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

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

A. Introduction

1. The secretariat received the third national communication under the United Nations Framework Convention on Climate Change (UNFCCC) of Iceland, hereinafter referred to as the NC3, on 23 April 2003. An in-depth review of the NC3 was carried out from July 2003 to October 2003, including a visit to Reykjavik from 1 to 5 September 2003. The review team consisted of Mr. Solomone Fifita (Tonga), Ms. Tatiana Ososkova (Uzbekistan), Mr. Vladimir Shevchenok (Belarus), Ms. Mariko Hara (Japan) and Mr. Vitaly Matsarski (UNFCCC secretariat, coordinator).

2. During the country visit, the review team had a number of meetings and discussions on different aspects of the climate policy of Iceland. During these meetings with government officials, academia, and business and environmental non-governmental organizations (NGOs), the review team was provided with a range of additional material and information that supported and updated the information provided in the NC3.

B. National circumstances

3. Located in the northern Atlantic, Iceland is the second largest island in Europe, with a total area of about 103,000 km^2. Vegetation of all sorts covers 23.0 per cent of the territory, glaciers 11.6 per cent and lakes 2.7 per cent. The remaining 62.7 per cent is waste land of volcanic origin. Iceland's coastline is almost 5,000 km in length and the country's average elevation is 500 metres above sea level.

4. Iceland's climatic conditions show the influence of warm oceanic currents. Winters are relatively mild for the high latitude, with mean January temperatures around 0 ºC; mean July temperatures are around 10 ºC. The weather is highly changeable, with relatively heavy precipitation of around 800 mm annually.

5. The population was estimated to be 286,000 inhabitants in 2001 and is projected to increase by at least 12 per cent by 2020. Apparently this growth will be largely due to immigration, which is a relatively new phenomenon, as well as return of Icelanders from abroad: in 1986–1990 net immigration was 0.5 persons per 1,000 and in 1991–1995 it was even negative (–1.2 per 1,000), whereas in 2000 it reached 6.0 per 1,000 inhabitants. The country's population is mostly concentrated in the area of the capital (Reykjavik) and surrounding regions, where more than 60 per cent of the population live. The remaining population resides mainly in the coastal towns and villages. The average population density is 2.8 persons per km^2. The average life expectancy is 80 years, the highest for all European countries.

6. The economy of Iceland is open and rapidly developing. However, the rate of economic growth fluctuated widely in the period 1990 to 2000. The average growth of the GDP in 1990–1995 was only 0.5 per cent, falling to as low as –3.6 per cent in 1992. From 1996 to 2000 the GDP grew at an average rate of about 4.8 per cent. According to the NC3, services accounted for 62.5 per cent of the GDP in 2001, followed by industry (including manufacturing and construction) 23.6 per cent, fisheries 12.5 per cent and agriculture 1.4 per cent. More than 68 per cent of the employed population work in the services sector, 23 per cent in industry and about 8 per cent in agriculture (almost half of them in fishing, which for the purposes of national statistics is included in agriculture). Tourism is a fast-growing industry; more than 300,000 visitors were registered in 2000.

7. Iceland relies heavily on fishing and fish processing; it has a 758,000 km^2 exclusive economic zone, and more than 50 per cent of total exports consist of fish and fish products. Overall, the fish catch grew steadily from 1.5 million tonnes in 1990 to almost 1.9 million tonnes in 2000. About 38 per cent of fish products are exported. Aluminium and ferrosilicon are other important sources of export revenues, accounting for more than 14 per cent of the total volume of exports in 2001. It is planned to further

increase the export of aluminium as a result of construction of a new aluminium smelter with an annual capacity of 322,000 tons, which should start operating in 2007.

8. Iceland is the oldest modern democracy in Europe. The Icelandic parliament, Althingi, is the country's legislative power, while executive power rests with the government. There are 124 municipalities that have responsibilities for local affairs, including those that indirectly relate to climate change, such as territorial planning, public transport and education.

9. Iceland has abundant geothermal and hydroelectric power resources but virtually no fossil fuel reserves. It is estimated that in 2001 72 per cent of all energy consumed in the country was derived from these renewable sources. Around 99 per cent of electricity was produced from renewable sources. According to national experts, only 16 per cent of Iceland's total geothermal and hydropower potential has been used so far. The total primary energy supply (TPES) increased from 2.17 Mtoe in 1990 to 3.36 Mtoe in 2001, an increase of more than 54 per cent. Electricity consumption in the same period increased by almost 87 per cent while the population increased by about 12 per cent, so the resulting increase of TPES per capita was almost 40 per cent, with electricity consumption per capita increasing by 67 per cent. Despite this rapid growth in TPES and electricity production, emissions of greenhouse gases (GHGs) per capita decreased by more than 14 per cent; the decrease in GHG emissions per unit of GDP was even more substantial, amounting to 20 per cent (see table 1).

Table 1. Main macroeconomic indicators and GHG emissions

	1990	2001	Change 1990–2001 (%)	Average growth rate 1990–2001 (%/year)
Population (million)	0.255	0.285	11.8	1.0
GDP (billion USD of 1995)[a]	5.78	7.71	33.4	2.6
Total primary energy supply – TPES (Mtoe)[b]	2.17	3.36	54.8	4.1
Electricity consumption (TWh)	4.11	7.68	86.9	5.8
TPES per capita cap (kgoe)	8.5	11.8	38.8	3.0
Electricity per capita (MWh)	16.1	26.9	67.1	4.8
GHG emissions without LUCF (Tg[c] CO_2 eq)	2.84	2.72	–3.6	–0.4
GHG emissions per capita (kg CO_2 eq)	11.1	9.5	–14.4	–1.4
GHG emissions per GDP(kg CO_2 eq per USD of 1995)	0.49	0.35	–20.0	–3.0

Source: Data are from the NC3 and the IEA database.

[a] Calculated using the method of purchasing power parities (PPP).

[b] Millions of tonnes of oil equivalent.

[c] One teragram (Tg) is equal to 1,000 gigagrams (Gg) or one million tonnes.

10. The country's geographical situation and unique national circumstances have major implications for its emission profile and related policies: (1) a very high share of renewable (geothermal) sources in energy use and electricity production makes Iceland one of the world's "cleanest" countries; (2) the important role of the fishing industry largely determines available policy options; (3) the small size of the economy means that any relatively large new industrial project could significantly increase the country's GHG emissions.

II. GREENHOUSE GAS INVENTORIES INFORMATION

A. Inventory preparation

11. Several agencies and organizations were involved in the preparation of the GHG inventory, which was compiled for submission to the UNFCCC secretariat by the Environmental and Food Agency of Iceland. Data on fuel sales were provided by the National Energy Authority, data on waste management were collected by the Environmental and Food Agency, industry supplied data on process-related emissions, and information on the imports of solvents used in road surfacing was provided by the State Road Administration. Estimates of emissions from agriculture were made on the basis of data provided by the Farmer's Association and the Agricultural Research Institute.

