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

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I. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

1. Estonia ratified the United Nations Framework Convention on Climate Change (UNFCCC), hereinafter referred to as the Convention, in July 1994 and its Kyoto Protocol on 14 October 2002. It chose 1990 as its base year. Estonia submitted the first and the second national communications (NCs) in March 1995 and March 1998 respectively. The third national communication, hereinafter referred to as the NC3, was submitted on 30 November 2001.

2. An in-depth review (IDR) of Estonia's NC3 was carried out from September 2002 to February 2003, including a country visit by a review team on 18–22 November 2002. The review team consisted of Mr. Marius Ţăranu (Republic of Moldova), Mr. Andrzej Kerner (Poland), Mr. Kari Hämekoski (Finland), 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, and environmental and business non-governmental organizations (NGOs).

3. The smallest of the Baltic states, Estonia has a total area of 45,227 km^2 with a moderate continental climate. The topography is flat, with the highest point being 318 m above sea level. The land level of Estonia is constantly rising, especially on the northern coast where an average rate of rise of 2.5 mm per year is observed. In the southwest, the rate of rise is about 1 mm per year.

4. Forests and wooded areas make up 51.5 per cent of the country's land area, and 46 per cent of the land area is managed and categorized under the Forest Act as protected forests and commercial forests. At the time of this review, about one third of forest was state owned, one third was privately owned, and one third was undergoing privatization. Agricultural land accounts for 25 per cent of the land area. Wetland (including peat land) accounts for 22 per cent, and is regarded by the Estonian government as the biggest sink for CO_2. The review team considered this to be controversial because wetland in Estonia is also used for peat mining and reclaimed for farming, and discussions on peat are still under way internationally.

5. The population in Estonia has fallen since 1990, partly due to net emigration but more as a result of a fall in birth rate. Today the population is estimated at about 1.4 million; two thirds live in the urban areas. The population density is 31.8/km^2, one of the lowest in Europe.

6. Estonia has one of the world's largest exploited deposits of oil shale, in addition to large forest resources and peat resources. In the last decade, Estonia has moved from a planned economy to a market economy. Privatization has been completed in most sectors except infrastructure and the energy sector. Negotiations on the privatization of Eesti Energia, the company dominating the energy sector, and Eesti Põlevkivi, the only oil-shale mining company in Estonia, which is owned by Eesti Energia, had not succeeded by the time of the visit.

7. After independence in 1991, radical economic and social reforms caused a sharp drop in Estonia's gross domestic product (GDP) and it fell by one third between 1990 and 1994. The economic situation stabilized by 1994 and the downward trend stopped in 1995. After the Russian economic crisis in August 1998 Estonia experienced a decline in its economy after the increase of 1994–1997, but the economy recovered and the GDP growth rate was 6 per cent in 2000 and 5.4 per cent in 2001,[1] although the total GHG emissions in 2000 were still lower than in 1990 (table 1). The share of industry in GDP has decreased but the share of the service sector has grown, accounting for more than 60 per cent of GDP in 2000. Figure 1 shows the change of energy mix in Estonia from 1990 to 2000 based on the energy

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[1] See: Estonia Investment Agency (http://www.eia.ee/pages.php3/020201 and http://www.eia.ee/pages.php3/020203).

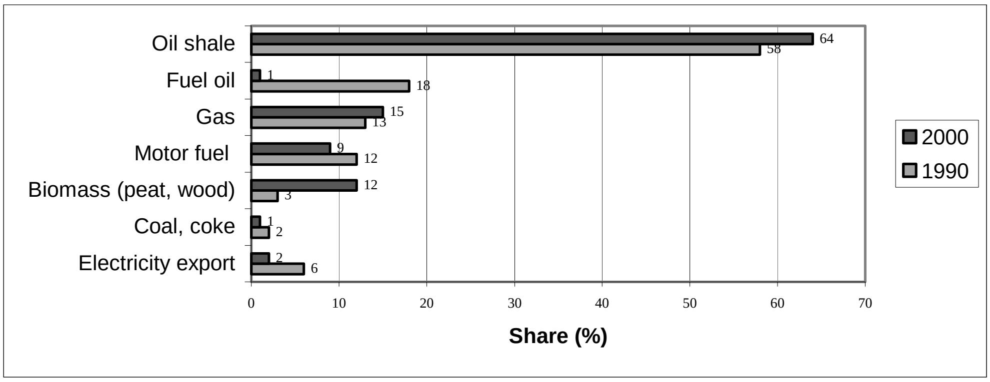
balance provided by the Statistical Office of Estonia. More details for each year during the 1990s can be found in table 5 of this report.

Table 1. Main macroeconomic indicators and GHG emissions for Estonia, 1990 and 2000

	1990	2000	Change (%)[a]
Population (millions)	1.57	1.37	–12.7
Gross domestic product – GDP (billions US$ of 1995 ppp)	14.05	11.98	–14.7
Total primary energy supply – TPES (Millions tons of oil equivalent, Mtoe)	na	4.53	na
GHG emissions (Tg[b] CO_2 equivalent, without LUCF)	43.49	19.75	–54.6
GHG emissions per capita (1000 kg CO_2 equivalent)	18.79	14.42	–47.9
GHG emissions per GDP unit (kg CO_2 equivalent per US$ of 1995)	3.10	1.65	–46.8

Source: The data for population, GDP and TPES are from the International Energy Agency (IEA) database, 2002 edition. The GHG emission data are from the NC3.
Note: na = not available.
[a] The change is calculated as: [(2000 – 1990)/1990] x 100.
[b] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes.

Figure 1. Primary energy mix in Estonia, 1990 and 2000



8. The process of accession to the European Community (EC) started when Estonia ratified the association agreement with the EC in August 1995. Thereafter, Estonia was obliged to harmonize its legislation with EC laws. Accession negotiations with the EC began in March 1998. By the time of the review team's visit, Estonia had finished most chapters of its *acquis communautaire*, the principle document for accession to the EC. The review team was informed that a referendum on joining the EC would be held, although it is said that Estonia will become a EC member state on 1 May 2004.

9. Estonia is a parliamentary democracy. The Ministry of Environment (MoE) is in charge of environmentally related issues nationwide, including environment, urban planning, land use and forestry. At local level there are 15 counties and 247 municipalities, which are responsible for public transportation and waste management, among other issues.

10. The MoE has the overall responsibility for implementation of Estonia's commitment under the UNFCCC, including the preparation of national communications. The Institute of Ecology (IE) at Tallinn Pedagogical University was contracted for the overall compilation of the NC3, the same team as for the NC1 and the NC2. The Statistical Office of Estonia provided most of the activity data. The Ministry of Economic Affairs, which merged with the Ministry of Transport in 2002 to form the Ministry of Economy and Communications (MoEC), provided data and policies and measures for the energy sector. The Ministry of Agriculture (MoA) provided input for the agriculture section of the NC3.

11. An inter-ministerial committee was set up in 1994 and has met two or three times a year since then. The MoE heads it, with representatives from other ministries, such as the MoEC and MoA, as well as research institutions and NGOs. This committee is a forum for general political discussion,

coordination of climate-change-related programmes and preparation of national communications. Good cooperation was observed among all actors in Estonia and confirmed by NGOs interviewed during the visit. The NGOs acknowledged that participation in the climate change policy-making process has been improving. For example, the umbrella organizations of several environmental and business NGOs have had talks with government representatives regarding energy sector and oil shale issues.

II. GREENHOUSE GAS INVENTORY INFORMATION

A. Inventory preparation

12. The Estonian IE, contracted by the MoE, coordinated the preparation of the national inventory of emissions and removals of greenhouse gases (GHGs). The Estonian Energy Research Institute and Estonian Forest Research Institute also actively participated. Among the documents provided during and after the review team's visit were the energy balances for various years and "Estonian Energy", a round up of statistical data on the development of the power industry and comments from industry.

13. The NC3 included summary information on Estonia's GHG inventories for 1990–1999. The base year used for the inventories is 1990. In accordance with UNFCCC reporting guidelines,[2] the inventory data included the three main GHGs, namely carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Data for fluorinated gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) – were not provided. The Estonian experts explained that no industrial facilities from which fluorinated gases could escape into the atmosphere currently existed in Estonia, and the country has no data available on the leakage of these gases from imported facilities. These emissions were therefore not estimated, though a data collection system was under development, as was the case for the NC2. Estimates of the emission for nitrogen oxides (NO_X), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2) were also included in the NC3.

14. The inventory in the NC3 is, in general, prepared in conformity with the UNFCCC reporting guidelines. A description of the emission trends for all gases and pertinent diagrams were included in the NC3. The emissions and trends were shown both in gigagrams (Gg) and in Gg of CO_2 equivalent, using the 1995 Intergovernmental Panel on Climate Change (IPCC) global warming potential values for a 100-year time horizon. Information on biomass-related CO_2 emissions for the years 1990–1999 is in line with the UNFCCC reporting guidelines, as it is presented separately from the summary tables. Information on international bunker fuels was not reported in the NC3.

15. During the review, Estonia's 2002 inventory submission, containing the national GHG inventory for the year 2000, was cross-checked with the inventory contained in the NC3. The national GHG inventory of Estonia was constructed on the basis of the 1996 IPCC revised guidelines.[3] The IPCC default methodology was utilized except for the emission factors for oil shale and shale oil within fuel combustion and for CH_4 from oil shale mining and handling within fugitive emissions, where country-specific emission factors were used. The inventory section of Estonia's NC2, the in-depth review of the NC2 and the centralized review of the GHG inventory of Estonia submitted in 2001 were also used as supporting information sources.

16. Both the NC2 and the NC3 opted for a similar approach in using the 1995 IPCC guidelines and the 1996 IPCC revised guidelines for GHGs inventory. The Estonian experts stated that the estimates for 1990–1998 in the NC3 differed from those in the NC2 primarily because of recalculations of the adjusted statistical data, and changes in methodologies and emission factors. The purpose of the recalculations

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[2] Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications. Document FCCC/CP/1999/7.

[3] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

was to improve accuracy and completeness. Currently the inventory for all years is estimated using the same (IPCC 1996) methodology with adjusted statistical data and emission factors.

