences in net values from the land-use change and forestry sector, as contained in tables 3.7.1 and 3.8.1, and was informed that the latter table incorporated changes occurring due to various human activities on peatlands and wetlands. Subsequent to the visit the review team was informed that the current estimates in the land-use change and forestry sector could be considered incomplete due to the difficulties associated with the measurement of emissions arising due to the amelioration of wetlands. Additionally, the

absence of data for this sector for 1991, 1992, 1993 and 1996 in table 3.7.1 of the NC2 obscured the trend in emissions and removals from this sector for the period 1990-1996. Furthermore, even in a single year such as 1995, an apparent increase in carbon sequestration was attributed by host officials primarily to a change in land categories. The review team also noted an abrupt change in the status of the land-use change and forestry sector, from being an emission sink in the period 1990-1995, to an emission source in 1997. The team strongly recommended that the country team examine the underlying reasons for this trend and also suggested that it refine and complete its data set.

17. With regard to the industrial processes category, though the industrial processes emitting CO_2 in Estonia include cement production, lime production, and limestone and oil shale ash consumption, the NC2 estimate was restricted to emissions from cement and lime production for the period 1990-1996. For 1990, the value was 613 Gg and for 1996 it was 206 Gg.

18. The reporting on international bunker fuels commenced in 1996, and in 1997 was estimated at 312 Gg CO_2 for the category of aviation bunkers. The host officials mentioned that all the related reporting concerns had not been resolved so far and there were still some remaining inaccuracies. The team also learned of the country work being done on CO_2 and CH_4 emissions from wetlands such as fens, swamps and flood plains.

B. Methane

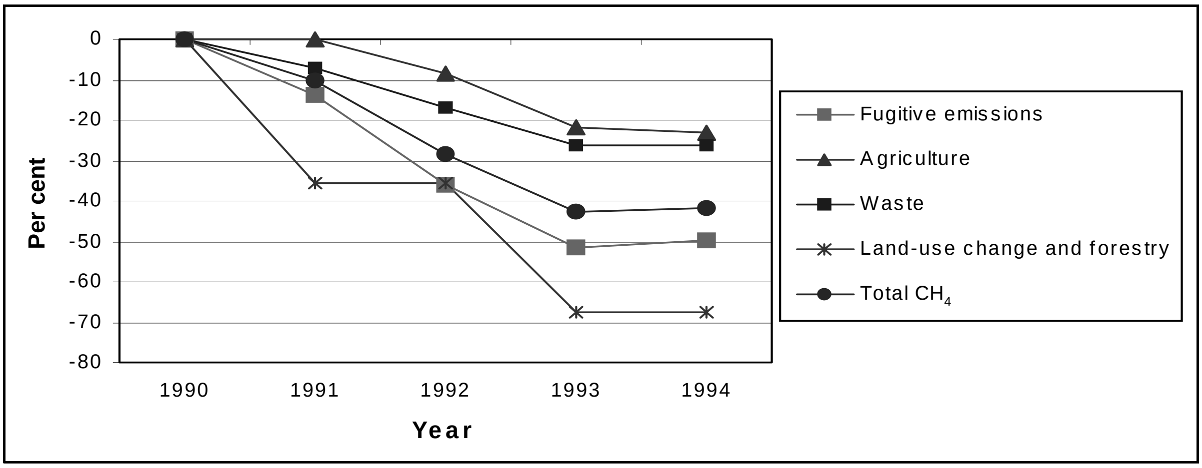
19. In the case of CH_4 emissions, the team noted that the major sources included fugitive emissions from oil shale mining and handling activities, and shale oil and natural gas activities (primarily distribution), and the agriculture and waste management sectors (table 3). In 1996, in the absence of reporting on fugitive emissions and emissions from the land-use change and forestry sector, the largest contribution was from waste (50 per cent) and agriculture (48 per cent). The emissions from waste arose from landfills, domestic and commercial waste-water treatment and industrial waste water. In the waste sector, the emission trend has been one of decline, primarily due to a reduction in industrial waste water. In agriculture, emissions resulting from animal husbandry fell from 60 Gg in 1990 to 34 Gg in 1995, due to a decline in the number of livestock. For the period 1996-1998, the host team felt that the livestock data needed to be reviewed and the emission calculations accordingly modified. In the case of fugitive emissions, the NC2 lacked data for 1995 and 1996, in spite of their otherwise high contribution to the total in other years for which data were available. Consequently, the CH_4 data for 1995 and 1996 contained in table 3 are not comparable with the rest of the data series, and are likely to be underestimates. In terms of the broad trends, however, the team observed a declining trend since 1990, with the decline attributed to a reduction in the mining and processing of oil shale and partially due to an altered emission factor. The latter was due to the initial use of the emission factor for lignite in the absence of IPCC emission factors for oil shale mining and handling, the values of which were further reduced on the basis of expert opinion.

Table 3. Emissions of methane by source, 1990-1998 (Gigagrams)

Source category	1990	1991	1992	1993	1994	1995[a]	1996[b]	1997	1998[c]
Fossil fuel combustion	3	3	2	2	2	2	2	3	6
Fugitive emissions	217	187	139	105	109	NR	NR	32	29
Agriculture	60	60	55	47	46	34	30	35	30
Waste	42	39	35	31	31	32	31	34	36
Total CH_4[d]	**322**	**289**	**231**	**185**	**188**	**e**	**e**	**104**	**101**

Note: NR: not reported; and NA: not available.
a and b: Total methane emissions for both a and b are not comparable with those of other years due to the absence of reporting of fugitive emissions and in b also due to the absence of reported data on land-use change and forestry.
c: No estimates of methane emissions from land-use change and forestry were available for 1998.
d: The total under this heading may differ slightly from that reported in the NC2 due to rounding of underlying numbers. The total also includes the land-use change and forestry sector.
e: The total is missing for the years 1995 and 1996 due to the lack of reported data on fugitive emissions.

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



Note: The data points in the graph are limited to the period 1990-1994, due to the non-comparability of total CH_4 data for 1995 and 1996.