12. In accordance with the relevant decision of the Conference of the Parties, Iceland submits its GHG inventory annually in the common reporting format (CRF).[1] The NC3 contains GHG inventory data up to 2000. This report uses the GHG data from the latest CRF submission of 5 May 2003, which covers 1990–2001. The national inventory report (NIR) was still pending at the time of the visit.

13. The NC3 mentioned two major changes introduced to the GHG inventory reporting as of 2000: (1) emissions from exploitation of geothermal sources were not included; (2) estimated emissions coming under COP decision 14/CP.7 (impacts of single projects on emissions in the commitment period) were reported separately.[2] In absolute terms, the amount of these emissions excluded from the national total and reported separately was 272.8 Gg of CO_2: 150.6 Gg from the expansion of the ferroalloy plant and 122.2 Gg from the expansion of the aluminium plant. In relative terms, these emissions equal 10 per cent of the reported national totals. The amount of emissions from exploitation of geothermal sources was not specified.

14. The review team was informed that emissions from geothermal exploitation were excluded because the reporting guidelines do not contain this source of emissions. Emissions from single projects were reported separately and not included in the national totals to avoid introducing "an abrupt change in the reporting approach in 2008". The review team considered it was not in its mandate to judge to what extent this approach is justified before the entry into force of the Kyoto Protocol. It noted, however, that excluding these emissions from national totals makes the consideration of the trends and policy options more challenging. In what follows, the discussion is based on the CRF submission of 2003, which excludes CO_2 emissions covered by decision 14/CP.7 unless otherwise indicated.

15. The inventory covered all GHGs and most sources of emissions and removals, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases: perfluorinated hydrocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6). Emission estimates were generally made using the revised 1996 IPCC guidelines, relying largely on default emission factors, because of the limited national research capacities and the relatively small number of important emission sources.

16. Iceland's GHG inventory was subject to a routine check by the UNFCCC secretariat as part of its inventory review process. In the course of the in-depth review the review team noted that estimates of total emissions from the energy sector for the base year and the following years in CRF 2003 differed from those provided in CRF 2002 and replicated in NC3. The differences ranged from 2.8 per cent in 1991 to –6.2 per cent in 2000. The latter difference may be explained by excluding CO_2 emissions coming under decision 14/CP.7. The reason for differences in the earlier years was less clear because CRF tables submitted by Iceland contained disaggregated data for 1999–2001 only. It should be noted, however, that those differences were minor.

B. Emission profile and trends

17. Table 2 and figure 1 illustrate overall trends in total aggregated GHG emissions in Iceland from 1990 to 2001 with a breakdown by individual gases. It can be seen that total GHG emissions were 4.1 per cent lower in 2001 than in 1990 if CO_2 emissions covered by decision 14/CP.7 are excluded, but 5.4 per cent above the 1990 level if those emissions are included. For CO_2 the difference between inclusion and exclusion of those emissions becomes even more pronounced: an increase of 16.9 per cent versus 4.0 per cent in 2001 relative to 1990. In figure 1 the estimates that exclude CO_2 emissions covered by decision 14/CP.7 are shown by a dashed line. In 2001, CH_4 and N_2O accounted for 10.1 per cent and 4.2 per cent, respectively, of the reported national total GHG emissions.

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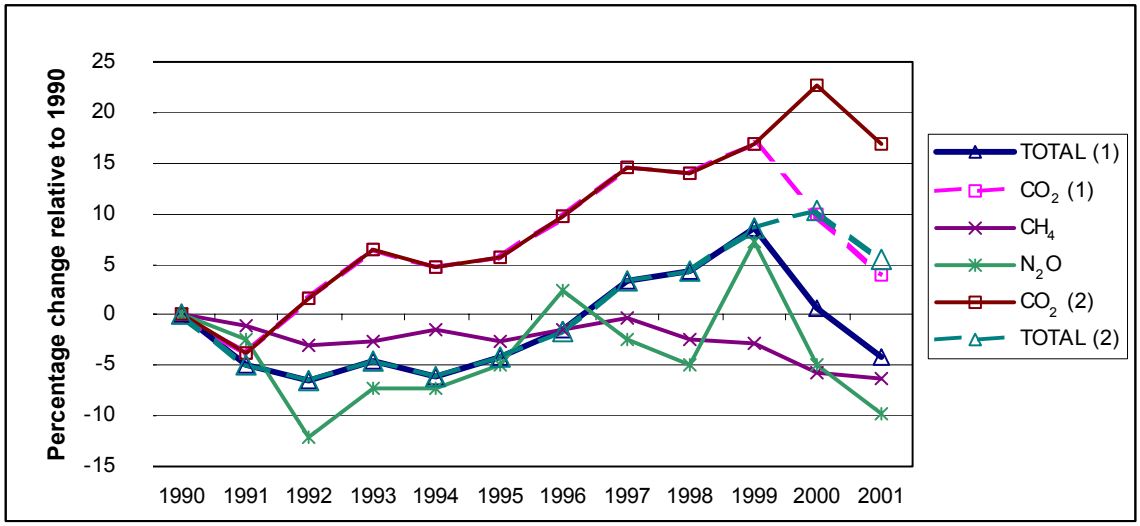
[1] FCCC/CP/1999/7.
[2] FCCC/CP/2001/13/Add.1.

Table 2. Total GHG emissions and emissions by gas, 1990–2001

	Gg CO_2 equivalent											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Total(1)	**2 838.0**	**2 696.7**	**2 653.3**	**2 708.8**	**2 664.8**	**2 722.0**	**2 794.0**	**2 934.0**	**2 961.0**	**3 082.0**	**2 859.0**	**2 721.0**
CO_2(1)	2 108.0	2 028.1	2 140.6	2 245.2	2 207.7	2 227.0	2 315.0	2 415.0	2 403.0	2 462.0	2 316.0	2 192.0
CH_4	294.0	291.1	285.0	286.0	289.8	286.4	289.8	293.2	287.1	285.6	277.2	275.7
N_2O	127.1	124.0	111.6	117.8	117.8	120.9	130.2	124.0	120.9	136.4	120.9	114.7
Fluorinated gases	308.9	253.5	116.1	59.8	49.5	87.0	56.0	103.0	151.0	199.0	145.0	138.0
CO_2(2)											2 588.0	2 464.0
Total(2)											**3 131.1**	**2 992.4**

Estimates indexed (1) *exclude* emissions covered by decision 14/CP.7 starting in 2000; estimates indexed (2) *include* these emissions.
Totals exclude emissions/removals from land-use change and forestry.
The cells for CO_2 (2) and Total (2) for 1990–1999 have been left empty because the figures are identical to those for CO_2 (1) and Total (1).
Discrepancies in totals are due to rounding errors.