17. Major recalculations have been made since the NC2. Some significant differences between the NC2 and NC3 were noted, as shown in table 2. By gas, the largest fluctuations in emissions were observed in N_2O, followed by CH_4. By sector, the following significant differences were noted in descending order of magnitude: CO_2 emission/removals from land use change and forestry (LUCF), the waste sector and the agriculture sector. The UNFCCC reporting guidelines require full explanations for differences identified after recalculations. During the review, the Estonian experts provided explanations of what caused these changes. The major reason is that after 1993 there were great changes in statistical data collection, processing methods, and publications of the Estonian Statistical Office (Statistical Year Books and Energy Balance Yearbooks) and several other governmental institutions, such as annual reports issued by the Estonian Farmers Federation, Forest Survey Centre, Estonian Environmental Register, Estonian Vehicle Registration Centre and Estonian Chamber of Commerce and Industry.

Table 2. Percentage change of 1990–1998 GHG inventory between the NC2 and NC3

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total CO_2	0.8	—2.8	–5.8	–6.5	–6.6	–8.9	–5.4	–2.4	–4.8
Total CH_4	–35.5	–39.6	–38.7	–38.0	–33.4	NA [a]	NA [a]	38.1	29.9
Total N_2O	43.6	40.5	55.0	21.4	17.3	10.3	3.9	24.1	6.8
Energy	–8.1	–10.2	–13.0	–13.8	–13.4	–6.5	–2.6	–2.1	–4.8
Industrial processes	0.2	0.3	0.0	0.0	0.0	–0.5	0.5	–36.0	7.6
Agriculture	58.6	51.3	49.4	29.7	21.0	33.4	34.9	24.4	0.0
LUCF	308.9	305.2	197.1	306.9	461.1	122.6	234.3	NA	NA
Waste	82.3	26.2	13.5	31.5	58.7	57.3	96.7	109.3	87.3

Note: NA – not available; in the NC2 no estimates of CO_2 emissions from LUFC were available for 1997 and 1998. The data presented in this table is based on a synthesis of the information from the NC2, IDR2 and NC3 and crosschecked with the CRF 2002 submission.

[a] In NC2 total CH_4 emissions for 1995 and 1996 are not comparable with those of other years because of the absence of reported data.

18. Although the IPCC Good Practice Guidance [4] were not yet used for uncertainty estimation, the review team was informed that Tier 1 uncertainty analysis was to be performed for the 2003 inventory submission. Currently the uncertainty of activity data used during GHG inventory compilation within the NC3 varies from 10 per cent to 25 per cent, depending on sectors and years. For instance, the reliability of statistical data on fuel consumption is ±10 per cent, in the transport and waste sector it is ±15 per cent but in LUCF the uncertainty is much greater, particularly for data concerning CO_2 emissions/removals from soil. At the moment there are no means for the Estonian experts to assess the error of these estimates. Data on timber felling used in the GHG inventory are considered by the national experts to be very much underestimated, and the uncertainty of other forestry-related activity data is about ±15 per cent. In the early 1990s the uncertainties were much higher than in recent years, as a result of change in statistical classification from the Russian system to the international practice.

B. Overall emission trends

19. GHG emissions decreased considerably from 1990 to 2000, with an overall decrease of 55 per cent. CO_2 emissions decreased by 56 per cent, CH_4 by 43 per cent and N_2O by 60 per cent (table 3). In 2000 CO_2 accounted for 85.3 per cent of total emissions, followed by CH_4 (12.6 per cent) and N_2O (2.1 per cent). As noted earlier, the fluorinated gases were not estimated and so are not included in the NC3. By source, in 2000 the energy sector (fuel combustion and fugitive fuel emissions) accounted for 87.7 per cent of the total emissions, industrial processes 1.8 per cent, agriculture 4.5 per cent and waste 6.1 per cent (figure 2).

[4] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000.

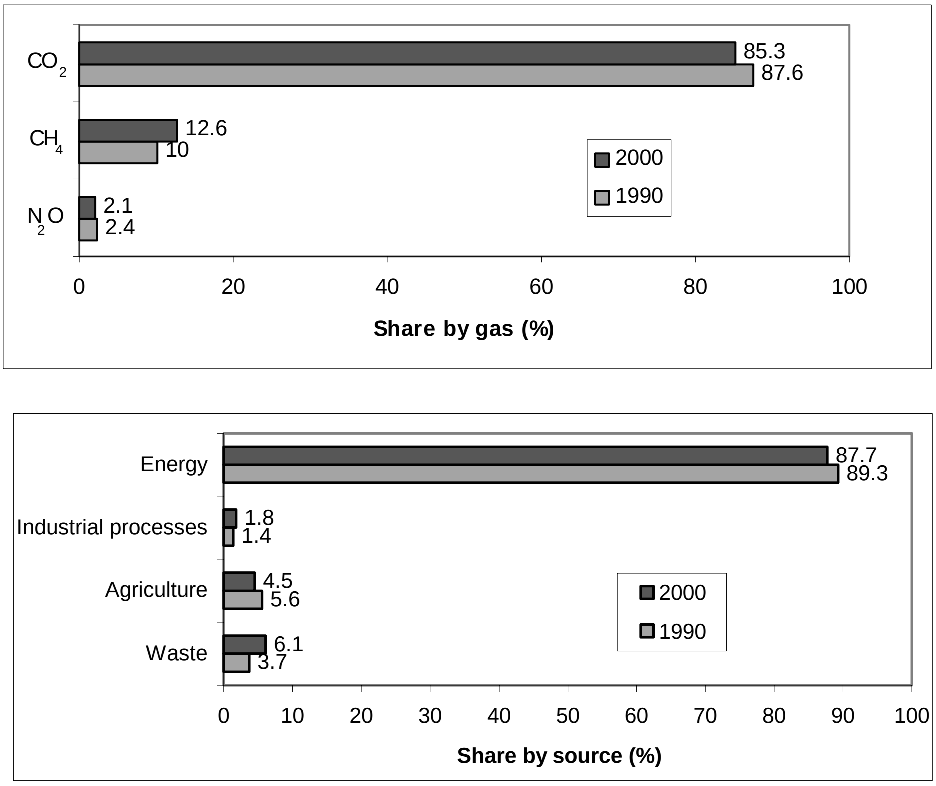
Table 3. GHG emissions by gas, 1990–2000 (Gg CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Change (%)[a]
CO_2	38 107	35 915	26 142	20 553	21 378	19 315	20 264	20 225	18 318	16 771	16 849	–56
CH_4	4 363	3 668	2 976	2 409	2 631	2 561	2 803	3 016	2 754	2 530	2 483	–43
N_2O	1 024	1 002	817	527	473	410	387	423	430	359	414	–60
LUCF	–6 317	–7 160	–7 814	–9 693	–7 603	–7 782	–9 607	–9 107	–8 522	–8 107	–8 365	32
Net GHG	37 174	33 422	22 118	13 794	16 877	14 505	13 846	14 557	12 980	11 552	11381	–69
Total GHG	**43 494**	**40 585**	**29 934**	**23 490**	**24 482**	**22 287**	**23 454**	**23 663**	**21 502**	**19 659**	**19 746**	**–55**

Note: Minor discrepancies in totals are due to rounding.

[a] The change is calculated as: [(2000 – 1990)/1990] x 100.

Figure 2. Structure of GHG emissions in Estonia, 1990 and 2000

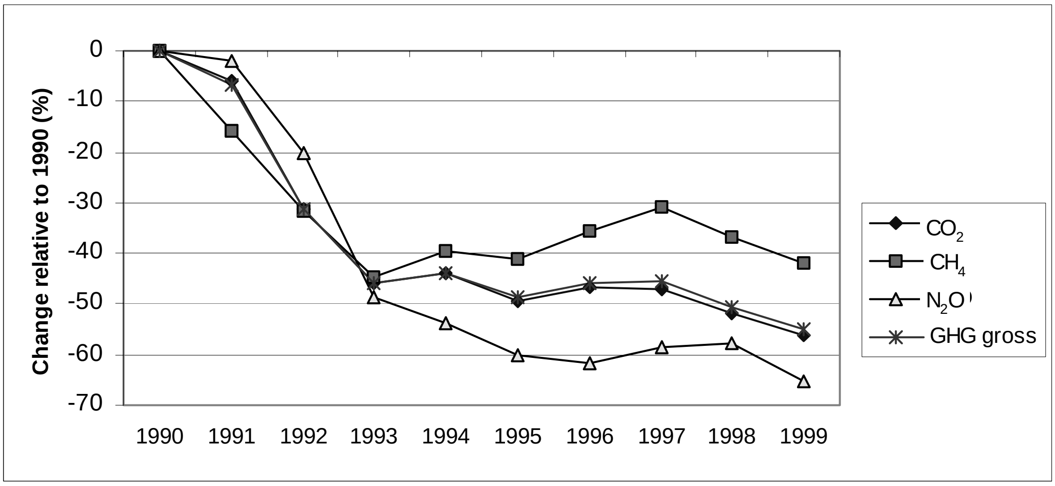


20. In 2000 most of the CO_2 emissions (82.8 per cent) came from the energy industry, followed by transport (6.1 per cent) and the “other” sector (residential and commercial, 6.1 per cent), manufacturing industries (2.9 per cent) and production of mineral products (2.1 per cent). The waste sector was the main source of CH_4 emissions (48.2 per cent of total CH_4), followed by fugitive emissions from fuels (26.7 per cent) and the agriculture sector (20.7 per cent), where enteric fermentation in animals dominated. In the same year agriculture (agricultural soils and manure management) was the dominant source of N_2O emissions (90.4 per cent of total N_2O emissions), distantly followed by fuel combustion (9.6 per cent). A similar pattern can be observed for the whole period from 1990 to 2000.

21. All three main GHGs reported in the NC3 decreased drastically in the 1990s (figure 3). This was driven mainly by the following factors: (i) a general economic decline leading to reduced production volume in all sectors; (ii) structural changes, with the share of energy-intensive sectors being decreased and the share of the service sector increased; (iii) reduced consumption of fossil fuels, especially of imported fuels, after the break-up of the former Soviet Union caused the loss of cheap supplies of these

fuels,[5] (iv) a change in the energy supply mix (an increased share of indigenous fuels such as firewood, woodchips and wood wastes, a reduced share of coal, coke, fuel oils and motor oils) and a sharp contraction of the export market for Estonian electricity generated from oil shale. During 1990–2000 power consumption dropped more than 5 times in industry, more than 18 times in construction and around 35 times in agriculture as a consequence of all the factors mentioned above. Climate change considerations did not play a notable role in these reductions.

Figure 3. GHG emission trends by major gases (relative to 1990 level)



Note: The line for CO_2 is largely hidden by that for total GHG emissions, because their changes are highly parallel.