C. Nitrous oxide

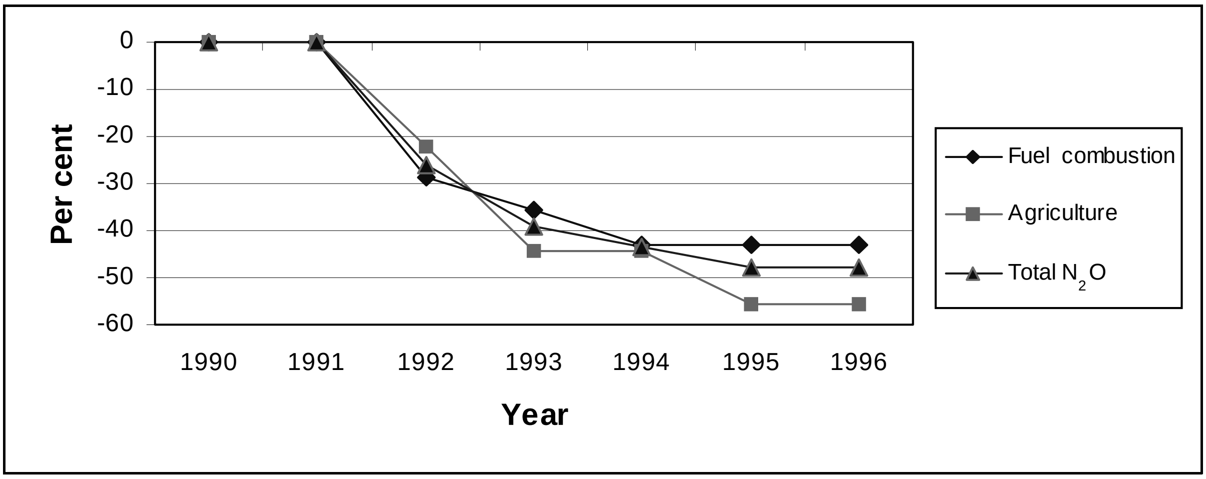
20. In the case of N_2O emissions, in 1996, the largest contribution of 67 per cent was due to fuel combustion (62 per cent in 1990), followed by agriculture at 33 per cent (38 per cent in 1990). Estonia limited its reporting for this gas to the two categories shown below (table 4). While the review team's attention was drawn to an apparent three fold increase in agriculture related N_2O emissions between 1995 and 1998, the team felt that the estimates for the period 1990-1996 and that for 1997-1998 were not strictly comparable due to the use of different methodologies (1995 and 1996 IPCC Guidelines respectively). The team also observed that though the arable land under cultivation had gone down slightly over the same period, the per hectare application of nitrogenous fertilizer had risen. It was also felt that the use of the IPCC 1996 Guidelines could have also affected the estimate upwards due to increased source coverage. It is therefore a combination of these factors which have led to this apparent increase in N_2O emissions in spite of low agricultural productivity.

Table 4. Emissions of nitrous oxide by source, 1990-1998 (Gigagrams)

Source category	1990	1991	1992	1993	1994	1995	1996	1997[a]	1998[b]
Fuel combustion	1.4	1.4	1.0	0.9	0.8	0.8	0.8	0.7	0.1
Agriculture	0.9	0.9	0.7	0.5	0.5	0.4	0.4	0.4	1.2
Total N_2O	**2.3**	**2.3**	**1.7**	**1.4**	**1.3**	**1.2**	**1.2**	**1.1**	**1.3**

a: 1997 data were estimated using the 1996 IPCC Revised Guidelines, and were part of the 1999 submission.
b: 1998 data were estimated using the 1996 IPCC Revised Guidelines, and were part of the 1999 submission.

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



21. The current trend of emissions from agriculture is associated with the process of privatization, which has led to a decline in agricultural production as reflected in the reduced area sown (from 1.1 million ha in 1990 to 850,700 ha in 1995). Cost considerations have also led to an increased tendency to use organic manure and compost, instead of inorganic fertilizers.

22. The team noted that the statistical service started data collection in the energy, transport and forestry sectors in 1992-1993, leading to an improvement in data reliability. Nevertheless the team was informed that the reliability of energy sector data was still low (due to low reliability of data on sectoral fossil fuel combustion), as was that of the agriculture and land-use change data, while that of forestry data was moderate (thanks to an official database dating back 200 years). The team was informed that the reliability of the energy sector data had improved recently.

III. POLICIES AND MEASURES

23. The NC2 improved considerably upon the NC1 by tabulating various policies and measures for the reduction of CO_2, CH_4 and N_2O emissions, though this was not organized in line with the UNFCCC guidelines. Information was not provided on the status of implementation, estimate of mitigation impact or monitoring of progress of the measure. The lack of adequate information on the subject in the NC2 required the provision of additional information both during and after the visit. Host officials referred to the difficulty of determining the impact of

various policies and measures. The team also observed that most of the measures identified within the table lacked description, with additional information being provided during the visit.

A. Cross-sectoral measures

24. Among the cross-sectoral measures the team was introduced to were the National Environment Strategy, the National Environmental Action Plan and the natural resource taxes. The 1997 National Environment Strategy had the goal of reducing air pollution, focussing primarily on those substances responsible for climate change and also air pollutants from the transport sector. The tasks identified by the Strategy to achieve this goal in the short, medium and long term, namely 2000, 2005 and 2010, were mentioned in the NC2. Furthermore, the team was informed that in order to implement the Strategy, the Government had developed a National Environmental Action Plan in 1998, with the aim of providing policy guidance for local environmental requirements, which identified cross-sectoral priority actions and their funding status and also prioritized such expenditure. The team noted however at the time of the visit, that there was no monitoring of the plan's implementation for even the short term (1998-2000), nor had there been any estimation of the anticipated impact, although the plan itself is to be reviewed at a future unspecified date. The team took note that the natural resource tax (applied to land, water, mineral resources, oil shale and peat) initiated in 1991 and also mentioned in the NC2, depended on the harmonization schedule with the EC. No further details were provided.

B. Energy supply and transformation

25. In the energy supply and transformation sector, the team learned of the Long-term Development Plan for the Estonian Fuel and Energy Sector, the Energy Act and the energy pricing and the taxation policy. The Long-Term Development Plan for the Estonian Fuel and Energy Sector, adopted by the Estonian Government in February 1998, forecasts the development of the fuel and energy sector till 2015 and the major development trends up to 2018. The team recognized that this document, which reflects the country's energy policy, would definitely have a positive impact on reduction of GHG emissions in the near term as it foresees a reduced role for oil shale in electricity and heat generation from a level of 68 per cent in 1996 (69 per cent in 1997) to 50 per cent in 2005. Additionally, the Plan visualizes that the share of natural gas in electricity and heat generation will double to 22 per cent by 2010, and the share of renewable energy sources will rise from a level of 8 per cent in 1996 to 13 per cent in the year 2010. The team questioned the target relating to natural gas, as a steady decline was noticeable in its share of the final energy consumption. Among the important elements associated with the Plan's implementation are the further development and amendment of the 1998 Energy Act.

26. The host officials stated that the enforcement of the Energy Act, which constitutes the main law regulating activities in the energy sector, and its subsequent amendments, could be considered as a first step towards creating an energy market, in harmony with the EC principles of promoting competition and access to the electricity market. Among the principles for the energy sector included in the Act and currently under implementation are: the transparency requirement in pricing, state supervision of the sector through technical and energy market inspectorates, prohibition of cross-subsidization (cross-subsidies still occur but are to be eliminated in the next couple of years) and promotion of energy conservation within the Energy Conservation Target Programme (discussed later). Under the heading of energy conservation, the Government referred to the reduction of fuel (important due to the country's complete dependence at the time on the former Soviet Union for all imported fuel) and electricity imports by almost half between 1990 and1997 (mainly due to reduced production capacities), and the replacement of such fuels through the wider use of indigenous fuels such as peat and wood (which have shown a limited increase in consumption), accompanied by other energy conservation measures. The host officials mentioned that most energy conservation were a result of the shift towards a market economy. Energy conservation measures have been financed mostly from loans guaranteed by the Government and from international aid programmes. In the context of EC market liberalization, third party access is a part of the Energy Act. Though the underlying principle of such access has been approved, the necessary acts for its implementation are yet to be developed. The team was apprised of the clauses relating to the obligatory purchase of renewable electricity as well as its pricing, but did not gather further details on their implementation.