Figure 1. Total GHG emissions by gas: percentage change relative to 1990



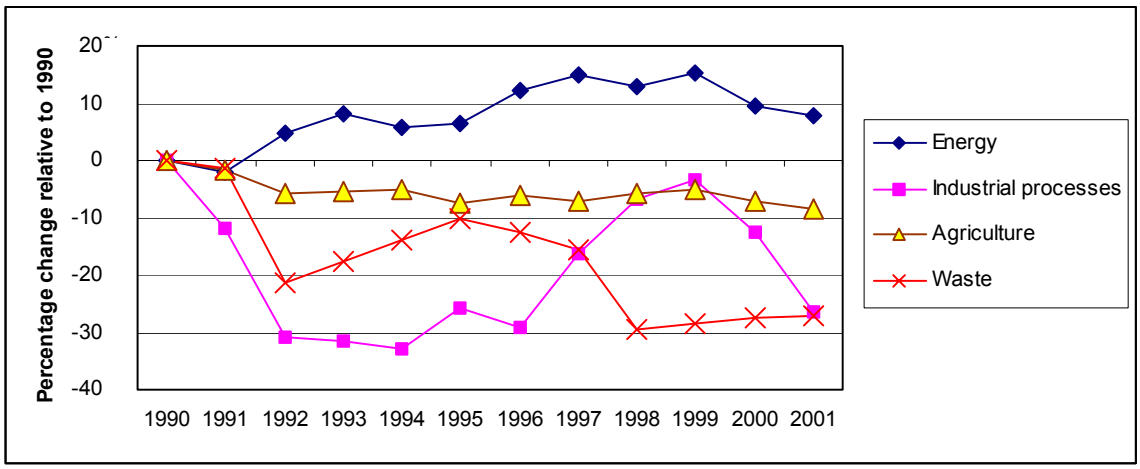
18. Table 3 and figure 2 illustrate overall trends in Iceland's total aggregated GHG emissions from major sectors from 1990 to 2001. This table also shows differences between emission estimates for the energy sector between the NC3 and CRF 2003. These differences relate directly to differences in totals mentioned above, because in the period 1990–2001 the energy sector accounted on average for more than 60 per cent of the total GHG emissions. Due to a decline in emissions from other sectors, the share of energy increased from about 59 per cent to almost 70 per cent in 2000. Energy was the only sector in which emissions were consistently above the 1990 level throughout the reporting period.

19. The estimates provided indicate that emissions from agriculture were slowly declining, whereas emissions from industrial processes, after an initial decrease, exhibited a tendency to growth followed by a steep decline after 1999. According to the national experts, these emissions peaked in that year because a new smelter was expanded in 1998 with a resulting increase in process-related PFC emissions. Later improvements in the process led to a subsequent decrease in these emissions. Emissions from waste, after an initial decrease and a subsequent increase, dropped in 2001 to their lowest level of almost 30 per cent below the 1990 level (see figure 2).

Table 3. GHG emissions by sector, 1990–2001

	Gg CO_2 equivalent											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Energy	1 690.8	1 654.3	1 771.9	1 828.8	1 791.0	1 800.2	1 894.3	1 944.2	1 907.8	1 946.0	1 851.6	1 820.0
Industrial processes	748.2	658.7	518.0	512.6	502.7	554.5	529.5	626.4	696.8	722.4	653.5	551.2
Agriculture	319.6	314.2	300.9	301.9	302.8	296.2	300.3	296.4	300.8	302.9	296.4	292.2
Waste	79.5	78.5	62.5	65.5	68.4	71.3	69.6	67.0	56.0	56.8	57.6	58.0
Energy (NC3)	1 647.6	1 609.2	1 739.9	1 800.5	1 771.4	1 801.9	1 891.0	1 916.1	1 909.6	1 971.3	1 973.2	–
Energy difference	43.2	45.1	32.1	28.3	19.6	–1.7	3.4	28.1	–1.8	–25.4	–121.6	–
Energy difference (%)	2.6	2.8	1.8	1.6	1.1	–0.1	0.2	1.5	–0.1	–1.3	–6.2	–

Figure 2. GHG emissions by sector: percentage change relative to 1990

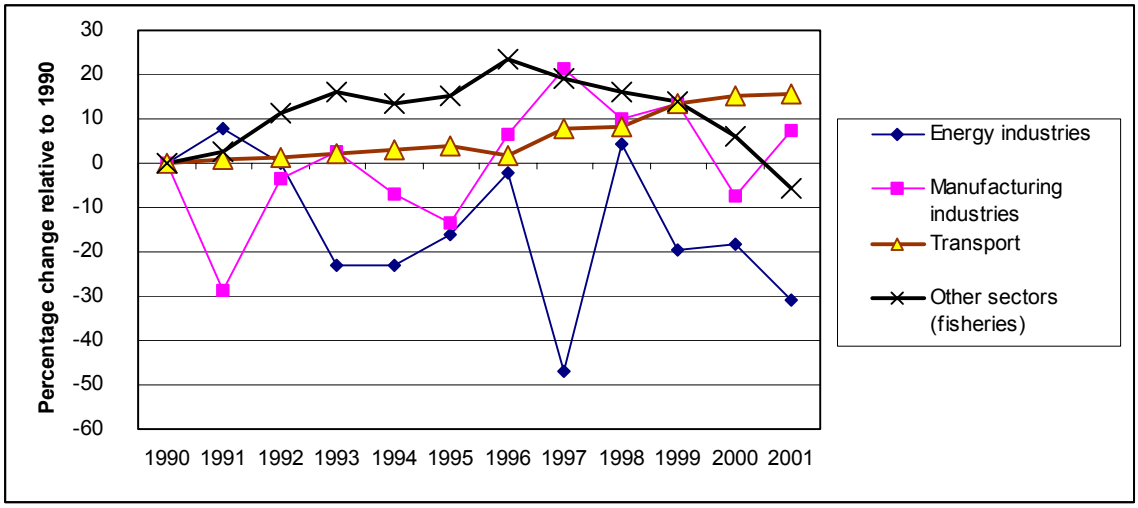


20. As can be seen from table 4, the main sectors responsible for CO_2 emissions were transport, fisheries and manufacturing industries. Transport exhibits a consistent increasing trend, exceeding the 1990 level by more than 15 per cent in 2001. Other sectors do not seem to have a consistent trend, apparently fluctuating in line with the level of economic activity. The review team was informed by representatives of the fisheries industry that CO_2 emissions from fisheries could be higher than presented in the NC3, by about 40 Gg in 2001 but that would not affect the overall trend. Estimates also indicate substantial increases in emissions from both aviation and marine bunkers. Removals of CO_2 due to new revegetation and reforestation activity in the period 1990–2001 increased almost 30-fold and equalled 5.8 per cent of total CO_2 emissions (excluding LUCF) in 2001.