C. Key emission sources and sectoral trends

22. Analysis of the inventory submitted by Estonia in 2001 shows that five sources account for nearly 90 per cent of the total GHG emissions in 2000: stationary combustion of solid (58.5 per cent), oil (11.2 per cent) and gaseous (6.8 per cent) fuels; solid waste disposal sites (5.2 per cent); and road transport (4.6 per cent). Table 4 and figure 4 show the GHG emissions by sector.

Table 4. GHG emissions by sector and subsector, 1990–2000 (Gg CO_2 equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Change (%)[a]
Fuel combustion	38 829	36 606	26 735	20 958	21 874	19 891	20 948	20 873	18 717	17 155	17 308	–55
Energy industries	29 781	28 683	22 087	17 025	17 786	16 386	17 152	16 877	14 816	13 502	13 968	–53
Manufacturing industries	2 659	1 907	1 234	654	909	635	731	657	668	661	484	–82
Transport	2 708	3 094	1 506	1 722	1 530	1 109	1 053	1 219	1 360	1 210	1 036	–62
Other sectors	2 480	1 762	1 106	1 050	1 045	1 131	1 313	1 442	1 264	1 204	1 156	–53
Fugitive emissions	1 201	1 159	802	507	603	631	699	679	609	577	664	–45
Industrial processes	614	615	313	193	215	221	207	226	368	347	354	–42
Solvents	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	2 440	2 328	2 050	1 480	1 358	1 117	1 018	1 070	1 002	854	887	–64
LUCF	–6 317	–7 160	–7 814	–9 693	–7 603	–7 782	–9 607	–9 107	–8 522	–8 107	–8 365	32
Waste	1 608	1 033	834	856	1 034	1 057	1 281	1 494	1 416	1 304	1 196	–26
Total GHG (without LUCF)	**43 494**	**40 585**	**29 934**	**23 490**	**24 482**	**22 287**	**23 454**	**23 663**	**21 502**	**19 659**	**19 746**	**–55**

Note: Small discrepancies in totals are due to rounding errors.
[a] The change is calculated as: [(2000 – 1990)/1990] x 100.

[5] According to the energy balance, in 1991–1998 the use of imported fuels fell from 173 PJ to 80 PJ, and in 1990–2000 the final consumption of fuel oils decreased by 89 per cent, coal and coke by 69 per cent, natural gas and motor fuels each by 66 per cent. (One petajoule (PJ) is equal to 10^{15} joules.)

23. The review team noted the following trends in GHG emissions by sector: (i) an overall decrease of the three main GHGs in all sectors over the 1990–2000 period (table 4); (ii) emissions from the energy industries, "other" sectors, transport, fugitive sources and the waste sector fluctuated but were generally in parallel with Estonia's economy as measured by the GDP (see table 4 and figure 5); (iii) the GDP increased from 1999 to 2000, but emissions from the transport and waste sectors decreased over the same period (table 4 and figure 5); (iv) emissions from manufacturing, industrial processes and agriculture decreased steadily.

Figure 4a. GHG emission trends by sector, 1990–2000

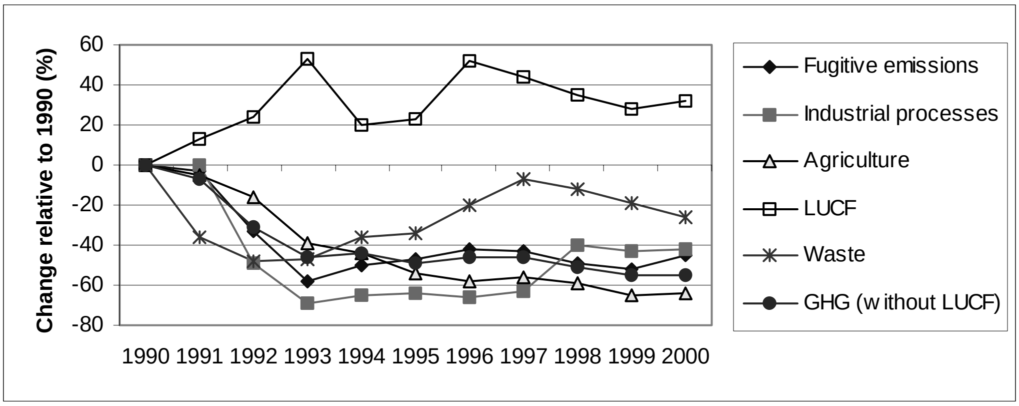


Figure 4b. GHG emission trends by subsector, 1990–2000

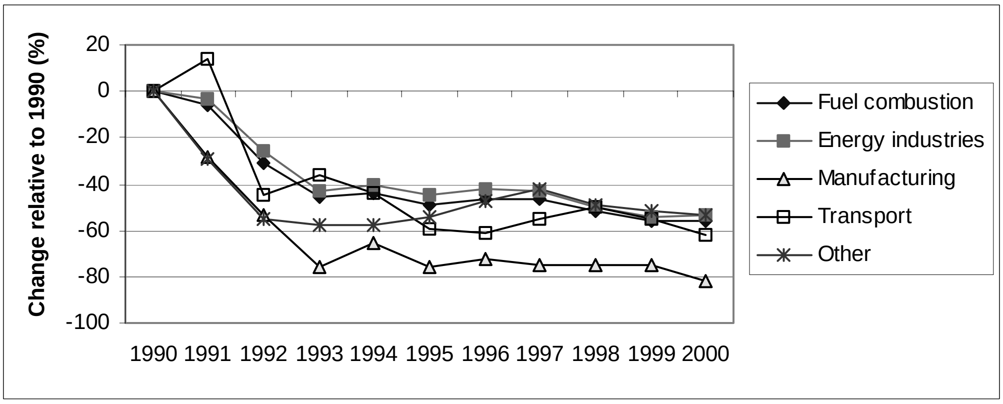
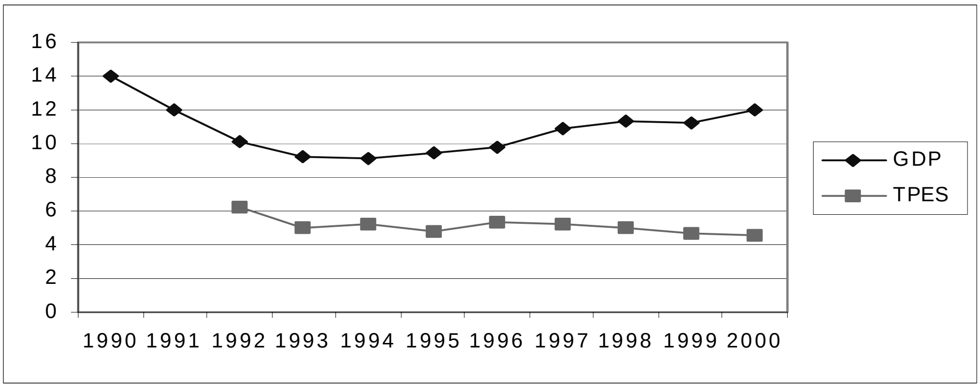


Figure 5. Trends of GDP and TPES, 1990–2000



Note: GDP in figure 5 is in billions of US$ at 1995 prices adjusted by PPP. TPES is in Mtoe.

24. **GHG emissions from energy industries decreased**, especially in 1990–1993, and subsequently varied further. This is due to economic decline and restructuring of the economy in the transition period.

A reduction in the supply of liquid and gaseous fossil fuels from the former Soviet Union caused a sharp increase in price. To tackle this situation, in 1992 the Estonian government adopted the first Energy Conservation Plan encouraging energy efficiency and the use of indigenous fuels. The Estonian experts explained that the plan also contributed to the decrease in GHG emissions from fuel combustion, especially in the **residential and commercial sector**, as a result of switching to biomass and reducing the use of coal and coke.

25. **GHG emissions from transport** decreased by 62 per cent between 1990 and 2000, although according to the NC3 the number of registered passenger cars in 1999 was 90 per cent higher than in 1990. The national experts noted that this situation resulted from the increasing share of new and more economical vehicles, decline in freight traffic, and stricter rules for motor vehicle inspections and engineering supervision. The decoupling of GDP and emissions from transport observed between 1999 and 2000 is particularly interesting, as few Annex I countries can achieve this. However, the Statistical Office of Estonia's "Energy Balance 2000" shows an actual increase in the total (2.5 per cent) and in some types of motor fuel supplied to the transport sector in 2000 compared to 1999, while the inventory of the same period demonstrates a decrease in total GHG emissions (by 14 per cent). Checking the common reporting format submission of Estonia to the UNFCCC secretariat reveals that the emission factors for N_2O from transport are smaller in 2000. This might explain partly why the GHG emissions from transport in 2000 were lower than in 1999, though further clarification is needed, at least to explain the reason for applying different emission factors.

26. **Fugitive emissions** in Estonia's inventory include only CH_4, which fell by 45 per cent between 1990 and 2000. The source of CH_4 emissions is mainly oil-shale mining and handling activities as well as shale oil and natural gas activities (distribution, fuelling). The decrease in CH_4 emissions is primarily attributed to a reduction in the mining and processing of oil shale. The estimates of these emissions were also affected by the recalculations of CH_4 emissions that were carried out for the 2001 inventory submission. The data presented in the NC3 are much lower than those in the IDR of the NC2, especially for 1990–1994 (for 1990 the CH_4 emissions in the NC2 are about four times the figure given in the NC3). The host country attributed these differences to a new statistics system and utilization of 1996 IPCC revised guidelines. In addition, the NC3 applied country-specific emission factors for fugitive CH_4 emissions from oil-shale mining and handling, instead of those for coal-mining that had been applied previously in the NC2. However, the review team pointed out that the change was not sufficient to account for the 3–4-fold difference between the NC2 and the NC3. The national experts further explained that the old statistics for shale oil during the NC2/IDR.2 period were higher because exports were also included. The review team is of the opinion that more effort may be needed to clarify the re-estimate of fugitive emissions.

27. **GHG emissions from the waste sector** dropped by 26 per cent during 1990–2000 and in general followed the economic trend. A similar decoupling of emission and economic growth as in the transport sector occurred from 1999 to 2000. According to the national experts, this situation is partially due to the fact that from 1998 to 2000 the amount of domestic waste decreased by 8 per cent compared to the 1997 level. Domestic waste makes up only 3.5 per cent of the total waste generated in Estonia, but its share is constantly growing. The dumping of waste in landfills has increased too, especially since 1993, and recycling has been insignificant. The downward trend of GHG emissions from the waste sector is expected to continue in the light of the implementation of the relevant EC directives.[6]

28. **GHG emissions from industrial processes** are mainly CO_2 emitted from cement and lime production and recently also from ceramic production. With only one factory in Estonia for each of these three industries, even fluctuation in production at one factory will affect the inventory data for that year.