27. The team gained some insight into the process of liberalizing energy and fuel prices, in progress since 1990, with prices being continuously increased, a trend also favoured by the Energy Act. The team learned that the prices of oil shale (which in 1997 averaged around EK 106 /tonne), electricity, shale oil and district heating were set by the Government and covered production costs, whereas those of natural gas, coal and petroleum products were at the level of EC free market prices. The team understood that though the prices of indigenous fuels such as oil shale, peat and wood had also registered price hikes they were still priced lower than solid fuels in neighbouring countries. The host officials also elaborated on the fuel price, which included both excise tax and value added tax (VAT), the latter set at 18 per cent; and the VAT exemptions accorded since 1997 to peat, peat briquettes and fuelwood sold to households, and heat energy sold to residents, churches and institutions financed by central or local budgets. A VAT exemption had also been provided to wind and hydro power under an amendment of the Energy Act. The team was informed that there had been a decline in cross-subsidies in electricity pricing, due to the frequent price increases, which in 1997-1998 were around 14.4 per cent for all consumers and around 19.9 per cent for small consumers. The team's visit occurred at the time the country was considering a CO_2 tax set at EK 5/tonne CO_2 for energy sources greater than 50 MW. This tax has been implemented since the beginning of 2000, and is anticipated to rise in 2001 to EK 7.5/tonne CO_2.

28. In the case of electricity generation, the review team noted a steep decrease from 17,181 GWh in 1990 to 9,103 GWh in 1996, a decrease primarily attributed by host officials to a

decline in electricity exports which in 1990 were 8,477 GWh and fell to 1,100 GWh in 1996. The team learned that the country's electricity generation, transmission and distribution is dominated by the largest state-owned company, Eesti Energia (accounting for 98 per cent of the total generation in 1998), apart from a 1-2 per cent market share contributed by some independent generators and distributors. According to the hosts, Eesti Energia is to complete restructuring by 2000, whereby it is to be split into different enterprises for production, transmission and distribution.

29. Oil shale, a key indigenous energy resource, had a fluctuating share in primary energy supply during 1990-1996, ranging from 70 per cent in 1960 to 61 per cent in 1996. On the one hand, the long-term significance of oil shale in the energy sector is evident in that the Long-Term Development Plan for the Estonian Fuel and Energy Sector envisages it providing a 50 per cent share of primary energy supply till 2010. On the other hand, given that its contribution to total fossil-fuel-related CO_2 emissions was as high as 71 per cent in 1996, any future CO_2 plans would have to address this emission source. Quite apart from these two aspects of its use, there is a significant social dimension to its continued usage, namely the employment of around 13,000 people, inclusive of mining. The team noted that though oil shale is utilized in heat production, in shale oil (synthetic crude oil) production, for direct final use (e.g. heating in industry) and for non-energy purposes (e.g. in the chemical industry), it is its use in the four oil shale powered plants (capacity of 3,059 MWe and thermal capacity of 1,642 MWth), including the Eesti plant) accounting for approximately 98 per cent of the generated electricity, and contributing around 12,500 Gg of CO_2, on which mitigation efforts are focussed.

30. Given this background, the team recognized the importance of the reconstruction of oil shale power plants reported in the NC2. The team was informed that Eesti Energia had been assessing the feasibility of replacing the current pulverized combustion technology (PC) by either the atmospheric circulating fluidized bed combustion (ACFB) technology or the pressurized fluidized bed technology (PFBC). The ACFB technology is estimated to lead to a 17 per cent decrease in CO_2 emitted (from 1.4 kg/kWh (PC) to 1.15 kg/kWh) and also a decrease in sulphur dioxide (SO_2) emissions. The use of the PFBC technology has the potential to increase efficiency to 42-46 per cent and reduce CO_2 emitted by 42 per cent in comparison to the PC technology. The team was informed that the estimated cost of replacing the 200 MWe pulverized firing oil shale power generating unit by PFBC boilers would require an investment of around EK 9,000-9,500/kW; and by ACFB technology EK 6,000-7,000/kWe.[1] The host country mentioned that so far combustion tests conducted by various energy companies using ACFB technology had proved successful and those using the PFBC technology were promising. To enable the future installation of the ACFB technology, one of the units of the Eesti power station was being dismantled since December 1998. Completion of the modernization plans was expected in the middle of 2002, progress being influenced by the planned privatization and restructuring.

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[1] The average annual exchange rate in 1995 was EK 11.46 to the United States dollar.

31. Peat, which has the next highest share of CO_2 emissions resulting from solid fossil fuels after oil shale, is also used for electricity and heat generation (approximately 1 per cent in 1996), and has a carbon emission factor of 28.9 tonnes C/TJ. The team also took note of the 1995 legislation which specified limits for the sustainable extraction of peat. According to a World Bank study, such extraction exceeded the natural peat accumulation by a factor of three and therefore could not be considered sustainable.

32. Although the NC2 made no specific mention of measures to enhance the use of renewable energy (of which biomass and wind energy are important), as earlier mentioned the review team learned of the related provisions in the National Environmental Action Plan and the 1998 amendment of the Energy Act allowing for the obligatory purchase by the public grid of electricity from renewable sources. The team also learned that the country's potential for annual fuelwood use was around 22-35 PJ, with potential for wind generated electricity being around 0.3 TWh per annum in the coastal areas. The high capital costs of wind generated electricity relative to the low cost of electricity from oil shale indicates that the former is still not economically feasible. To date, there is only one commercial wind turbine (150 kW), which has been in operation since 1997. The country's limited hydro power potential is due to the flat nature of the terrain and relatively small discharge of Estonian rivers. The installed capacity is currently approximately 1.385 MW for five mini-hydro plants, with the restoration of a few old plants likely to add another 4-5 MW. The host officials stated that solar energy was not in use except for a limited application for household water heating. The team learned of the 1998 assessment of policy options promoting wood energy conducted as part of NEAP, apart from the fact that electricity production from wood was not competitive unless subsidized.

33. The team was also informed of two cogeneration plants installed in Tallinn having an installed electricity capacity of 201 MWe and heat capacity of 1,027 MWth. In addition to these, there are some small old industrial combined heat and power generation (CHP) plants and two plants based on natural gas.

C. <u>Residential and commercial building sector</u>

34. In the residential sector, energy is mainly consumed for space and water heating. The team understood that Estonia possessed a well developed district heating network, with heat being produced by power and cogeneration plants in district heating boiler houses and industrial enterprises. In 1996, in the case of the district heating boiler houses the consumption by fuel type was heavy and light fuel oil and shale oil (37 per cent in 1996), gas (35 per cent), oil shale (1.7 per cent), wood (10.8 per cent), peat (4.3 per cent), coal and other fuels (10.5 per cent). The trend since 1994 towards increased use of natural gas and decline in use of fuel oils in heat generation has positively influenced the related GHG emissions, as has the increased use of cogeneration in power plants, with cogeneration accounting for 33 per cent of the total heat produced in 1998, in contrast to 18 per cent in 1997. In 1998, 36 per cent of the heat was generated in power plants (including 88 per cent by cogeneration) and 64 per cent in boiler houses. The team also learnt that other changes which were expected to increase the efficacy of heat production include ownership changes of district heating companies, including the transfer

of smaller companies to municipalities, the conversion of larger companies to public limited companies and the conversion of some smaller companies to private limited companies, leaving some large companies under partial state ownership.