Table 4. Carbon dioxide emissions by sector, 1990–2001

	Gg											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Energy industries	4.1	4.4	4.1	3.2	3.2	3.5	4.0	2.2	4.3	3.3	3.4	2.8
Manufacturing industries	242.9	172.8	234.1	249.7	226.1	209.6	258.8	294.6	267.5	275.9	224.5	261.0
Transport	720.8	726.6	728.8	738.0	742.9	748.9	734.8	775.8	780.7	819.2	829.9	832.4
Other sectors (including fisheries)	704.1	722.5	784.4	816.7	798.8	811.1	870.0	838.8	817.1	801.3	748.1	663.8
Other	1.7	1.6	2.2	2.8	1.7	2.1	1.0	0.6	5.6	4.9	4.9	19.9
LUCF	–5.4	–14.1	–24.5	–37.2	–42.7	–56.0	–65.6	–80.4	–93.7	–112.0	–130.9	–144.9
Aviation bunkers	219.7	222.0	203.6	195.6	213.6	236.2	271.5	292.1	338.1	363.4	407.7	349.1
Marine bunkers	99.0	37.7	60.0	97.4	93.5	140.7	124.0	148.7	176.5	163.9	218.6	149.0

Figure 3. Carbon dioxide emissions by sector: percentage change relative to 1990

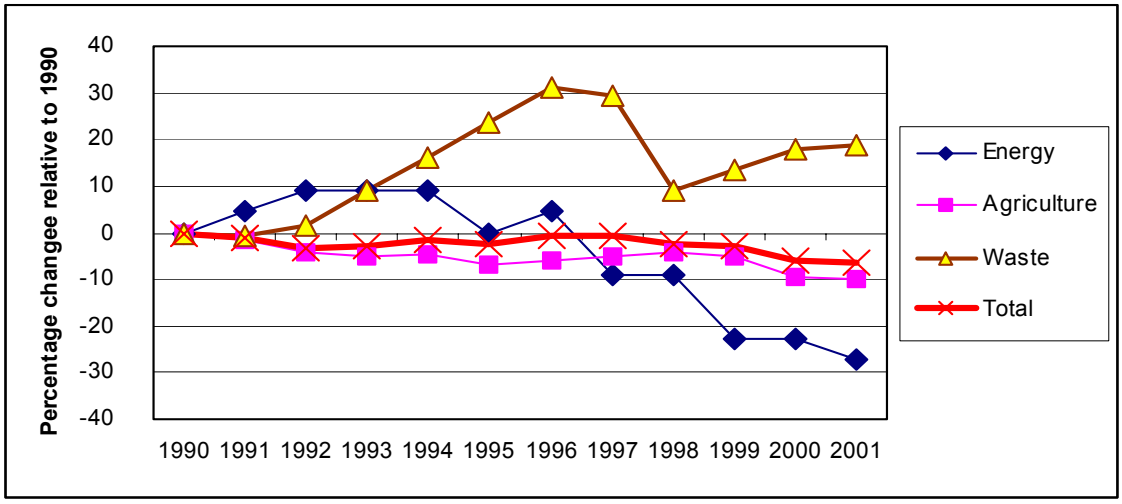


21. Total emissions of CH_4 declined in the period 1990–2001 by more than 6 per cent, mainly as a result of a decrease in agricultural production, which is the main emitter of CH_4. Contributions of other sectors, including waste, were relatively small and thus did not greatly affect the overall trend (see table 5 and figure 4).

Table 5. Methane emissions by sector, 1990–2001

	Gg											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Energy	0.22	0.23	0.24	0.24	0.24	0.22	0.23	0.20	0.20	0.17	0.17	0.16
Agriculture	11.90	11.74	11.41	11.31	11.36	11.08	11.18	11.29	11.40	11.27	10.79	10.71
Waste	1.90	1.89	1.93	2.07	2.21	2.35	2.49	2.46	2.07	2.16	2.24	2.26
Total	**14.02**	**13.86**	**13.58**	**13.62**	**13.81**	**13.65**	**13.90**	**13.95**	**13.67**	**13.60**	**13.20**	**13.13**

Figure 4. Methane emissions by sector: percentage change from 1990



22. Total emissions of N_2O were relatively stable in 1990–2001, because an increase in these emissions from the energy sector was compensated by a corresponding decrease in emissions from industrial processes, whilst emissions from agriculture remained practically unchanged (see table 6). Overall, N_2O emissions decreased by about 10 per cent.

Table 6. Nitrous oxide emissions by sector, 1990–2001

	Gg											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Energy	0.04	0.04	0.04	0.04	0.04	0.07	0.07	0.09	0.09	0.12	0.12	0.12
Industrial processes	0.16	0.15	0.14	0.14	0.14	0.14	0.16	0.13	0.12	0.12	0.06	0.05
Agriculture	0.21	0.20	0.18	0.19	0.19	0.19	0.20	0.17	0.18	0.20	0.21	0.20
Total	**0.41**	**0.39**	**0.36**	**0.37**	**0.37**	**0.40**	**0.43**	**0.39**	**0.39**	**0.44**	**0.39**	**0.37**

23. Estimates of emissions of fluorinated gases are shown in table 7. None of these gases is manufactured in Iceland, and emissions were calculated on the basis of import and consumption figures. It can be seen from the table that overall emissions of fluorinated gases decreased by more than half in the period 1990–2001, mainly due to a decrease in emissions of PFCs, despite a considerable increase in emissions from HFCs (which were non-existent in the early 1990s). Estimates of emissions of SF_6 indicate that they were stable over the reporting period. The review team noted that increases in aluminium production starting in 2003 might change this picture in the future.

Table 7. Emissions of fluorinated gases, 1990–2001

	Gg CO_2 equivalent											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
HFCs	0.00	0.00	0.47	1.56	3.12	25.01	28.56	37.46	63.90	59.40	32.28	53.78
PFCs	303.97	249.14	109.67	53.48	41.03	57.00	22.27	59.91	81.58	134.11	107.30	79.34
SF_6	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
Total	**309.35**	**254.52**	**115.52**	**60.42**	**49.53**	**87.39**	**56.21**	**102.75**	**150.86**	**198.89**	**144.96**	**138.50**

24. The NC3 did not provide any indication of the uncertainties associated with emission estimates. During the visit the review team was informed that national experts are working on this issue. They are fully aware of the fact that the small absolute figures of GHG emissions make verification of the estimates particularly challenging, especially under the strict reporting and review requirements of the Kyoto Protocol.

III. POLICIES AND MEASURES

25. The NC3 contains a general overview of the approach of the Government of Iceland to combating climate change. With regard to the presentation of information on policies and measures in the NC3, the review team considered that the information was less complete than in the NC2. The degree of progress in the implementation of policies and measures was often not clear in the NC3, which did not use the classification of measures suggested by the UNFCCC guidelines (implemented, adopted, planned). During the visit the review team was presented with more details on the policies and measures, which to a certain extent clarified and supplemented the information contained in the NC3.