[6] 1994/62/EC on packaging and packaging waste, 1999/31/EC on landfill, 2000/53/EC on disposal of end-of-life vehicles and 2000/76/EC on waste incineration.

The privatization process greatly influenced the production level of these factories. Another factor that is thought to have affected production levels is the contraction of the export market for Estonian mineral products, especially after the break-up of the former Soviet Union. Although the economy revived after 1994, the GHG emissions from industrial processes in 2000 were still 42 per cent lower than in 1990.

29. **GHG emissions from agriculture** are mainly CH_4 and N_2O, and agriculture is the major source of these two gases in Estonia. In 1990–2000 the share of agricultural GHG emissions varied between 4.3 and 6.8 per cent of the total GHG emissions. GHG emissions from this sector decreased over the decade by 64 per cent. The restructuring of agricultural production, the shift to private farming, partial loss of the traditional market in other parts of the former Soviet Union, and rises in the price of fuels and fertilizers have immensely influenced the whole sector. All these contribute to the reduction of the sown area of field crops, of livestock numbers (down by about 60 per cent from 1990 to 2000) and of the use of nitrogen fertilizers (down by about 70 per cent from 1990 to 2000). The application of fertilizer in the country is still low in comparison with the EC average.[7] The combination of these factors caused a decrease in N_2O emissions from agriculture by 61.7 per cent from 1990 to 2000.

30. **CO_2 removals from LUCF** increased by 32 per cent from 1990 to 2000, although according to the NC3 it varied considerably between 1990 and 2000. The national experts explained that the variation in CO_2 uptake by LUCF has been affected mostly by a decrease in agricultural land, an increase in forestland (by about 10 per cent) and an increase in total wood harvest (by 109 per cent) during 1990–1999. The data on timber felling were based on felling documentation (licences issued to harvesters). Since 1999, the Estonian Forest Inventory Centre has used a new approach, statistical sampling, and this has resulted in almost a doubling of the felling figure. This made the national experts believe that the current data on timber felling for 1990–1999, estimated on the basis of felling licences issued, underestimated actual timber felling. The uncertainty regarding the trend of CO_2 removals is therefore very high. Moreover, the data on CO_2 emissions/removals from soils are particularly unreliable. Agricultural soil constituted a net sink (2,400 Gg) for the base year in the NC2, but a net source (3,053 Gg) in the NC3. This proved to be the key reason for the halving of LUCF sink capacity reported in the NC3 compared to the NC2. The Estonian experts indicated that as yet they had no means of handling this problem but were striving for improvement.

31. In summary, the review team believed that making emissions data between 1990 and 2000 more consistent was a prerequisite for a credible trend analysis. In future, Estonia may wish to (i) consider a more complete summary of emissions profiles, emissions trends and major developments since the last NC; (ii) start to employ the IPCC Good Practice Guidance on a large scale in GHG inventories.

III. POLICIES AND MEASURES

A. General

32. The structure of reporting on policies and measures is broadly in line with the UNFCCC reporting guidelines. In comparison with the NC2, more information was provided on gases affected, the status of implementation and implementing entities. The review team was informed during the visit that some cost calculations of policies and measures were also available for the energy sector, as suggested by the UNFCCC guidelines. As different policies and measures have other benefits in addition to CO_2 mitigation, a question of how to distribute the costs for different components was raised. The NC3 presented non-GHG mitigation benefits as a clear decrease in NO_X, CO, NMVOC, SO_2 and particulate matter. Policies and measures that were already adopted or were at the planning stage were not,

[7] According to FAOSTAT (the database of the Food and Agriculture Organization), in 1999 the total fertilizer consumption in Estonia was half (20.26 Mt per 1000 capita) of the EC (15) average (45.92 Mt/per 1000 capita). See also: http://apps.fao.org/default.htm

however, clearly indicated in the NC3. This issue was partly clarified during the visit. The review team got the impression that most policies and measures defined in the NC2 are still valid in the NC3, even though the names may have changed.

33. Policies and measures in Estonia are mainly planned, adopted and implemented at state level. Some activities relevant to climate change mitigation are also found at county and municipal level, for example district heating, local energy plans, waste management and activities related to forestry. Interaction of these with other policies and measures at national level was not discussed in detail in the NC3 or during the visit, so it is difficult for the review team to assess. No major policies and measures mentioned in the previous NCs and now no longer in place have been identified; there are no policies and measures concerning international bunkers or fluorinated gases, as in the NC2. The fluorinated gases are mainly leakages from imported equipment; there are no domestic sources of emissions as such. This corresponds to the fact that Estonia’s inventory does not so far include fluorinated gases.

34. The MoE has prepared annual progress reports on the implementation of the National Environmental Action Plan (NEAP). No specific information concerning monitoring and evaluation of climate change mitigation was provided in the NC3, and third-party evaluation is not used either. The review team felt that the lack of comprehensive monitoring processes was mainly due to the shortage of resources in a small country like Estonia, as was pointed out in discussions at several stages. The review team considered monitoring and assessing the effectiveness of policies and measures an important element in climate change policy.

B. Cross-sectoral policies and measures

35. The main reasons for the sharp decrease in GHG emissions in 1990–2000 are the decreases in energy-consuming economic activities, import of fuels and exports of electricity due to economic decline in the early 1990s. A drastic rise in the price of imported fuel in the early 1990s also played an important role. In 1993–2000 prices approximately doubled for coal and light fuel oil, and increased by 50 per cent for heavy fuel oil. In addition, the price of natural gas in real terms increased about tenfold from 1991 to 1992. To cope with this situation, the first energy conservation programme, aiming to improve energy efficiency and use more domestic fuels, was approved in 1992. Changes since then are clearly reflected in the structure of the primary energy supply, as indicated in table 5.

Table 5. Structure of primary energy supply in Estonia, 1990–2000 (%)

	1990	1995	1996	1997	1998	1999	2000
Oil shale	58	63	61	62	58	58	64
Peat, wood, woodchip, woodwaste	3	11	12	13	12	12	12
Gas (natural, liquefied, other gas)	13	11	12	11	12	12	15
Motor fuel (gasoline, diesel, etc.)	12	11	11	12	13	12	9
Fuel oil (heavy and light)	18	5	4	3	5	6	1
Coal and coke	2	0	1	1	1	1	1

Source: Energy Balance 2000, Statistical Office of Estonia.
Note: The total in each year may exceed 100 per cent. The surplus is electricity exported in that year.

36. The review team learned that several new policy developments might have an impact on the reduction of GHG emissions in the near future. These include EC accession, which is clearly affecting policies and measures in Estonia in general. The exception is the forest sector, in which domestic policy is the main driver. Even though EC accession is already reflected in the NC3, more concrete and new measures are being taken in Estonia in order to fully harmonize its legislation with that of the EC. This has direct implications for GHG mitigation in Estonia, for example through the requirement for the share of renewable energy, the operations of the oil-shale-based Narva power plants, and liberalization of the electricity market and waste management.

37. The main cross-sectoral measures currently include the National Environmental Strategy (NES) adopted in 1997, the revised NEAP approved by the Government in 2001, and the Climate Change Mitigation Programme (the final name is still undecided).

38. The Climate Change Mitigation Programme is expected to be adopted by the Government in the spring of 2003. This will be the main strategic programme for climate change mitigation in Estonia. Its main purpose is to integrate various existing policies and measures rather than to develop new ones. The programme will also clarify the role of the Kyoto mechanisms in Estonia, which will affect mitigation efforts. The review team was informed that the current government was against trading "hot air", should that become possible in practice. Hot air trading (i.e. selling surplus emission allowance in the case of Estonia) was also considered unethical by some NGOs interviewed during the visit.

39. The Government's position towards joint implementation (JI) is, however, very positive. Several activities implemented jointly (AIJ) have been carried out, and Estonia is moving to the JI phase. Active discussions are going on with Finland and Sweden, and to a lesser extent with Germany and the Netherlands. A framework agreement on GHG reduction through JI between Estonia and Finland was signed in December 2002, in addition to a memorandum of understanding signed earlier. Similar discussions are taking place with Sweden. A Strategy for Sustainable Development in Estonia until 2030 is also being drafted and expected to be accepted by parliament in March 2003. The review team was informed that sustainable development and climate change mitigation would be kept separate. In addition, new legislation on air pollution, defining both emission standards and ambient air quality requirements, is being drafted.

40. Several economic instruments already in place are having some impact on climate change mitigation. A pollution charge for pollutants including CO_2 (7.5 Estonian kroon (EK)/tonne CO_2) is being applied to large-scale plants, although the rate was considered by the national experts as too low to have any important steering effect. Fuel excise duty, vehicle excise tax and requirements for electricity produced from renewable sources are discussed in more detail in the respective sectors. There was insufficient information for the review team to assess the impacts of these instruments.

C. Energy

41. Energy-related activities are the most significant contributors to GHG emissions in Estonia, with a share of 88 per cent in 2000. Per capita emissions have clearly decreased, but energy consumption per production unit is still high compared to the EC average level. There has, however, been a decrease in the ratio of primary energy supply to GDP from 2.1 kWh/EK in 1993 to 1.0 kWh/EK in 2000.[8]

42. The effect of policies and measures is generally difficult to verify because the decrease in emissions is mainly due to reasons other than climate policies. The implementation status of several measures also appeared unclear. During the visit, more information was provided in order to clarify which policies and measures were implemented and which were considered additional.

43. The Estonian experts acknowledged that it was difficult to distinguish between different scenarios in estimating the effect of policies and measures. The mitigation impacts given in tables 4.2.1–4.2.3 of the NC3 were based on expert opinion and estimation about each individual programme or policy package. The exception is the Swedish AIJ project on boiler conversion, which was obtained from actual statistical data. Eighteen policies and measures were identified in the NC3. The reduction achieved by several major policies and measures in the energy sector was nearly 900 Gg CO_2 equivalent in 2000 (table 6). Comparing this figure with the total reduction in GHG emissions of 2500 Gg from

8 *Source*: Estonian Energy 1991–2000, Ministry of Economic Affairs, Estonia, 2001. The reason for choosing 1993 is that reliable statistical data are available since that date.

1995 to 2000 in energy excluding transport illustrates the level of the effect of policies and measures. Table 6 gives updated figures for the total impact estimated for 1995, 2000 and 2005.