35. The team gained some insight into the energy conservation potential in this sector, which was estimated to be in the range of 20-30 per cent relative to the present-day situation. Among the measures identified in the NC2 were the reconstruction of heat distribution networks and installation of heat meters, the reduction of heat losses through improved building insulation and the use of indigenous fuels such as peat and wood; of these, the implemented measures included metering of heat and hot water, hydraulic balancing of the internal heat distribution system, installation of thermostats on radiators, improvement of thermal insulation of external walls, additional insulation of roofs, and replacement of existing boilers. The review team learned that in 1998, 28 per cent of the local municipality investments were directed at modernization of heating systems, leading to a 20 per cent energy saving. The team was also informed that the first Energy Conservation Target Programme for the period 1992-1998, whose main focus was on updating heat production and distribution facilities and wider exploitation of local fuels, was allocated a sum of EK 82.2 million for the entire period. In 1992, programmes relating to heat metering, and energy conservation in public and institutional facilities were set up. The team noted with concern, however, that state funding in 1996 for this programme was only EK 14.7 million, and dropped to about EK 8.7 million in 1998. The team also learned that, in addition to the contribution by the State, several international financial organizations such as the World Bank and the European Bank for Reconstruction and Development had also financed the programme through soft loans. Furthermore, the team gathered that an action plan to implement the Energy Conservation Target Programme for the period 2000-2005, was under development.

36. The energy conservation efforts in the residential sector have also been boosted by the Swedish Programme "Environmentally Adapted Local Energy Systems" in the Baltic region. Under this programme, which started in1996, 16 projects relating to boiler conversion, renovation of district heating and increased energy efficiency were initiated at an investment cost of US$ 24 million, with an associated annual reduction potential of 297 Gg CO_2. As regards the use of indigenous fuels in district heating mentioned in the NC2, the team noted a decline in the number of peat boilers (121 in 1996 to 96 in 1997) and wood-fired boilers (885 in 1996 to 792 in 1997).

D. Industry

37. The amount of information provided on this sector was limited, but host officials referred to the steep decline in industrial production between 1990 and 1998 and the fact that 95 per cent of industry had been privatized. In terms of background information on the sector, the team noted that in 1995, of the manufacturing industries, the largest primary energy consumers were the chemical industry, other non-metallic mineral products, fuels and power engineering and the food industry. In those industries which emit GHGs through their industrial processes, the NC2 singled out the emissions from the cement and limestone industries. However, the team noted that no concrete information on the measures in place in industry were contained either in the

NC2 or provided during the review, with the exception of information on the Estonian Innovation Fund, which was initiated in 1991.

38. The Estonian Innovation Fund was set up to enable the implementation of high-risk technological projects which, due to their risk level and long payback period, would not normally be financed by commercial banks. In 1997, the Fund initiated the financing of 43 new projects (one of which involved the reconstruction of a boiler for burning local fuels using fluidized bed technology) and continued financing of 10 earlier projects to the sum of EK 20.4 million, of which EK 4.77 million was in loans and EK 15.67 million in grants.

E. Transport

39. The team noted that, while the NC2 tabulated a few policies and measures for this sector, there was a lack of information on their objective, their content and associated CO_2 reduction potential. Among the measures tabulated were improvements in the public transport system, the application of a differentiated excise tax on types of gasoline, a governmental tax policy for renovation of the car fleet and annual vehicle check-ups. The team learned that the prevalent transport policy, which was harmonized with the EC requirements, focussed on increasing the competitiveness of public transport, supporting infrastructure maintenance and development and reducing environmental impact. Though it had been anticipated that a new transport policy for the period till 2006 would be introduced in late 1999, this had not occurred by March 2000. This policy was expected to lead to an (unspecified) improvement in the quality of diesel and gasoline and an incentive for their consumption via the use of a lower internal revenue tax, and the promotion of public transport, particularly electric transport.

40. The total vehicle fleet involved in public transport dropped from 6,900 vehicles in 1995 to 6,300 vehicles in 1998, in contrast to the number of passenger cars, which rose from 383,000 to 452,000 over the same period (table 5). Some stabilization in this transport occurred in 1997-1998. The host officials indicated that public transport was being promoted by means of subsidies, and personal vehicle ownership discouraged by annual vehicle taxes and parking charges. The team learned of the Public Transport Act, which was under development at the time of the visit and was expected to enhance funding of public transport, but no further details were available as of March 2000. The level of subsidies provided in 1997 by state and local budgets was around EK 405,000, the subsidy for local railway passenger transport having doubled in 1997-1998. The annual vehicle tax, which has been in force since 1996, is primarily based on the engine capacity and vehicle age, with higher taxes levied on cars having an engine capacity of more than 2 litres and vehicles older than 10 years. The team learned of the attempt in 1998 to introduce a new bill on the annual vehicle tax, aimed at increasing the prevailing level of tax, which was rejected by parliament. However, subsequent to the visit, the team gathered that the tax levied on private cars had risen by around 30 per cent.

Table 5. Composition of vehicle fleet in Estonia, 1995-1998 (thousand vehicles)

Type of vehicle	1995	1996	1997	1998
Passenger cars	383.3	406.6	428	452
Heavy goods vehicles	65.7	71.3	76.6	80.8
Buses	6.9	6.8	6.4	6.3
Motorcycles	*	4 680.0	5 337.0	6 136.0

* No data were available for the year 1995.

41. The team noted that the current structure of the differentiated excise tax on motor fuels based on fuel type, was favourable to GHG reduction. As of January 2000, the excise tax on gasoline was EK 4/l (sales price of EK 10 is inclusive of 18 per cent VAT) and EK 3.7/l on diesel (sales price of EK 9 is inclusive of 18 per cent VAT), slightly favouring diesel usage. The team also noted that the revised Car Duty Act (originally enacted in 1998) also favoured the renovation of the vehicle fleet by penalizing large cars (of over 2 litres) and older imported cars.

42. The team also learned of a regulation facilitating the annual vehicle inspection, in accordance with the EC directives, the frequency of the inspection being determined by the type and purpose of the vehicle. For instance, lorries and cars older than 10 years require annual check-ups, cars less than 10 years old are to be checked every second year, and buses bi-annually checked for hydrocarbons, carbon monoxide and carbon dioxide. Diesel engines in older vehicles have to undergo a check every year. The country also intends to harmonize its emission standards with those of the EC.

F. <u>Waste</u>

43. The country’s municipal waste generation was quite stable over the period 1993 to 1996. In terms of background, the team gathered that at present there are approximately 400 landfills of which 300 are municipal service enterprises, with the remainder owned by industrial waste generators. The small landfills come under the authority of local government, a large number of them being unauthorized sites where dumping of domestic waste occurs. Though the NC2 mentions the drafting of new laws, fines for unauthorized dumping, the improvement of waste storage conditions and the utilization of biogas from dumps, the hosts primarily referred to the 1998 Waste Act drafted in accordance with the EC draft proposal on landfills. The Act itself includes elements such as the construction of new landfills (to be sited under the NEAP), the closure of old landfills and the use of landfill gas for energy purposes. At the time of the review, Tallinn was the only city with an installed gas collection system and a pilot project under way for gas utilization in heating boilers; the implementation status of the remaining elements was unclear.