26. In the period from 1995 to 2002 policies and measures in the climate change area were based on a strategy aimed at implementing Iceland's commitments under the UNFCCC. After the adoption of the Kyoto Protocol in 1997, the Government of Iceland focused its attention on developing a coherent strategy that would allow the achievement of a quantitative target established for Iceland under the Protocol – not exceeding 110 per cent of its base year emissions in the first commitment period. Taking into account the small size of its economy and its heavy reliance on renewable energy sources, Iceland successfully promoted adoption of a COP decision that would take its unique national circumstances into account. Decision 14/CP.7 on the impact of single projects on emissions in the commitment period, adopted by the COP in 2001, stipulates a set of conditions under which CO_2 emissions from single projects could be excluded from accounting for the purposes of verification of commitments under the Kyoto Protocol. As mentioned in the previous section, Iceland decided not to include emissions covered by decision 14/CP.7 in the estimates of the national totals but to report them separately as of 2000.

27. In March 2002 the government approved a new climate strategy that takes into account Iceland's commitments under the Kyoto Protocol and decisions adopted at COP 7. On that basis the Parliament

approved ratification of the Kyoto Protocol in April 2002. The main directions of the Icelandic climate policy are discussed below.

A. Energy

28. All electricity-producing companies in the country are owned by the state or municipalities. The generating companies also own the distribution grids. In July 2003 the Icelandic Parliament adopted an act on deregulation of the electricity market, which will bring national legislation in line with the relevant European Community (EC) directives.[3] This act envisages separation of electricity generation from its distribution and will allow consumers to choose a supplier. Until 2003 electricity prices were fixed by the Ministry of Industry and Trade, but this will be discontinued.

29. Iceland's TPES grew from 2.17 Mtoe in 1990 to 3.36 Mtoe in 2001, an increase of almost 55 per cent. Non-combustible renewables represented about 48 per cent of the TPES in 1990 and 56 per cent in 2001. This increase was primarily due to a reduced share of both oil and coal, with a particularly marked reduction in oil: from 32.6 per cent in 1990 to 24.4 per cent in 2001. The share of hydro energy remained almost constant, at about 16.8 per cent.

30. Annual generation of electricity increased by 42 per cent, from 4,447 GWh in 1990 to more than 7,700 GWh in 2001. In 2001 almost half of the electricity was consumed by aluminium plants, more than a third by private households and the remainder by other power-intensive industries. The average per capita consumption of electric power in 2001 was about 25,000 kWh, which is among the highest in the world.

31. Given that the share of fossil fuels in electricity and heat production is almost negligible, there are no specific measures to reduce emissions from the energy supply sector. The review team was informed about ongoing exploration of the sources of geothermal energy, which could potentially reduce the share of fossil fuels even further. This is one of the measures included in the national strategy for sustainable development which was approved by the government in mid-2002.

B. Transport

32. The review team was informed that the first comprehensive plan for the development of transport in Iceland was prepared in 1999. Unlike previous plans, which focused mainly on infrastructure, this one took into consideration environmental indicators, including emissions of CO_2. In 2002 the new plan was submitted to Parliament, which endorsed it. This plan formed a basis for the transport policies and measures, including those relevant to climate change.

33. The national circumstances of Iceland determine its high reliance on road transport as a means of delivering goods and ensuring mobility of population. There are no railways in the country and the inland waters are not suitable for transport. There is some transport of goods between coastal towns and villages by ship, but most is transported by road or to a lesser extent by internal flights. Road transport was the source of 93 per cent of CO_2 emissions from this sector in 2001, internal air transport accounted for 4 per cent and sea transport for the remaining 3 per cent. Iceland has a high number of passenger cars per 1,000 inhabitants – 562 in 2000 (the second highest figure in the world). The number of privately owned cars grew by almost 25 per cent in the period from 1990 to 2000; for 1990, a value of 2.7 billion passenger-kilometres was reported to the European Conference of Ministers of Transport (ECMT).

34. As can be seen from figure 3, CO_2 emissions from transport, which accounted for 31.2 per cent of total emissions in 2001, have increased by 15.5 per cent since 1990. That growth was less than the increase in the number of cars, which local experts explain by improved engine efficiency of the newly imported cars. According to the Ministry of Transport, specific CO_2 emissions (kg CO_2/km) from cars decreased by 22 per cent in the period 1990 to 2001, from 350 g/km to 280 g/km. It was noted by the

[3] Iceland is not a member of the European Union.

review team, however, that the recent trend of increased sales of bigger sport-utility vehicles (SUVs) could further accelerate the growth in GHG emissions despite improved engine efficiency.

35. The review team noted the efforts of national and local authorities to promote public transport. The frequency of the bus service has been increased in the capital area, and long-distance coaches are supported by, for example, refunds of annual taxes. To encourage a renewal of the motor coach fleet and to facilitate the import of more environment friendly vehicles for passenger transport, a temporary refund of two thirds of VAT on the purchase or rental of coaches was introduced as of 1 September 2000. Nonetheless, individual passenger cars remain the preferred means of transport.

36. Taxation remains the main policy in the private transport sector. Up to 2000, for the purposes of levying excise duties, imported vehicles were divided into two groups (gasoline and diesel engines), subdivided into three categories according to the volume of the engine. This differentiated excise duty ranged from 30 to 65 per cent of the purchase price of a new passenger car. In 2000 the distinction between gasoline and diesel engines was abolished and the three categories were reduced to two, with duties of 30 per cent applying to engines with capacity up to 2,000 cm^3 and 45 per cent on engines of larger capacity. The purpose of this change was to make it make it attractive for people to buy more efficient cars by abolishing a flat-rate annual payment and introducing a differentiated tax on fuels. It was also expected that it would lead to a reduction in the import of used cars, which often have insufficient pollution prevention equipment. Some NGOs expressed a concern that this measure could make the purchase of bigger cars more attractive and thus contribute to an increase in emissions from cars. Also, partly because of a high fuel taxation policy, gasoline prices in Iceland are among the highest in the world.

37. A new policy direction in the transport sector is the international hydrogen project. A committee established in 1997 by the Ministry of Industry and Trade recommended forming a private company to support research and development of hydrogen-based fuels. Such a company, Icelandic New Energy Ltd, was established in 1999, with international participation. Its objective is to investigate the potential for eventually replacing the use of fossil fuels in Iceland by hydrogen-based fuels and creating the first hydrogen society in the world. This goal is endorsed and supported by the Government of Iceland.