Table 6. Major policies and measures identified in the NC3

	Sector	Status	Projection	Mitigation impact ($Gg\ CO_2$ equivalent)		
				1995	2000	2005
Long-term national development plan for the fuel and energy sector	Energy	Planned/ ongoing	WAM	na	110	800
National Energy Conservation Programme	Energy	Planned/ ongoing	WAM	na	90	950
Estonian National Environmental Strategy	Energy	Planned/ ongoing	WAM	na	70	190
National Programme for Reduction of Pollutant Emissions from LCP	Energy	Planned/ ongoing	WAM	na	70	200
Fuel switch from coal	Energy	Implemented	WM	350	350	350
Swedish assistance, AIJ	Energy	Implemented	WM	40	94	131
Renovation of Narva power plants	Energy	Ongoing	Not included	na	na	500
Development plan for transport sector	Transport	Implemented	WM	na	5	100
Estonian Forestry Strategy	Forestry	Planned/ ongoing	WAM	na	na	1096
Forest Act	Forestry	Implemented	WM	1 460	1 950	1 739

Note: WM = “with measures”; WAM = “with additional measures”.

44. The review team learnt that a new package of energy legislation is under way to replace the existing Energy Act, with the aim of clarifying legislation and harmonizing with EC directives. The package includes the Electricity Market Act, Natural Gas Act, District Heating Act and Liquid Fuel Act. The last of these is unique to Estonia, aiming to combat illegal fuel imports and trade.

45. Eesti Energia, the biggest company in Estonia and 100 per cent state-owned, produces 93 per cent of electricity in Estonia utilizing oil shale. Its largest plants are located in Narva, in the north-east of the country near the border with Russia and close to the oil shale deposits. The Narva power plants comprise the Estonian power plant and the Balti power plant, with a total installed electrical capacity of 2700 MW and thermal capacity of 589 MW. Discussions about the privatization had not reached agreement by the time of the visit. Oil-shale-based electricity production is expected to continue in Estonia in the medium term, for both economic and social reasons. Oil-shale-fired power plants and mining employ more than 10,000 people. No major alternative is foreseen.

46. Economically extractable oil shale reserves in Estonia are estimated to last for approximately 100 years, and for 25 years at current mining cost. However, major additional investments are needed to upgrade the boilers at the Narva plants in order to comply with the EC directive on large combustion plants (LCP Directive) and allow production at the Narva plants to continue to operate at a high level. The special status of oil shale allows the same support mechanisms (state aid) to be used in the Estonian as are used in coal- or lignite-mining regions by some other EC member States.

47. Renovation of four of the largest boilers at the Narva power plants and conversion from pulverized fuel combustion to circulated fluidized-bed combustion is expected to reduce CO_2 emissions by approximately 500 Gg by 2005. Two boilers are currently being renovated in response to enforcement of the LCP Directive. A reduction of CO_2 emissions is being achieved by minimizing the decomposition of mineral carbonates in oil shale and increasing efficiency during combustion. The specific CO_2 emission factor is expected to drop from 1400 g/kWh to 1200 g/kWh. Four additional boilers will be renovated by 2010, and some other boilers will be closed down by 2008. The EC has granted Estonia a transitional period until 31 December 2015 for full implementation of the LCP directive. However, the review team formed the impression that the renovation of additional boilers may also depend on the future electricity price, among other factors.

48. One of the main issues in new energy legislation concerning GHG will be the support scheme for renewable energy. The current feed-in tariff (60–90 per cent of the final consumer price, designed to achieve 2 per cent of the total electricity consumption from renewable resources) has been replaced by a new subsidy. The new scheme is based on the price of electricity produced by the Narva plants, i.e. 1.8 times the price of electricity produced in Narva plants, as currently intended by the scheme. The EC Renewable Electricity (RES-E) Directive probably will set up a target for the use of renewable electricity in Estonia by 2010. The issue is still open, but the review team learned that the possible target might be between 5 and 14 per cent. The share of renewables in electricity production in Estonia in 2000 was 0.22 per cent. This implies a need for greater effort in the current energy policy. The review team learned that the main potential for developing renewable energy in Estonia lies in biomass utilization and wind energy.

49. Biomass in Estonia mainly takes the form of wood and wood wastes. Biomass is generally used in heat generation because its efficiency in electricity generation is low. The potential of biomass utilization in combined generation of heat and power (CHP) has been explored in Estonia through a programme supported by Denmark. The main objectives of this CHP programme included: (i) to support the MoEA in identifying necessary changes in Estonian legislation for the promotion of CHP; (ii) to analyse possible effects of these changes; (iii) to support the MoEA and the main Estonian stakeholders in the development of a NEAP for CHP; and (iv) to carry out a comprehensive feasibility study for a full-scale biomass CHP demonstration plant. More intensive application of CHP would double its share in electricity generation (from 12 to 24 per cent). The forthcoming EC CHP Directive will also affect CHP production in Estonia. The CHP strategy is also being drafted as an early response.

50. The technical potential for wind energy in Estonia is high, theoretically over 1 TWh annually, according to the national experts. The total electricity production in 2000 was about 8.5 TWh[9], which gives an idea of the relative magnitude of such potential in wind energy. However, the economic viability of wind power depends on many other factors such as the subsidies mentioned above, grid connections and environmental considerations.

51. According to the Estonian experts, the potential for energy conservation in households may be 15–25 per cent, and in some cases even as much as 50 per cent. The losses in electricity transmission were 15–18 per cent in 1998 and could be cut to 10 per cent. In order to ensure an acceptable level of power supply security and refurbishment of the Narva power plants, in the EC accession negotiations the Estonian government has obtained a right to liberalize only 35 per cent of the electricity market by 2008, and not before 2012 for all business customers.

52. The expected changes in the Nordic and Baltic electricity market might also affect electricity production in Estonia, especially in the Narva power plants. One of the main factors could be the closedown of the Ignalina nuclear power plant in Lithuania, scheduled for 2008. Construction of a grid connection to Finland (part of the Scandinavian electricity market) might open up additional export rather than import possibilities, as electricity produced in Scandinavia seems unlikely to be cheaper than domestic electricity in Estonia in the foreseeable future. This might lead to higher GHG emissions in Estonia. The competitiveness of oil shale in electricity production might be affected by the development of energy taxation in the EC.

D. Transport

53. The main policies and measures mentioned in the NC3 for the transport sector came from the Development Plan for the Transport Sector for 1999–2006. A new Development Plan for the Transport Sector for 2003–2007, to replace the existing plan, is currently being elaborated. A public transport

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[9] Estonia Energy 1991–2000, Ministry of Economic Affairs, Tallinn, 2001.

development plan is also being drafted in order to define measures to support public transport. All the policies and measures defined in the transport sector of the NC3 were classified as implemented. The potential effect of policies and measures in transport is estimated to be 10 Gg CO_2 equivalent by 2000, while the total decrease in GHG emissions from the transport sector was 70 Gg from 1995 to 2000.

54. The review team thought that the linkage between policies and measures and projections seemed weak. Only general data for the transport sector were used in projections, and the projection for transport was subsumed into the energy sector. The effectiveness of policies in transport is difficult to assess because of insufficient information. The review team also questioned whether and how the EC voluntary agreement with car manufacturers has been taken into account.

55. The review team was informed that in 1998 subsidies covered approximately 50 per cent of the cost of different modes of public transport. The subsidy was considerably increased from 1995 to 1998 but was still unable to keep up with the increase in cost. From 1992 to 1996 there was a sharp decline (by 50 per cent) in the number of passengers using public transport, and this decline is still continuing. The main reason is the rapid growth in the use of passenger cars and deteriorating public transport services. The increased use of private cars has resulted in several problems such as traffic congestion, accidents, local air quality and problems related to regional and social policy. The passenger car fleet is increasing by 7–8 per cent per year. Currently the government's objective is to curb the deterioration of public transport and maintain its share at the 1999 level, i.e. 185 million passengers per year.

56. The review team noticed with great interest that in spite of the large increase in the number of vehicles, the inventory data shows a decrease in CO_2 emissions in the transport sector during the same period, and emissions have roughly stabilized in the recent years, although some doubts were raised regarding the inventory data as discussed in the inventory part of this report. The main reasons given by the Estonian experts were the decrease in freight transport and agricultural activities, and the replacement of old lorries and inefficient tractors. Higher emissions from the transport sector in the early 1990s were also explained by the fuel usage of Soviet military forces deployed in Estonia at that time.

57. The Heavy Goods Vehicle Tax replaced the Motor Vehicle Excise Tax on 1 January 2003. The new tax applies only to heavy goods vehicles, which means that new cars will pay only value added tax and fuel excise duty. This caused the review team some concern, as it may have a negative impact on GHG mitigation. Imported second-hand cars will continue to be taxed according to age and engine size in order to favour newer vehicles that emit less GHGs. Domestic air travel and shipping are rather insignificant in terms of GHG mitigation, considering Estonia's small territory, so no policies and measures are defined in these areas.

E. Industry

58. The contribution of industrial processes to GHG emissions is rather minor in Estonia, and there is a clear decrease in GHG emissions from 1990 to 2000 (from 614 Gg to 354 Gg). The emissions are CO_2 only: no emissions of CH_4, N_2O or fluorinated gases were reported, since Estonia does not have industrial processes that generate these gases as by-products.

59. The EC Integrated Pollution Prevention and Control Directive (IPPC) is the major driver for mitigation effort in industrial processes. The IPPC entered into force in Estonia in 1 May 2002 and the deadline for full implementation is set as October 2007. A total of 50 plants in Estonia need IPPC permits, but the impact of the IPPC on GHG emissions is indirect, mainly through best available technology (BAT) and energy efficiency requirements. The actual policies and measures found in the projections were mainly aimed at improving production efficiency, meaning that the same output will be maintained with less GHG emissions. Companies might be motivated to improve production methods in

order to avoid a CO_2 charge levied on their emissions. However, the effectiveness of this CO_2 charge was unclear to the host and to the review team.

F. Agriculture

60. Emissions from agriculture formed 4.5 per cent of the total GHG emissions in Estonia in 2000. The clear fall in emissions is attributed mainly to the decrease in production of both livestock and crops. No specific policies and measures in this sector were identified in the NC3. Development in the agricultural sector is closely connected with EC accession. Several Estonian and EC programmes (i.e. SAPARD[10]) support the agricultural sector, as this sector is closely related to rural development. Production might increase in the coming years, but improvements in production efficiency are expected to bring down the GHG emissions per production unit. Regulations such as the EC Nitrate Directive and the Estonian Organic Agriculture Act are also expected to contribute to a reduction in GHG emissions.