44. The team learned that a feasibility study on the treatment and incineration of Tallinn’s municipal waste, which constitutes one third of the country’s waste, a measure identified in the NC1, had not yet been implemented due to its financial non-viability. Municipal waste is currently incinerated in ordinary combustion plants. Other efforts in the waste sector include the

encouragement of waste separation and recycling, tax exemption for recycling of alcoholic drink packaging and the treatment and composting of organic waste prior to landfill entry.

G. Agriculture

45. The host officials referred to the general lack of accurate statistics in this sector, though some discernable trends were evident to the team. The background situation for this sector was that between 1990 and 1995, the volume of agricultural production fell by around 40 per cent, followed by some stabilization in 1996 and a slight increase in 1997. Among the measures mentioned in the NC2 is the use of fertilizer in accordance with soil requirements, while the actual situation in 1996 was a per hectare application of fertilizer at approximately 10 per cent of the level applied in 1987. The level of fertilizer application was expected to show some increase, with implications for N_2O emissions. In the same context, the team learned of the ongoing development of a directive on the application of nitrogenous fertilizers.

46. The NC2 also lists the improvement of cattle-breeding productivity as a CH_4 emission mitigation measure. Although the team was not provided with any further details on cattle breeding, it gathered that livestock populations, which had been declining, have stabilized; while the number of pigs dropped from 1 million in 1989 to 449,000 in 1995. Some work is also being done under a Danish project to improve the norms of fertilizer application, especially cattle manure, with the aim of reducing CH_4 emissions. The host officials also mentioned ongoing collaborative projects with Finland and Sweden, wherein guidelines for organic manure management and good agricultural practices, respectively, were being developed. The team noted that the country had already implemented the 1997 Organic Agriculture Act, which recommends the use of composted solid and liquid manure in amounts not exceeding the nutritional requirements of plants and prohibits pollution of the environment with animal husbandry waste products, and was developing a long-term strategy for sustainable agriculture.

H. Land-use change and forestry

47. The team gathered that the Estonian forests fall within a belt of mixed and coniferous forests having relatively favourable growth conditions and extend to 2.02 million ha. In terms of ownership, 57 per cent of the forests are state-owned and the rest in the course of privatization. Privatization has led to the formation of smaller holdings with an average size of 10 ha, and a restriction of normal management activities due to the ongoing property and land reform process. The team gathered that privatization could lead to an overcut in such forests though this was not expected in the near term and contrasted with the current undercut in the Estonian forests.

48. The NC2 mentioned measures such as the laws on forestry and land management, forest preservation, fines for unauthorized felling, and consultations offered to private owners, but did not give estimates of the expected CO_2 emission reduction. The review team observed that the identified measures were of such a nature that quantification of their GHG reduction would be difficult. The review team was informed that the National Forest Policy adopted in June 1997 was expected to serve as the basis for new legislation and identify development and investment

programmes in the sector. Additionally, the Government was expected to fund forest management plans promoting the rational use of forest resources, and enforce new and higher penalties on illegal felling, which currently accounts for 1 per cent of the total felling within the country.

49. Though the NC2 did not specifically mention the National Afforestation Plan, the team felt it was important as the ministries of agriculture and forestry were screening land from a "plantability" standpoint. So far, it has been estimated that the abandoned agricultural land available for afforestation would be around 120,000 ha, but till early 2000 no planting had occurred; a limited (10 per cent) natural regeneration with woody plants had however occurred in these lands. Currently Estonia is involved with Sweden in a demonstration project in which such agricultural land is being planted with hardwood species, with the Government providing technical know-how, plant material and fencing and the farmer contributing manual labour. Additionally, a working group has been constituted under the new Estonian Forest Development Plan to address afforestation of these lands. As regards reforestation, the team acknowledged that a recent amendment of the 1999 Forest Act requiring forest owners to reforest all clear-cut areas and "perished" portions of over 0.1 ha of protection and commercial forests, within three years of their cutting or perishing, would encourage reforestation, which the Government does not currently subsidize.

IV. PROJECTIONS AND THE EFFECTS OF MEASURES

50. In comparison to the NC1, which lacked projections, the NC2 made a significant effort towards meeting this reporting requirement. It included well developed and consistent modelling of energy consumption and CO_2 emissions from 1995 to 2035. The primary purpose of the entire projection exercise of the Estonian energy system was to prepare an integrated energy strategy during the country's transition to a market economy, leading to the formulation of the "Long-Term Development Plan for the Estonian Fuel and Energy Sector" discussed earlier. As a result, the projections contained in the NC2 on the energy and industrial sectors are based primarily on the 1996-1997 EC PHARE project on energy strategy and the 1998 UNEP/GEF Estonian Case Study on Economics of GHG Limitations, involving the Tallin Technical University, the Stockholm Environment Institute (SEI) and the Netherlands Energy Research Foundation (ECN). The host country officials provided the team with comprehensive and transparent information on the country case study, the long-term development plan and other sectoral information.

51. The team recommended that further efforts to adhere to the UNFCCC guidelines were required, including the future inclusion of projections for CH_4, N_2O, PFCs, HFCs and SF_6, which were currently lacking. The host officials referred to their difficulties in accurately estimating emissions from international bunker fuels up to 1993, in spite of their high share in total transportation, which had in turn led to their exclusion from the projection exercise. Additionally, the review team noted the presence of limited inconsistency between the inventory and the base year (1995 in projections) data used in the projection. The team also recommended

the provision of sectorally disaggregated CO_2 emissions in the future; and suggested that the energy-related CO_2 emission scenarios would be considerably improved by a more precise definition of the “without additional measures”or baseline scenario and the “with measures” scenarios.

52. Though there was information in both the NC2 and the UNEP/GEF country case study, the team identified the need for the country to provide a more transparent picture of the underlying implemented and planned policies and measures. For instance, the NC2 does not elaborate on the specific energy intensity improvements assumed in the industrial and agricultural sectors. The host team indicated that there were no official documents on the specific energy intensity by sector as the Target Programme on Energy Conservation only identified general energy conservation measures. The team also felt that the effectiveness of major mitigation measures such as the reconstruction of oil shale power plants and the reconstruction of heat distribution networks which were in progress, had consequently not been assessed. The only such assessments undertaken had been limited to pilot energy efficiency projects in the residential sector or those projects using biofuels. The team felt that any progress in actual assessment of implemented policies and measures could be then translated to the projections.

53. The host country used the MARKAL model, a demand-driven, multi-period linear programming model of the technical energy system, which simultaneously deals with supply and demand side options. The model is a cost minimizing energy-environment system planning model used to investigate mid- and long-term responses to different future technological options and emission limitations. In addition, MARKAL was linked with a (simple) macroeconomic model called MACRO. The use of MARKAL leads to a sophisticated model results on the optimal allocation of technologies and energy fuels on the supply side. Based on the information provided, the team recommended that demand and supply should be better linked and economic feedback processes integrated into the model, for instance by strengthening the MARKAL MACRO results of the GEF/UNEP study. Furthermore, it suggested that the strengths and weaknesses of the model, a qualitative discussion of the method, results and sensitivities, and underlying scenario assumptions, could improve the transparency and comparability of the projections.