38. The hydrogen project, entitled ECTOS, is scheduled to run from 2001 to 2005. In the first two years, the focus was on establishing the necessary infrastructure and maintenance facilities as well as on conducting economic and social research. In the second two years, the project aimed to demonstrate the practical feasibility of hydrogen-based transport. In April 2003 the first hydrogen filling station was commissioned and in the autumn of the same year the city of Reykjavik introduced three fuel cell buses. They are capable of transporting up to 60 passengers each, with a range of about 200 km, reaching a maximum speed of 80 km/hour.

39. At a later stage, it is planned to demonstrate the feasibility of producing passenger cars and fishing vessels running on hydrogen fuel cells. The review team was impressed with the scope and success of the first stages of the hydrogen project.

C. Fisheries

40. Fishing and fish processing remains a major sector of the economy in Iceland. The fishing fleet is not subsidized, although it is exempt from fuel taxation. There is also no tax on the import of fishing vessels. The total catch increased by more than 20 per cent from 1.5 million tonnes in 1990 to almost 1.9 million tonnes in 2000. In the same period GHG emissions from this sector, which in 2000 accounted for about 26 per cent of the total emissions, increased by 6.2 per cent.

41. The number of decked fishing vessels decreased from about 1,000 to 800 between 1990 and 1997, when a law was enacted allowing anyone to own a fishing vessel once they had obtained a licence. As a result, after 1997 the number of fishing vessels started to increase, reaching 900 in 2000. The type and size of vessels also changed: after 1997 the number of larger ships increased. In 1990 there were

67 trawlers that stored fresh fish on ice, whereas in 2000 there were only 32 such vessels. In contrast, the number of trawlers with modern freezing equipment increased from 34 to 52 over the same period. According to national experts, these factors explain the increased efficiency of the fleet and of fish processing, resulting in a less rapid growth of emissions compared to the volume of catch. A trend towards fewer but larger and more energy-efficient vessels also contributes to the reduction in GHG emissions.

42. The review team was informed that representatives of the Fisheries Technology Forum and of the Federation of Icelandic Fish Processing Plants conduct regular seminars and workshops for the owners of fishing vessels where they are made aware of fuel conservation measures. Oil consumption by fishing vessels peaked in 1996, reaching 315 m^3, and then declined to 258 m^3 in 2001; this is 1.7 per cent lower than the 1990 level. A special project aimed at informing fishermen about the best practices in maintaining and choosing equipment and reducing fuel consumption, funded by the Ministry of Fisheries, amounted to 1.7 million Icelandic króna (i.e. about USD 22,000) per year.

43. Another measure is promoting the use of hydroelectricity generated onshore for vessels in port. In addition to other benefits, such as noise reduction and cost savings, using hydroelectricity instead of generating electricity on board by diesel engines reduces GHG emissions. The review team was informed that at present almost all the larger vessels use onshore electricity while in port. As a result, consumption of oil by vessels in ports decreased from 2,000 tonnes in 1998 to about 1,300 tonnes in 2001.

44. The fish meal industry also consumed crude oil for energy generation. There were 21 fish meal factories in 2000 (19 in 1990), which consumed about 44 kg of oil per kg of raw material in 1990. With the introduction of new quality standards for fish meal, the energy efficiency of factories decreased, with estimated consumption of 47 kg of oil per kg of raw material in 2000. That amounted to an increase in oil consumption of about 2,400 tonnes, with a corresponding increase in emissions. High oil prices provided an incentive for switching to hydroelectricity, and by 2003 six factories were already using it instead of oil. It is expected that within the next few years the number of fish meal factories will decline further and more factories will switch to hydroelectricity.

45. Fishing vessels are the major users of refrigerating equipment and hence of HFCs. Most trawlers use HFCs in the cooling and freezing equipment; only 8 out of 40 use ammonia (NH_3), which is not a GHG. The Fisheries Technology Forum and the Federation of Icelandic Fishing Vessels Owners advise fishing operators to use NH_3 as the first option for cooling and freezing, but no other measures, such as economic incentives, are in place or envisaged. Nevertheless, the total consumption of HFCs as refrigerants decreased from about 100 tonnes in 1996 to about 63 tonnes in 2003.

D. Industry

46. Apart from the fisheries sector, the major industry is aluminium production. By 2007, the capacity of Iceland's aluminium smelters is expected to increase by 300,000 tonnes, leading to a projected increase in CO_2 emissions of 1.6 million tonnes. Such an increase would account for 60 per cent of the total CO_2 emissions from this small island economy. Increased production will result from the expansion of the existing aluminium smelter, and from the construction of a new plant in the eastern part of the country.

47. Given the fact that both plants will operate totally on electricity produced from renewable energy sources (85 per cent of which is provided by hydro and 15 per cent by geothermal sources), and that both projects come under decision 14/CP.7, CO_2 emissions from these aluminium smelters will be excluded from the assigned amount under the Kyoto Protocol commitments.

E. Agriculture

48. The NC3 did not discuss the agriculture sector, which was responsible for 10 per cent of the total GHG emissions in Iceland in 2001. The review team was informed that the bulk of emissions from this sector were attributed to herds of cattle, sheep and horses. The CH_4 emissions from this sector decreased between 1990 and 2000. This was due to a reduction in the number of sheep and the introduction of new feeding practices. The government assessed the potential GHG reduction from policy intervention in this sector, but concluded that additional policies will not yield noticeable reductions in GHG emissions.

F. Land-use change and forestry

49. Increasing the level of carbon sequestration resulting from afforestation and revegetation programmes is one of Iceland's major objectives in its aim to implement the UNFCCC and the Kyoto Protocol. According to this policy, a nationwide inventory system on carbon sequestration is planned for 2007. Since 1997 the Parliament has adopted two programmes focusing on carbon sequestration: a new strategic plan for soil conservation and revegetation and a five-year action plan for the forestry sector. A special governmental fund to support implementation of these plans was established and is administered by the Ministry of Agriculture. The government expects that additional sequestration capacity resulting from these activities could offset any unforeseen increases in GHG emissions from the transport and fisheries sectors.

50. Since at present only 25 per cent of the land is covered by woods, revegetation and reforestation is popular in Iceland and takes different forms. When farmers plant trees on their land, they receive remuneration of EUR 2,000–5,000 per year (ISK 160,000–400,000). Research and development programmes also engage in revegetation programmes, with financial support from the government. Between 1997 and 2000, the government increased by 30 per cent the funds for revegetation and afforestration activities and related research and development programmes. It also succeeded in securing funds to support these activities between 2003 and 2014. By 2010, the Government of Iceland expects that the carbon sequestration capacity will amount to 200 Gg CO_2.

51. The government acknowledged that the performance of the revegetation and afforestration programme needs to be closely monitored, and that the projected carbon sequestration figures will subsequently need to be verified.

G. Waste

52. The most important measure to reduce GHG emissions from the waste sector since 1997 was the collection of CH_4 from the largest landfill in the country, in the Reykjavik area. Since autumn 2002, the Reykjavik municipalities have started to introduce the use of CH_4 from landfills as a vehicle fuel. Concerns for GHG emissions from waste have been integrated by municipalities into their Local Agenda 21.