G. Land-use change and forestry

61. Forests cover 52 per cent of the total area of the country. LUCF is an important sink, having absorbed 8,100 Gg CO_2 equivalent in 1999, i.e. approximately 50 per cent of the gross CO_2 emissions of that year. Forest policy is based on the Estonian Forest Strategy and Forest Act, with the main aim of improving forest growth. The review team learned during the visit that a new forest strategy is currently being discussed. According to the new strategy, felling must not exceed increment. Currently felling permits are issued based on the notification given by the owner to the county environmental administration, but more control is envisaged for the future.

62. The national experts saw privatization as having a negative impact on forests as a sink for GHGs in the short term but a positive impact in the long term, since the age structure of Estonian forests is rather young. The review team learned that there is an underestimate in the current felling data. Illegal felling was also mentioned. The review team believed that accurate data concerning increment and felling, and control of felling, are essential for the estimation and maintenance of the sequestering effect of the forests. By 2000 there were also more than 300,000 ha of abandoned agricultural land. The review team understood that measures concerning this land had not been defined.

H. Waste management

63. Policies and measures in the waste sector are based on the current Waste Act, Waste Management Plan and the MoE regulations. The EC landfill directive was transposed into Estonian legislation, such as “Requirements for the construction, operation and closure of landfills”, which came into force in September 2001. The review team learnt that a new Waste Act has received approval from the government and will be sent to the parliament. The Waste Management Plan, in reading in parliament at the time of the visit, proposes that there should be seven to eight regional landfills by the year 2009, one hazardous waste landfill and some special landfills for oil-shale waste. All new landfills will have a gas collection system, as required by the EC directives. There is a transition period until 2009 for Estonia to fulfil the EC landfill directive concerning oil-shale ash. In 1999 there were 221 municipal and 47 industrial landfills in Estonia, but more than 200 were closed in 2000–2001.

64. About 40 per cent (by weight) of municipal waste is packaging. The Packaging Act and Packaging Excise Duty Act were adopted in 1996 in order to enforce the EC packaging directive and to

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[10] SAPARD (the Special Accession Programme for Agriculture and Rural Development) aims to help the EC candidate countries deal with the structural adjustment in their agricultural sectors and rural areas, as well as in the implementation of the *acquis communautaire* concerning the CAP (Common Agricultural Policy) and related legislation. SAPARD came into effect on Jan. 2000 and is budgeted until the end of 2006.

tackle the waste problem. Under these acts, producers and importers who do not collect 60 per cent of packaging waste are subject to excise duty. This legislation is aimed to achieve recycling of 21 per cent of packaging waste by early 2004 when Estonia will join the EC, and 25–50 per cent in future. By the time of the visit, only 15 per cent was recycled, mainly alcohol and beverage packaging. Additional measures in order to achieve the recycling targets were drafted in the Waste Management Plan.

65. Policies and measures on CH_4 emissions from waste management are mainly to reduce the share of biodegradable wastes landfilled to 45 per cent of total biodegradable municipal waste produced in 1995 by 2010, to 30 per cent by 2013 and to 20 per cent by 2020, in line with the requirements of the EC landfill directive. This is expected to lead to a 50 per cent reduction in emissions from the waste sector by 2020 with current measures and 80 per cent with additional measures. The actual implementation of the measures (e.g. source separation to reduce landfilled biowaste) will be mostly at local level. If implemented successfully, GHG emissions from the waste sector would be cut down considerably.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

A. Reporting and coverage

66. The projections contained in the NC3 were based on the Long-Term Development Plan for the Estonian Fuel and Energy Sector. This plan was developed by Tallinn Technical University, the Estonian Energy Research Institute (EERI), Stockholm Environment Institute and the Netherlands Energy Research Foundation (ECN) during the preparation of the NC3.

67. In comparison to the NC2, which lacked projections for GHG gases other than CO_2, the NC3 presents emission projections for CH_4 and N_2O. Another improvement is that all projected values are presented in both tables and graphs. From this point of view the coverage of projections in the NC3 has significantly improved over that of the NC2. Since there are no industries emitting fluorinated gases, these gases were not included in the projection parts of the NC3. Some other aspects of the projections did not fulfil some requirements of the UNFCCC reporting guidelines: (i) actual data for the base year 1999 are not presented, and (ii) projection of emissions from international bunkers was not reported.

68. The CO_2 emissions projected in the NC3 are significantly lower than those in the NC2. For 2020, the NC3 reports 14,230 Gg with measures implemented and adopted. The NC2 projected an emission of about 20,500 Gg for the same year. Note the starting point for the NC3 projections: the actual CO_2 emissions were 16,771 Gg in 1999, compared to what was projected (around 17,700 Gg) for 2000 in the NC2. Also, the CO_2 emissions including CO_2 removal from LUCF projected in the NC3 are significantly lower than those in the NC2. Corresponding figures for the year 2000 are 8,430 Gg in the NC3 (“with measures”), and around 13,000 Gg in the NC2. As the national experts explained, there was an error in calculation of the CO_2 removals, as discussed in detail in the inventory chapter of this report. This affected the projections for LUCF, as the NC2 projected that in 2000 LUCF would account for a net CO_2 removal of about –5,000 Gg, while as stated in the NC3 the actual LUCF data in 2000 was -8,365 Gg.

69. It is difficult to compare the effects of policies and measures in the NC2 and the NC3 because of the different scenarios considered. Two scenarios were considered in the NC2: “West–West” and “West–East”. Within each, “baseline” and “all high taxes” options were presented. Projections in the NC3 were based on “with measures”(WM) and “with additional measures”(WAM) scenarios. Projections of CO_2 emissions from the energy system in the “West–West” scenario with the “baseline” option do not differ much, with regard to the time horizon, from corresponding ones (WM) in the NC3. The projections in the NC2 were (approximately)[11] 15,150, 14,400, 14,300 and 15,700 Gg for the years

[11] In the NC2 the results of the CO_2 emissions projections are presented only in graphs, not in tables.

2005, 2010, 2015 and 2020, respectively. The corresponding values in the NC3 are 15,740, 15,500, 15,050 and 14,910 Gg. Unfortunately, it is not possible to compare the projections of the overall GHG emissions in CO_2 equivalent, since in the NC2 only CO_2 emission was projected.

B. Scenarios, assumptions and methodology

70. Two scenarios were considered in the projections section of the NC3: the WM scenario which reflects the impact of adopted measures and the policies and measures implemented in 1995–2000, and the WAM scenario which includes additional policies and measures that may be taken in future.

71. In addition, a graph of GHG emissions including LUCF for a so-called "without measures" case was presented. The figures for this graph were obtained under the assumption that the elasticity coefficient between GDP growth and CO_2 emission growth is 1.0, based on the 1990–1994 statistics. This assumption may be contested, as the driving forces for emission and sinks of GHGs are not all in direct proportion to GDP growth. The national experts explained that for the CH_4 and N_2O emissions, the WM scenario was actually equal to the "without measures" one.

72. Regarding the energy-related emissions, it is unclear from the NC3 how the energy demand/supply projections and consequently the CO_2 emissions were estimated. The Estonian experts explained that a simplified econometric model was used, with GDP as the only exogenous variable. Another issue is that a very short statistical time series (1995–1999) was used for the projection of 20 years' energy demand. The national experts explained that the MARKAL model mentioned on page 51 of the NC3 was actually not used at all, because of financial constraints. Instead, according to the host, the following approach was used for the projection of energy supply and demand:

(a) The total energy demand was predicted to be the extension of the trend seen from 1995 to 1999 when measures were implemented. It was then broken down into economy sectors, keeping the same proportions as they were in the base year for the projections (1999);

(b) Based on the energy supply structure in 1999, projections of primary energy supply and the projection for CO_2 emission were calculated;

(c) Effects of policies and measures were estimated on the basis of expert opinion.

73. Such a simplified treatment of the projections caused the difficulty in defining a "without measures" scenario projection. The review team felt that the methodology and approaches used in the NC3 for energy-related projections of emissions have at least three weaknesses:

(a) There are different driving forces for different energy end-use categories, e.g. area of dwellings for space heating, mobility of people for transport, and so on. However, the assumption implied in the NC3 is that GDP is the only driving force for energy consumption.

(b) A five-year time series (1995–1999) can hardly be used for a 20-year projection, especially for a country in transition from a centrally planned to a market-oriented economy;

(c) The use of only a top-down approach makes it impossible to construct a baseline scenario and calculate the effects of policies and measures.

74. An end-use scenario approach is the state-of-the-art for long-term energy demand projections and is often employed for this purpose, as it was in the NC2. The MARKAL model mentioned in the NC3 is suitable. It enables the national experts to evaluate final energy demand, to model policies and measures, and finally to model primary energy demand. The MARKAL model or any other optimization model would make it possible to perform projections defined as "non-policy" where no measures are

implemented to reduce carbon emissions.[12] This could be considered as the "without measures" scenario and its outcomes could be used for modelling impacts of each particular policy on projected emissions.

75. The modelling requires input at end-use level. It would therefore have been useful if the NC3 could have contained more data on energy use, both actual data in the base year and projected ones over the study period regarding: (i) final energy demand broken down by economy sectors; (ii) electricity and heat demand by economy sectors; and (iii) non-energy use of fuels. Such information can also be obtained from international sources, such as the IEA. For example, in the base year for projections (1999), data from the IEA about the final energy consumption (excluding energy and transformation sectors) is quoted in table 7. If changes in such parameters over the projection period, both in absolute terms and in the shares of the total consumption, were provided, it would help to clarify the assumptions made in Estonia's projections.

76. **Table 7. Estonia's total final energy, electricity and heat consumption, by sector, 1999**

	Final energy		Final electricity		Final heat	
	PJ	**%**	**PJ**	**%**	**PJ**	**%**
Industry	27.5	26.6	6.6	38.4	1.9	8.2
Transport	20.1	19.5	0.3	2.0	0.0	0.0
Agriculture	2.5	2.4	0.8	4.9	0.1	0.4
Commerce and Public	11.1	10.7	4.5	26.2	4.2	17.9
Residential	42.1	40.8	4.9	28.6	17.2	73.6
Total	**103.2**	**100.0**	**17.1**	**100.0**	**23.4**	**100.0**

Source: Energy Balances of Non-OECD Countries, IEA/OECD.
Note: Minor discrepancies in totals are due to rounding errors.