54. The host team took into account the uncertainties associated with the specific national circumstances of a transition economy through the use of two different economic growth scenarios based on the extent and direction of future market orientation. Energy consumption forecasts were developed for the two scenarios, one of modest economic growth (the low energy demand growth or West-West scenario, assumes Estonia’s close integration with Western political and economic structures, especially the EC) and the other of high economic growth (the high energy demand growth or West-East scenario assumes that Estonia’s market is oriented towards both East and West and that it could become a transit country). The baseline scenario is not a business-as-usual scenario but may instead be considered as a ‘without additional measures’ scenario, as some mitigation measures have been assumed with regard to the base year. The four mitigation scenarios were applied to conditions of both low energy and high energy demand growth (see figures IV and V).

55. The key assumptions on population, GDP growth and energy price development were well described in the case study and further clarified during discussions. The low energy demand growth scenario assumes an average GDP growth rate of 2.5 per cent annually between 1995 and 2035, and the high energy demand growth scenario one of 5.3 per cent. In both scenarios, the GDP increase is assumed to be higher in the first decade (3.7 per cent in the low growth scenario) than in the following decades. The host officials informed the team that during the last five years the actual average GDP growth rate had been 5 per cent, and official economic forecasts for the next four years were based on an average rate of 6 per cent. Based on the GDP growth rates of the scenarios, different assumptions on sectoral energy efficiency improvements were made, with the average under the low energy demand growth scenario assumed to be 1.4 per cent per annum and under the high energy demand growth scenario 2.9 per cent per annum. Nevertheless, per capita energy consumption is assumed to rise from 76 MJ in 1995 to 121 MJ in 2030 in the low growth scenario and to 168 MJ in 2030 in the high growth scenario, a high figure compared to other European countries.

56. On the demand side, the baseline scenario includes measures such as: very low pollution taxes for NO_x and SO_2, low-cost heat conservation measures such as sealing of cracks and gaps in windows and doors, improvement of thermal insulation of pipes in basements, hydraulic balancing of the internal heat distribution systems, repair of domestic hot water system, reduction of energy network losses (gas, heat and electricity), and energy conservation in industry and agriculture in the form of decreased energy intensity of production. On the supply side, both the low and high growth scenarios assume that Estonia will implement its existing international agreements on CO_2 (Kyoto Protocol), SO_2 (50 per cent reduction by 1997 and 80 per cent by 2005, relative to the 1980 level) and NO_x (not to exceed 1987 level) emissions and that these constraints will serve as the upper bound on total emissions. The Kyoto Protocol would require Estonia's CO_2 emissions between 2008 and 2012 to be at least 8 per cent lower than in 1990. As mentioned above, since the MARKAL model runs always optimize the system on the energy supply side in each new period, the scenario does not reflect a business-as-usual or base year situation, and due to the inclusion of several mitigation options can be considered a mitigation scenario with respect to the base year situation. The model therefore reflects an ideal least-cost energy supply system without considering political (e.g. national security), social (e.g. social costs of oil shale phase-out) and financial (e.g. capital supply) constraints.

57. The four GHG mitigation scenarios modelled under both low energy demand growth and high energy demand growth were: (a) low CO_2 tax, US$ 4/tonne CO_2 starting from 2005; (b) high CO_2 tax, of US$ 4/tonne CO_2 starting from 2005 and US$ 20/tonne after 2015; (c) all high taxes, with a CO_2 tax of US$ 4/tonne CO_2 starting from 2005 and US$ 20/tonne CO_2 after 2015, combined with a NO_x tax (gradually rising to US$ 5,700/tonne until 2010 and to US$ 12,500/tonne until 2035) and a SO_2 tax (gradually increasing to US$ 400/tonne until 2010 and to US$ 6,000/tonne until 2035); and (d) expensive oil shale, with oil shale prices rising due to special taxes and increased mining costs. The results of only the last scenario were included in the NC2.

58. The mitigation scenarios are based on technical and economic evaluation of various CO_2 reduction measures, which on the supply side included such options as fuel switching, new clean fossil fuel conversion technologies, wider use of renewables, nuclear power and reduction of grid losses, and on the consumer side medium and high investments such as additional insulation of external walls, ground floors and roofs, installation of heat and hot water meters and new efficient boilers. For instance in the residential sector, they assumed that if all the buildings are fully renovated to the present Estonian standards and if domestic hot water consumption is in harmony with present Estonian standards, about 40 per cent of the actual consumption could be saved. The demonstration projects of energy efficient houses show an even higher saving potential in the residential sector of a further 25-30 per cent.

59. In the residential sector, the baseline scenario predicts a slow consumption increase from 32 PJ in 1995 to 35 PJ in 2010, in spite of the absence of population growth and the considerable energy saving potential (40-60 per cent) using improved insulation of dwellings, regulation facilities, more efficient boiler systems and other measures. Furthermore, any improvements in energy efficiency were likely to be neutralized by a higher demand for apartment space and specific electricity consumption for new household appliances. In industry, in 1995, the largest primary energy consumers included the chemical, other non-metallic mineral products, fuels, power engineering and food industries; with the highest energy improvements expected after 2000 in the chemical, wood, iron and steel, machinery and electronic industries, and limited improvements in food, textile, paper and construction industries. It is likely that massive investments will lead to a change in the chemical industry (moderate reduction in energy consumption), other non-metallic products (increase due to economic restructuring), paper (new paper mill after 2005) and wood industries (moderate increase). In the other sectors, energy consumption is assumed to be more or less stagnant. The team noted that the sectoral projection data are given only for energy consumption and not in terms of CO_2 emissions.

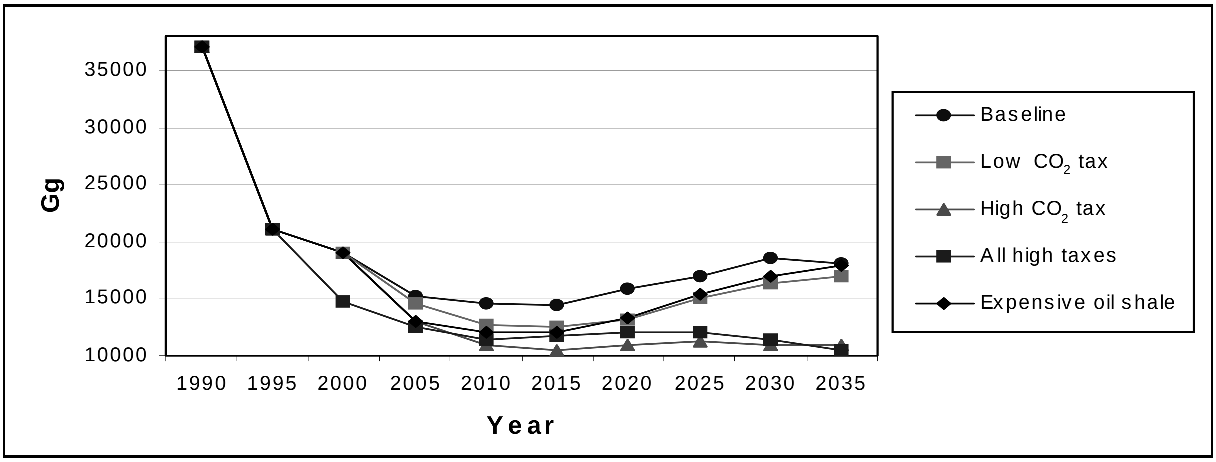
60. In transport, the density of cars is expected to double to 450 per thousand inhabitants and 550 per thousand inhabitants by 2030, in the baseline and high growth scenarios, respectively. The average car mileage is expected to grow from 9,700 km to 15,000 km a year over the same period. Of the energy consumption in transport, passenger and freight road transport will account for 75 per cent. The share of rail transport is predicted to fall drastically (with energy consumption remaining stable at 2 PJ until 2035).