53. The government officials indicated to the review team that all but two open-air incinerators had been closed down by the time of the review. The two remaining sites, located in remote villages, will continue to operate unless other cost-effective alternatives are found.

IV. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

A. Preparation of projections

54. The work on projections for Iceland's GHG emissions was led by the Environmental and Food Agency through a working group composed of representatives from various related institutions and with major inputs from the Energy Forecast Committee (EFC). The EFC is made up of representatives of business, institutions and organizations involved in the energy sector. The projections, particularly for the consumption of fossil fuel, were largely based on projections prepared by the EFC. The EFC collected relevant information relating to specific sectors prepared by other agencies and compiled that

information into a coherent set of projections in 2001. The review team noted that the EFC projections were prepared for a longer period, up to 2030, whereas the GHG emission projections presented in the NC3 covered the period up to 2020. Assumptions about the future developments of new energy-intensive industries made by the Ministry of Industry and Trade were also taken into account. The review team was informed that no baseline ("business as usual") scenario was prepared since it was believed that such a scenario would not serve any useful purpose.

55. The projections covered all the major GHG gases – CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 – and were presented by sector: transport and machinery, residential, industry, fishing vessels and others. The breakdown by sectors was different from the suggested IPCC categories; in particular, transport and machinery were presented together in the projections. During the visit, the review team was provided with additional data on the estimated use of fossil fuels by various sectors but not on projected GHG emissions. It was noted that, in a few instances, there were differences between figures provided by the EFC and those from other sources, in particular for fisheries and transportation for 1990 and 2000. The review team was informed that CO_2 emissions falling under decision 14/CP.7 were not included in the projections. There was generally a lack of information on the effects of specific policies and measures required by the reporting guidelines. This was a challenge to the review team and made the projections presented in the NC3 and during the review less transparent.

B. Scenarios, models and assumptions underlying future emission trends

56. Neither the sectoral GHG projections nor the EFC projections were based on an econometric model; a simple spreadsheet analysis was used instead. Possible future trends in the use of fossil fuel for the period 2002—2030 were considered based on the following assumptions:

(a) Average economic growth was assumed to be 2.5 per cent per year;
(b) Price of oil was expected to increase slowly relative to the 2000 level;
(c) No change in the taxation system other than that proposed for diesel cars was assumed;
(d) Energy use per unit of catch in the fishery sector was expected to decrease;
(e) Number of private cars was expected to increase;
(f) Average annual use of each car was expected to decrease;
(g) Number of utility vehicles was expected to grow in line with GDP growth;
(h) Cars using fossil fuel were expected to become more efficient;
(i) Share of small diesel cars was expected to increase;
(j) 15 per cent of the car fleet was expected to use hydrogen by 2030.

57. The projections for Iceland's GHG emissions were prepared for a 20-year period covering 2000–2020. The review team was informed that projections took into account expected effects of the key policies and measures envisaged by the overall climate change policy adopted by the government in March 2002. Specific effects of these policies and measures were not quantified but were presented qualitatively.

58. Two scenarios were presented, incorporating the above-mentioned projections of the use of fossil fuels. The first scenario assumes no expansion of existing energy-intensive industries other than implementation of additional activities already agreed upon in October 2001, i.e. those activities for which licences have already been granted. The second scenario is based on the assumption that a new aluminium smelter will be built in Reydarfjordur and the existing aluminium plant will be enlarged. These two sets of projections indicate the extent to which future GHG emissions depend on the implementation of single projects in industry. The most recent projections take this factor into account.

59. In the transport sector, the effects of the following measures were incorporated: changes in taxation, creating incentives to use small diesel cars; review of import fees to encourage energy-efficient vehicles; increased coordination of traffic lights; improvement of public transportation systems; participation of municipalities in Local Agenda 21.

60. For industry it was expected that a consultation process leading to voluntary agreements with aluminium smelters would lead to minimizing PFC emissions and achieving a PFC emission target of 0.22 tonnes of CO_2 equivalent per tonne of aluminium produced for existing installations and a target of 0.14 tonnes for new smelters.

61. In the fisheries sector, an increase in energy efficiency was assumed as a result of education programmes for vessel owners and fishermen, encouraging new fishing vessels entering the market to use energy-efficient technologies, and reducing the use of HFC cooling systems.

62. In addition, GHG emissions were expected to be reduced by further reduction in waste, especially organic waste, promoting recycling and increasing collection of landfill gas for energy-related purposes.

63. In the projections, particular attention was paid to effects of increased carbon sequestration. It was estimated that soil conservation, afforestation and revegetation programmes could sequester on average about 200 Gg of CO_2 annually in the period 2008–2012. This equates to 6.7 per cent of total GHG emissions in 2010.

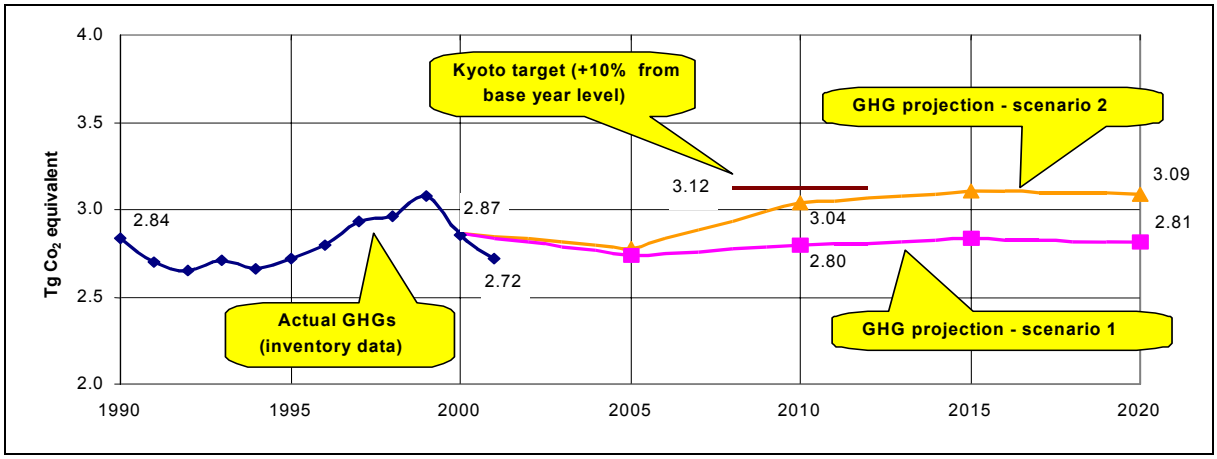
C. Results of projections

64. As can be seen from figure 5 and table 8, the emission trends in the two scenarios are virtually identical for the period 2000–2005, but different levels of emissions are projected after 2005. This corresponds to the planned coming on line of the new smelter in 2006. The review team was informed that according to the latest plans the new smelter is now expected to become operational in 2008. The Ministry of Industry and Trade estimated that PFC emissions from the new smelter were expected to peak in the first two years of its operation and then stabilize; this is reflected in the projections of the PFC emission for 2015 and 2020.