76. Another issue concerns the omission of motor fuels as a part of the total primary energy supply (TPES). From the NC3, it is not clear whether these fuels and subsequently the transport sector were taken into account in the projections for energy and associated GHG emissions and whether projections on traffic volume were included. The national experts stated that transport was included in the projections for the whole energy sector**.**

77. Technological improvement is assumed as an important driving force for energy efficiency on both demand and supply sides. On the demand side, space heating gives the highest potential for energy conservation through modernization of buildings and energy networks. Introduction of CHP makes it possible to substantially increase energy efficiency compared to separate production of electricity and heat, as gas-fired CHP plants (particularly those with heat storage) can achieve operational efficiency of up to 85 per cent. Developments in the electricity sector are of key importance for reducing GHG emissions, though large investments, such as the renovation of the Narva power plants, are needed to increase the efficiency of fuel–electricity conversion processes. The review team understood that the renovation of the Narva power plants was not taken into account in the projections of the NC3.

78. The projections in the agriculture sector were based on data provided by the MoA, the IPCC methodology and carbon emission factors for domestic animals in western Europe. The review team was told that the additional measures in this sector are mainly policies and measures required by EC accession. Key assumptions made in the agriculture sector are that while efficiency increases, the production level will remain almost the same. The EC quotas will limit the size of food production, e.g. milk, which will lead to a decrease in animal numbers. As a result, CH_4 emission is projected to decrease proportionally. A similar extrapolation approach was applied to N_2O emission from the same sector. The major parameters that facilitate the understanding of projections of CH_4 and N_2O within the

[12] "Possible Energy Sector Trends in Estonia. Context of Climate Change" by Tiit Kallaste, Olev Liik, Arvo Ots. Tallinn, 1999.

WM and WAM scenarios are numbers of dairy cattle, average milk yield per cow, sown area and the use of nitrogen fertilizers.

79. Projections for GHG emissions from the waste sector were carried out following a similar approach to that used for agriculture. The IPCC methodology and emission factors were used in the calculations. The assumptions made included the amount of municipal waste generated and the proportion of it that is biodegradable, and future waste management practice, based on the relevant government documents and implementation of relevant EC directives.

80. Fugitive emissions from mining and fuel handling are another major source of CH_4 emission. The WM projection is based on the assumption that the amount of fugitive CH_4 will be dominated by oil-shale mining and will be proportional to the future mined volume of oil shale. Under the WAM scenario, the installation of a gas recovery system was planned and considered.

C. Results of projections

81. Three sources of CO_2 emissions and sinks were distinguished: (i) the energy sector (including manufacturing, transport, tertiary, and "other" sector); (ii) industrial processes, mainly cement and lime production, and (iii) LUCF. In the energy sector emissions CO_2 are projected to decline slightly, by 0.3 per cent per annum, in the WM scenario, compared to a decline of 0.8 per cent per annum in the WAM scenario. Emissions from industrial processes are expected to decline from actual data of 354 Gg in 2000 to 320 Gg in 2020 (a decrease of 0.6 per cent) under the WM scenario, and to 300 Gg (a decrease of 1 per cent) under the WAM scenario. LUCF accounted for a net removal of –8,365 Gg in 2000, in contrast to –8,100 Gg projected in the NC3. This is projected to shrink to –6,800 Gg by 2020 in the WM scenario, an average annual decline of 0.8 per cent, and to increase to –8,700 Gg in the WAM scenario.

82. The projections for net CO_2 emissions (including LUCF) for 1995–2000 in the NC2 are noticeably higher than the actual ones in the NC3. The main difference lies in the LUCF sector: –5,167 Gg was projected in the NC2 and –8,010 Gg in the NC3, while the actual inventory data is –8,365 Gg for the year 2000. Total net CO_2 emissions (including LUCF) for 2000 were projected in the NC2 to be around 12,700 Gg, compared to the actual value of 8,154 Gg in the NC3. The host explained the discrepancies by corrections of calculation errors for agricultural soil and forestry in the NC2. The influence of other factors was negligible. The review team commented that the net emission (including LUCF) approach used throughout the projections made it hard to see the key factors of GHG emissions. It was less transparent than the emission (without LUCF) approach because of its inclusion of LUCF, which has higher uncertainty and undergoes frequent recalculation.

83. Figure 6 illustrates the projections for total CO_2 emissions, including inventory data for 1990–2000. The WM scenario is also presented. The elasticity of GHG emissions in the energy sector against GDP was assumed to be 0.781[13] and emissions of industrial processes remained as they were in 2000. It must be noted that the assumptions underlying the graph in figure 5.2.9 of the NC3 (Net Estonia's emission) where a curve for a "without measures" scenario is presented, should be contested. For CH_4 and N_2O, only WM and WAM were presented.

84. The share of domestic oil shale in TPES (excluding motor fuels) was 67 per cent in 2000, as derived from table 5.2.1 of the NC3, though data from the energy balance of Estonia show a share of 64 per cent (table 5). It is projected to fall to 51 per cent in 2020 at the expense of imported natural gas, the share of which is projected to be 13 per cent in 2000 and 30 per cent in 2020.

85. The share of renewables, mostly biomass, in TPES is projected to increase only slightly: from 12 per cent in 2000 to 14 per cent in 2020. In 2000, 93 per cent of electricity was generated from oil

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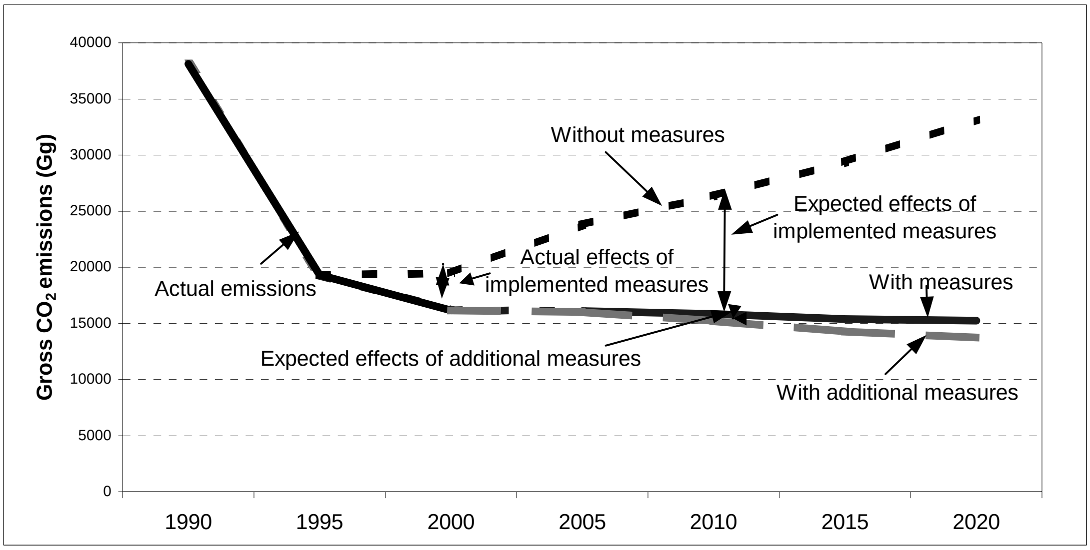
[13] Based on the baseline scenario in "Possible Energy Sector Trends in Estonia. Context of Climate Change".

shale. Estonian oil shale has a high ash content, moderate moisture and sulphur contents, and low calorific value. Electricity production is therefore "dirty" and the costs are rather high. On the other hand, oil shale is the only significant domestic energy resource for electricity generation. The alternative for the foreseeable future might be natural gas imported from Russia, but this option is considered with caution as it might threaten the security of the country's energy supply.

86. Estonian power plants are old, inefficient and mostly oil-shale-fired, with installed capacity considerably higher than domestic demand. Therefore, the policy of electricity generation and possible increase in electricity export is one of the key issues in the CO_2 emissions projections. The NC3 did not mention the impact of the future energy/electricity markets on GHG emissions, but there is a statement about the uncertainties of a switch to biomass or natural gas in electricity generation. The influence of electricity and district heat prices on the use of these energy carriers is considered, but no elasticity of price versus consumption was presented. During the visit, the implications of EC accession and related market liberalization of the energy sector were discussed.

Figure 6. Projections for the gross CO_2 emissions in Estonia



87. The document regulating waste management is the National Waste Management Plan, which requires that from 2009 all categories of waste must be disposed in landfills that are in compliance with the EC requirements. On this basis, CH_4 emissions were projected to decrease from 2000 to 2020 by 50 and 80 per cent in the WM and WAM scenarios respectively.

88. There are estimates of the effects of individual measures. However, it is difficult to verify how the national experts calculated these figures, especially as there are inconsistencies between the data in table 4.2.1–4.2.3 of the policies and measures chapter and those in table 5.2.4–5.2.5 of projections of the NC3. Estonian experts regarded the estimations in the policy chapter were more reliable than those in the projections, as the latter were derived relative to the baseline scenario, which is difficult to define.

89. No analysis of sensitivity in the following areas has been presented:

(a) **Macroeconomic growth**. The government's long-term projections for the national economy are lacking. The comparison between projections for 1995–2000 performed in the NC2 and actual data for 2000 presented in the NC3 show how sensitive emission projections are to the assumptions made in macroeconomic growth;

(b) **World market prices**, especially for crude oil (and petroleum products) and natural gas. They stimulate (when high), or hinder (when low) the switch from oil-shale-fired power plants to renewable fuels, mostly biomass;

(c) **Energy policy** in the field of electricity and district heat pricing, or rather cross-subsidizing household consumers by industrial ones. According to the host, the cross-subsidy on fuels and energy in Estonia has gradually been removed. Higher electricity and district heat prices for households may give stronger incentives for energy saving;

(d) **Governmental policy** concerning emission taxes and incentives for renewable energy;

(e) **Policies concerning transport development**.

90. For future studies, a combined approach of simultaneous end-use (bottom-up) and top-down analyses for possible corrections of assumptions concerning both driving forces and technology improvements could be recommended. The bottom-up approach consists of the following steps: (i) establish a consistent scenario with two sub-scenarios: a socio-economic sub-scenario (GDP growth, demography, lifestyle) and a technological sub-scenario (technical factors, market penetration); (ii) break down energy consumption into end-use categories, as was done in the NC2; then (iii) calculate the energy demand projections.[14]

91. A top-down approach (e.g. regression analysis) for sectoral energy demand projections can be employed, and then compared with the results from using both bottom-up and top-down approaches. In case of significant discrepancies, assumptions such as driving forces or technology improvement coefficients in the bottom-up approach or time series in the top-down one may need to be revised. Such calculations can be performed using a spreadsheet. Therefore, if the MARKAL model is not available for the team preparing the national communication, this simple simulation approach would help. The use of a bottom-up approach would also allow the analyst to model the impact of individual policies and measures on the projections of energy demand (and consequently the CO_2 emissions).

V. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

92. Comprehensive information regarding vulnerability assessment and climate change impacts based on extensive modelling using several different models (i.e. Model for the Assessment of GHG Induced Climate Change (MAGICC), SCENGEN, RipFor) has been included in the NC3. Estonia is sensitive to climate change because of its wide coastal areas, water resources, forests and wetlands. Meteorological observations in Estonia show that the mean temperature has risen in recent decades, especially in winter. Precipitation has also increased. The main impact of expected climate change is a decrease in crop yields, especially on dry sandy soils. The impact on forest biomass production is expected to be positive.

93. The vulnerability of the coastal area was assessed on the basis of a hypothetical 1-m rise in sea level, taking into account the rate of land uplift. The most substantial changes would occur on the western coast. Most impacts are expected to be attributable to a combination of stronger storms, higher sea level and mild, ice-free weather. Rising sea level is more of a concern in southwestern Estonia. The

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[14] One option for calculation is to use the formula

$$E_y = \frac{E_b}{DF_b} \times DF_y \times (1-k)$$

where E_b, E_y are the energy demand (consumption) in the base year and the year considered, respectively; DF_b, DF_y are the driving forces for the energy demand in the base year and the year considered; and k is the coefficient of technology improvement.

results are also given in monetary terms, based on submerged and damaged land, loss of land and loss of profits. Total economic losses were estimated at approximately US$ 980 million.

94. No specific adaptation measures are included in the NC3, and apparently none are implemented. The team learned, however, that some discussions related to adaptation are underway. For example, it seems impossible to protect all coastal areas, especially in the southwest of the country.

VI. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

95. Estonia is not an Annex II Party to the UNFCCC, so it is not bound by the commitments relating to the provision of financial resources and promotion of technology transfer to developing countries defined in Article 4.3–4.5 of the UNFCCC. Accordingly, the NC3 is not obliged to follow the UNFCCC reporting guidelines on this subject. Nevertheless, the review team held a session on this topic during the visit. On the basis of that discussion, the review team was able to form an overview in this area.

96. As a country in transition, the major means for Estonia to promote access to climate-related environmentally sound technologies is active participation in AIJ and JI projects. During 1992–2000 Estonia was involved in bilateral aid programmes with Sweden (total investments SEK 75 million), Denmark (DKK 78 million) and Finland (FIM 10 million). Other foreign sources are loans received from the EC during 1990–1994 (EK 75.8 million), European Bank of Reconstruction and Development (EBRD) during 1992–1996 (EK 367. 5 million), World Bank, Swedish International Development Agency during 1994–2000 (EK 768.7 million), PHARE[15] pre-accession funds during 1996–2000 (EUR 7.3 million) and Nordic Investment Bank. Estonia is trying to reduce the bureaucratic burden associated with implementation, as well as to prepare itself for timely implementation of JI projects (e.g. registries, monitoring system, etc.).

97. Estonia has actively participated in international projects aimed at capacity-building in GHG inventories, mitigation and adaptation. The main projects were: Economics of GHG Limitations – Phase 1: Establishment of a Methodological Framework for Climate Change Mitigation Assessment. UNEP/GEF (GF/2200-96-15) 1996–1998; Publishing Collective Monograph on Climate related Energy Issues in Estonia. UNEP Collaborating Centre on Energy and Environment at the Ris National Laboratory, Denmark; Capacity for Climate Change in Central and Eastern Europe. Regional Environmental Centre for Central and Eastern Europe, Szentendre, Hungary; Japan Special Fund; Research in the Capacity of an expert to UNFCCC Annex I Countries Expert Group in GHG emission trading, reporting and baseline construction, OECD Environmental Directorate.

98. Since the end of the 1990s, the emphasis has gradually shifted to implementation of the Convention and the AIJ and JI as the means for real technology transfer, since preparations for emissions trading are not as well established in Estonia as AIJ and JI. In addition, Estonia has been active in the cooperation between the Baltic States and Nordic countries in the implementation of the UNFCCC.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

99. The NC3 presents the status of research activities and observations almost in accordance with the UNFCCC guidelines. Estonian organizations participate in meteorological atmospheric observations. The Estonian Meteorological and Hydrological Institute (EMHI) also exchanges observations and data collected with the Global Climate Observing System (GCOS).

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[15] PHARE is a European Community programme and major means to help candidate countries to adopt, implement and enforce all the required *acquis*. Since 1998, the main aims of the PHARE have been: to train the candidate countries to manage the Community funds available for accession; and to focus on certain crucial needs for accession. See: http://europa.eu.int/comm/enlargement/pas/phare/pdf and http://www.fin.ee/index.html?id=694

100. During the last decade, many scientific groups from the IE and the Institute of Marine Research at the University of Tartu, the EMHI, the Energy Research Institute, Estonian Agricultural University and Tartu Observatory performed basic research on global climate change impacts and adaptation in agriculture, water resources, forestry, the Baltic Sea and the Estonian coast. Many Estonian scientists take part in international cooperative research projects on climate change. Domestic research is normally funded by the grants of the Estonian Science Foundation. Every year, up to 10 grants are channelled to climate change, amounting to EK 1–1.5 million in total. In addition, the Ministry of Education funds many target-oriented projects.

101. Climate change research concentrates on climate change modelling and climate change impact. In modelling, the construction of climate change scenarios for the 21st century was an important achievement. They are based on the utilization of MAGICC and SCENGEN, a regional climate change database. Three GHG emissions scenarios elaborated by IPCC-IS92a, IS92c and IS92e were used in the MAGICC model. The 14 global circulation models (GCM) experiments provided a range of possible climate change scenarios in Estonia, all of them including exceptional warming throughout the year.

102. Most studies deal with the impacts on water resources, coastal resources, agriculture and forestry. The economic impacts of climate change have been only partly studied. For example, in the scenarios of a 1-m rise in sea level, the greatest destruction of the country's coastal zone is associated with stormy periods. The potential losses over Estonia's entire coastal territory could be US$ 868.4 million.

103. Environmental NGOs are active in climate-change-related research. The Stockholm Environment Institute Tallinn centre has been running various research and training projects, especially in the field of GHG mitigation options in the energy sector. The Estonian Green Cross has also initiated many projects in the field of sustainable development and climate change.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

104. This part of the NC3 follows the UNFCCC guidelines. The Ministry of Education plays the main role in environmental education and has developed a detailed plan for the improvement of environmental education as a part of the NEAP. The estimated funding for the relevant projects was EK 907 million (including EK 12 million as targeted international aid). In 2001 the budget amounted to EK 14 million for the support of environmental education and public awareness. The Ministry has prepared special environmental sciences curricula for secondary schools and gymnasiums. Pupils are acquainted with the atmosphere and the ozone layer, energy economy, air quality and pollution, fossil fuels, ecosystems and natural cycles.

105. From the point of view of the Ministry of Education, the bottleneck in education and public awareness is the level of knowledge and skills of schoolteachers. In March 2000 education ministers from the Baltic region met to discuss a network within the framework of Baltic 21. They decided to build a sector network for education for sustainable development and the Centre for Development Programs (EMI-ECO), which provides professional training and management consulting for Estonian industries and governmental institutions. Many NGOs are involved in environmental education and awareness. Environmental NGOs are currently running several projects related to climate change. Estonia joined a worldwide GLOBE project in 1996. A total of 33 schools are taking part in observations, the results of which are sent regularly to the coordination centre in the United States of America.

IX. CONCLUSIONS

106. The NC3 of Estonia reported all major issues required by the UNFCCC guidelines for the national communications. The information provided in the NC3 is comprehensive in general, in spite of

certain omissions. It covered all major sectors and emissions of the three major GHGs, although the inventory of fluorinated gases is still lacking. Key climate change policies and measures are reflected sufficiently and concisely, with more information than in the NC2. Unlike the NC2, the NC3 includes projections for CH_4 and N_2O in addition to CO_2. The presentation of CO_2 removals is not sufficiently separated from emissions, particularly in the projections, which has affected the analysis to some extent. The review team identified some discrepancies in the inventory, as compared with the NC2. The NC3 has some inconsistency between estimation of effects of policies and measures and those resulting from the projections, as discussed in detail in this report, and this also needs clarification.

107. The review team analysed the information contained in the NC3, the 2002 inventory submission which contains data for 1990–2000, and information provided during the visit. The analysis suggests that Estonia's GHG emissions in 2000 (without fluorinated gases) are 54.6 per cent below its 1990 level.

108. The main reasons behind the significant decrease in GHG emissions are the decline of the economy in the 1990s and its further restructuring in the transition to a market economy, and, to a lesser extent and more recently, the country's accession to the EC. Policies and measures driven by concern about climate change have played a limited role so far. The new developments in the policy portfolio are mostly driven by harmonization with EC legislation. Nevertheless, compared with the NC2, concrete policies and measures have been adopted, implemented and are being further defined in Estonia's forthcoming climate change mitigation programme.

109. Estonia's target under the Kyoto Protocol is to limit the emission of GHGs to 8 per cent below its 1990 level in 2008–2012. With the policies and measures currently implemented, the emission of three major GHGs (without LUCF) is projected, under the current projections undertaken in the NC3, to reach 18,860 Gg CO_2 equivalent by 2010, 56.6 per cent below the 1990 level (43,494 Gg) and well below Estonia's Kyoto target. With additional measures identified in the NC3, the GHG emissions were projected to be slightly lower, down to 17,420 Gg, 57.1 per cent below the 1990 level. LUCF constituted a significant net sink in 1990–2000 and the sink capacity is projected to continue to increase in future.

110. The review team is of the opinion that the projection of CO_2 emission is methodologically less rigorous than that in the NC2. The resulting projections for overall GHG emissions should therefore be taken with caution. Despite limited resources, a better projection might have been achieved by an alternative approach and more detailed assumptions, as discussed in this report. The current state of affairs may have arisen because Estonia enjoys a substantial margin in meeting its commitments under the Convention and in future under the Kyoto Protocol. However, it is to the country's benefit to maintain and enhance this margin by various efforts so as to take the advantage of the Kyoto mechanisms and to prepare for more stringent requirements in the next commitment period.

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