61. The potential and costs of renewable energies were well evaluated in the country case study. According to the long-term energy development plan, a 10 per cent increase is predicted in the use of renewable energy sources such as wood, wind and peat, from 8 PJ in 1996 to 13 PJ in 2010. The annual wood consumption in 2010 is expected to reach 22-35 PJ. Further contributions could be achieved by wind energy and sustainable use of peat.

62. The projections are modelled against a background of a sharp fall in CO_2 emissions between 1990 and 1996 from 37,000 to 21,000 Gg due to the economic transformation and the decline in production. The host officials informed the team that the baseline scenarios showed a decrease in CO_2 emissions from 37,000 Gg in 1990 to 19,000 Gg in 2000 (under the low energy

demand growth scenario) and 19,800 Gg in 2000 (under the high energy demand growth scenario). The CO_2 emissions under either the low CO_2 tax or the high CO_2 tax mitigation scenarios, modelled under conditions of low and high energy demand growth, show an identical decline in emissions from 37,000 Gg in 1990 to 19,000 Gg in 2000 (low energy demand growth) which corresponds to a reduction of 49 per cent from 1990 levels, and 19,800 Gg (high energy demand growth) which corresponds to a reduction of 46 per cent from 1990 levels; and in 2010 application of the low CO_2 tax leads to emission levels of 12,700 Gg (low energy growth) and 16,300 Gg (high energy demand growth), whereas the option of a high CO_2 tax leads to emission levels of 11,000 Gg (low energy demand growth) and 14,000 Gg (high energy demand growth). Essentially the "low CO_2 tax" scenario shows a moderate decrease in CO_2 emissions in the medium term under both demand scenarios. In the long term, the low CO_2 tax loses its reduction impact and the emission levels come steadily closer to the baseline.

Figure IV. Projected CO_2 emissions from energy system for baseline and four mitigation scenarios, under low energy demand growth



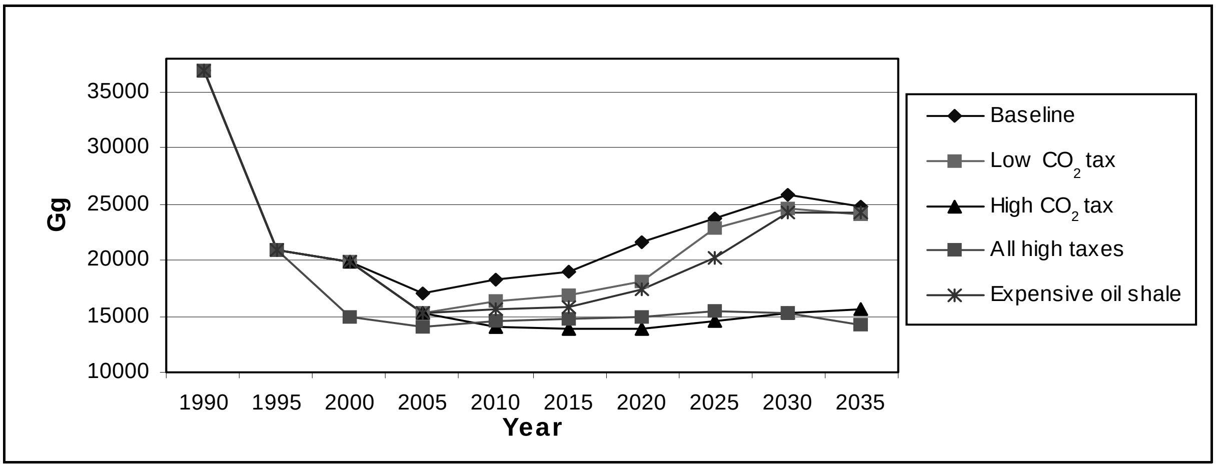
63. CO_2 emissions under the "all high taxes" mitigation scenario, modelled under conditions of low and high energy demand growth, show a decline in emissions from 37,000 Gg in 1990 to 14,800 Gg in 2000 (low energy demand growth) and 15,000 Gg (high energy demand growth). In the fourth mitigation scenario, of "expensive oil shale", modelled under conditions of low and high energy demand growth, emissions decline from 37,000 Gg in 1990 to 19,000 Gg in 2000 (low energy demand growth) and 19,800 Gg (high energy demand growth). In the "expensive oil shale" scenario there is a prediction of a significant decrease in CO_2 emissions in the short and medium term comparable to the high CO_2 tax scenario, for both energy demand scenarios. In the long term, the projected emissions closely follow those of the low CO_2 tax scenario, for both energy demand scenarios.

64. On the energy supply side, the oil shale power plants are to be reconstructed and phased out slowly by 2035. A new oil shale unit of 200 MW is under construction and expected to be operational in 2000. In addition to the baseline scenario, all four mitigation scenarios anticipate a relatively quick phase-out of oil shale until 2010 and its substitution mainly by imported natural

gas.

65. In the medium term until 2010, there exists a significant low-cost reduction potential of 300-500 Gg compared to the baseline, for energy conservation measures such as rectification of pipe insulation in basements, new insulation in houses, additional attic insulation, temperature control valves on radiators, and triple glazing (partial substitution of shale oil by natural gas being included in the baseline). The projection exercise identified a higher reduction potential in measures such as the restriction of electricity export and opening of import and the PFBC reconstruction of oil shale power plants (-2,500 Gg compared to the baseline), all of which could be implemented at relatively low marginal costs within US$ 20/tonne CO_2. Wind turbines and biomass-based CHP plants are expected to have a significant reduction potential at reasonable cost only in the long run. In the MARKAL model, nuclear power is also considered to be a mitigation option in the long term, i.e after 2025.

Figure V. Projected CO_2 emissions from energy system for baseline and four mitigation scenarios, under high energy demand growth



66. The host country recognized that the achievement of the most significant CO_2 reductions would be via shifts of the fuel base in power generation, due to the current dominant share of oil shale based power generation and high associated CO_2 emissions. Though a rapid shift from indigenous oil shale to imported oil products (latter is mainly used for transport) and natural gas (for combined heat and power) would have a positive effect on the environment and reduce CO_2 emissions, a phase-out of oil shale fired power plants seems undesirable from the viewpoint of the balance of trade, supply and national security while Estonia has a single gas supplier (the Russian Federation). Giving up the use of oil shale would also have large employment implications. Consequently, the Long-term Development Plan for the Estonian Fuel and Energy Sector envisages the continuation of oil shale power generation at a reduced rate during the next few decades and foresees incentives for the use of such indigenous fuels.

67. Because of the economic transition and the uncertain circumstances of future economic development, the team recognized that future GHG emissions would depend heavily on such

factors as the probable EC accession, the liberalization of the energy market and the ongoing process of privatization, especially in the mining and energy sector. The possible privatization of the two largest power plants, for which there were ongoing negotiations with a United States power company, went in the same direction. The team realized that while the relatively cheap oil shale based power generation could in theory lead to increased production and export of electricity, an actual increase in the short or medium term was unlikely due to technical and political constraints. The fact that the Estonian Energy Act is in harmony with the EC principles of promoting competition and free access to the electricity market and also that the Long-term Development Plan for the Estonian Fuel and Energy Sector considers significant the interconnection of the Estonian electricity and gas systems with those of Western Europe are promising. Nevertheless, the team understood that the possibility of energy market liberalization remained one of the most important uncertainties of the projections.

68. Besides the energy-related emission projections, the NC2 included a section on projections of CO_2 emissions and removals in land-use change and forestry, based on implemented measures such as laws and regulations for sustainable forest management. These projections included a single “with measures” scenario and no “without measures” scenario. The underlying assumptions were clarified during discussions with different experts. The net removal of CO_2 by the land-use change and forestry sector is expected to rise from 11,317 Gg CO_2 in 1990 to 11,546 Gg CO_2 in 2010, after which it is expected to rise further.

69. A “with measures”scenario was provided for wetlands with implications for CO_2 and CH_4 emission projections. The team understood that there remained uncertainties about the reliability of wetland data and the future development of the agricultural sector. The team was informed of the construction of a detailed inventory of Estonian wetlands being carried out under the World Bank ‘Estonia Agriculture Project’. In the NC2, the emissions in 2010 are projected to be the same as in 1990. According to the host officials, intensified drainage activities between 1970 and 1990 have led to an increase in CO_2 emissions from this source, from 3,000 to 9,000 Gg/annum respectively.

V. ACTIVITIES IMPLEMENTED JOINTLY

70. There are 20 ongoing projects on activities implemented jointly, on improved district heating (9), energy efficiency (2) and boiler conversion (9). The team noted that no information was provided on how these projects were being monitored.

VI. RESEARCH AND SYSTEMATIC OBSERVATION

71. Estonia has completed a study on global climate change impacts and adaptation in agriculture, water resources, forestry, the Baltic Sea and the Estonian coast. The study analysed climate change impacts on seasonal cycles of nature, the aquatic ecosystem of the Baltic Sea, the ground water regime, areal evapotranspiration and agriculture. The greatest impact of climate change is expected to be on agriculture, forestry and coastal resources, although the impact on forestry could not be well defined. According to the study, climate change was not expected to

lead to problems in water supply.

VII. EDUCATION AND PUBLIC AWARENESS

72. In 1999, funding under the Ministry of the Environment's Environmental Fund, for promotion of environmental awareness and public participation rose from EK 0.5 million in 1992 to EK 7 million, with programmes being targeted at academic institutions and the industrial sector (relating to the adoption of cleaner technologies in paper and food industries). In 1997, a new integrated environmental education programme was introduced in schools. The team was informed of an energy-saving information campaign funded by the Ministry at the municipality level, targeted at the household sector by means of booklets with instructions for the insulation of walls, roofs and windows; replacement of old refrigerators, improvement of the energy efficiency of electric lighting and promotion of heating. The team gathered that the Ministry intended to create at an unspecified future date, a separate unit to handle issues arising from the Climate Change Convention and the Montreal Protocol.

VIII. CONCLUSIONS

73. Estonia used the 1994 IPCC Draft Guidelines and the 1995 IPCC Guidelines in preparing its national inventory. In terms of compliance with the UNFCCC reporting guidelines, the NC2 lacked data tables and worksheets for the energy, agriculture and land-use change categories, but the worksheets were provided during the visit. Financial constraints led to the absence of an official submission in 1998, which was then made in 1999. Even though the 1999 submission contained estimates for 1997 and 1998 constructed using the recent 1996 IPCC methodology, this could not be used by the review team as the data series for 1990-1996 was constructed using the earlier IPCC Guidelines. The lack of such a complete homogeneous data set prevented the team from making an accurate analysis of GHG emission trends up to the current date or constructing a link between such trends and policies and measures. Among the aspects which need more detailed examination at the country level are the bases of the land-use change and forestry CO_2 estimates for the entire data series and also the marked deviations in sectoral trends for 1997 and 1998. Nevertheless, total CO_2 emissions declined by around 52 per cent between 1990 and 1998.

74. In terms of compliance with the reporting guidelines for policies and measures, the NC2 contained a tabulation of policies and measures for CO_2, CH_4 and N_2O. Though the table contained some information on the nature of the measures, there was a lack of information regarding the status of implementation, estimate of mitigation impact or monitoring of progress. The review team was considerably handicapped by the lack of adequate information in the NC2, which necessitated the provision of additional information both during and after the visit. Though the absence of any quantification of the GHG reduction potential of identified measures prevented a link from being drawn, the team gathered that the decline in total GHG emissions between 1990 and 1998 could be attributed primarily to the economic recession, privatization and economic restructuring.

75. Due to the fact that the country continued to undergo the process of economic transition and due to the uncertain circumstances of future economic development, future emissions will depend heavily on external influences such as the probable accession to the European Community, the liberalization of the energy market and the ongoing process of privatization, especially in the mining and energy sector. The liberalization and privatization of the energy market will in turn have significant implications for the Estonian energy sector and consequently for related emissions. In particular within the energy supply and transformation sector, which accounted for around 87 per cent of the CO_2 emissions in 1996; the implementation of the energy policy as contained in the Long-Term Development Plan for the Estonian Fuel and Energy Sector, assumes importance due to the planned decrease in oil shale use and simultaneous enhancement of natural gas usage in electricity and heat generation. This shift would in reality have to be balanced against the social costs, supply security and other considerations.

76. There was a significant improvement in the projections section reported in the NC2 in contrast to the NC1. These projections had been primarily prepared as part of the integrated energy strategy as contained in the Long-Term Development Plan for the Estonian Fuel and Energy Sector. The team suggested that there was a need to incorporate the projections for CH_4, N_2O, PFCs, HFCs and SF_6, apart from the projections of international bunker fuels; and also a need to ensure consistency between inventory data and the base year data used in the projection exercise. Despite the provision of the country case study in addition to the NC2, the review team nevertheless suggested that the country provide a more transparent picture of the underlying implemented and planned policies and measures.

77. The baseline scenarios show a decrease in CO_2 emissions from 37,000 Gg in 1990 to 19,000 Gg in 2000 (under low energy demand growth conditions) and to 19,800 Gg (under high energy demand growth conditions). Thus both scenarios project that CO_2 emissions in 2000 will be clearly within the UNFCCC target. Likewise the four mitigation scenarios project that CO_2 emissions in 2000 will resemble or be lower than the emissions in the baseline scenarios for both low and high energy demand, and will be below the baseline from then onwards.

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