Table 8. Summary of the projections

	Percentage change in total GHG emissions			
	2010–1990	**2020–1990**	**2010–2000**	**2020–2000**
Scenario 1	–1.5	–0.9	–2.4	–1.8
Scenario 2	7.1	8.9	6.1	7.9

Figure 5. Projections and the target under the Kyoto Protocol



Note: Projections and the estimated target under the Kyoto Protocol do not include GHG emissions/removals by LUCF, or CO_2 emissions falling under decision 14/CP.7.

65. According to additional information provided to the review team during the visit to Reykjavik, based on estimates of the future consumption of oil, CO_2 emissions from fishing vessels were projected to increase slightly (by about 8 per cent) from 2002 to 2015 and then decline; emissions from transport were

expected to grow steadily, increasing by 16 per cent in 2020 compared to 2000, whilst emissions from industry were projected to decline after 2002 by about 5 per cent in 2020 relative to the 2000 level.

66. The review team was also informed of a limited sensitivity analysis of the projections that was carried out on the basis of the following parameters, but apparently did not affect the results of projections substantially:

(a) A 10 per cent reduction in the use of gasoline for transport but with a similar increase in the use of diesel fuel;
(b) PFC emissions from the aluminium smelters remaining at the level of 0.4 tonnes of CO_2 equivalent per tonne of output;
(c) A decrease of 10–15 per cent in emissions per unit of catch in fisheries.

67. According to the results of the projections, net emissions (including sequestration), given the above scenarios and assumptions, would allow Iceland to fulfil its commitments under the Kyoto Protocol. This would be the case for both scenarios (2,789 Gg and 3,028 Gg respectively) if all the additional measures and policies lead to the expected results. Since the projections did not take into account carbon sequestration from the planned revegetation and/or reforestation schemes, the "safety" margin could in reality be greater.

68. The review team took note of the stated intention of the national experts to continue working on improving both the process of the preparation of projections and their presentation. It was acknowledged by the representatives of Iceland that a more coherent approach to preparing sectoral projections and to assessing effects of measures would facilitate the monitoring of implementation of domestic policies and their future review.

V. FINANCIAL ASSISTANCE AND TRANSFER OF TECHNOLOGY

69. In 1998 the Government of Iceland accepted the official development assistance (ODA) target of 0.15 per cent by 2003. Since 1999 Iceland has increased its ODA spending, both in real terms and as a share of the GDP. In 1999 the amount allocated to development cooperation was 0.09 per cent of the GDP and by 2003 ODA amounted to 0.16 per cent of the GDP. According to the data provided by the government officials during the review, Iceland's total ODA increased from USD 8,027 million in 1999 to USD 13,062 million in 2002. It was noted that more efforts would be required to reach the level of ODA commitment of other countries of the Organisation for Economic Cooperation and Development, and that achieving that goal is facilitated by strong support from Icelandic society. Notably, there is bilateral and multilateral monitoring of financial assistance, and the Ministry of Foreign Affairs reports to the government on this matter.

70. The review team noted that only general ODA data were provided in the NC3. It was unclear for which environmental purposes in 1999–2002 Icelandic financial development assistance was allocated. Country officials acknowledged that more needs to be done to improve reporting by sectors as required by the UNFCCC guidelines.

71. Though no political decision has been made by Iceland to contribute to the third replenishment of the Global Economic Facility (GEF), the review team was informed of some encouraging developments in that regard. In relation to possible contribution to Kyoto Protocol funds in the future, cooperation through the GEF remains the priority for Iceland in developing financial multilateral environmental assistance.

72. Sustainability has remained a central theme in the Icelandic development cooperation policy since publication of the NC2. Emphasis is placed on assistance in the areas of geothermal energy development and soil reclamation, as well as fisheries. More focus is placed on hydrogen as an energy carrier in the transport sector. The review team was informed that Icelandic institutions actively cooperate with the United Nations University on the UNU Geothermal Training Programme and Fisheries Training Programme, as well as on international hydrogen project initiatives in transport.

VI. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

73. It is uncertain what impact climate change will have on Iceland, or on the oceanic currents that play an important role in the Icelandic climate. Brief information on ecological impacts and effects on Icelandic society was included in the NC3. However, the review team was impressed by the number of national and international studies which have been conducted in Iceland as a response to possible impacts of climate change on society. Icelandic experts participated in the preparation of the Intergovernmental Panel on Climate Change (IPCC) Working Group II report on Impacts, Adaptation and Vulnerability. A Nordic research team on climate change estimated that the temperature increase in Iceland due to the greenhouse effect could be 0.3°C per decade in the next few decades.

74. Climate change may have both positive and negative effects on Iceland's society, national economy and ecosystems. For example, an increase in sea temperature could have some positive effect on marine resources and fish stocks. However, an increase in the number of insects could increase the risk of disease in both plants and humans. A rise in air temperature could positively affect vegetation, increasing the cover by about 11 per cent for each 1 °C increase in temperature. A worst-case scenario for Iceland would be if climate change led to major disruptions in oceanic circulation and this negatively impacted fish stocks. Expected sea level rise has already been taken into account in the design of new harbours.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

75. Within their mandates and competence, every ministry is engaged in research and development activities aimed at reducing negative impacts of climate change. Private companies are also actively involved in research and development activities. In order to encourage active cooperation between industry and academia on research and development projects, a Programme on the Environment and Information Society Technologies was launched in 1999. The overall budget allocated to the programme during 1999–2004 was USD 7 million, 50 per cent of which was spent on information technology development and the rest on environmental research.

76. New legislation on the organization of science and technology policy and funding of research and technological development was enacted at the end of January 2003. The Prime Minister headed the newly established Technology Policy Council. The legislation is composed of three separate laws: the Law on the Science and Technology Policy Council, under the Office of the Prime Minister; the Law on Public Support to Scientific Research, under the Ministry of Education, Science and Culture; and the Law on Public Support to Technology Development and Innovation in the Economy, under the Ministry of Industry and Commerce.

77. Climate processes and climate system studies, as well as impacts of climate change, constitute most of the climate-related research in Iceland. Other directions include modelling and mitigation studies. Research on socio-economic analysis was not substantial, but several research projects dealt with technical mitigation issues. These projects focused either on revegetation and reforestation for carbon sequestration or on the development of technology to make renewable energy a more attractive alternative to fossil fuels. The Agricultural Research Institute and the National Forestry Institute were both involved in studies focusing on carbon sequestration.

78. The Icelandic Meteorological Office (IMO) and Marine Research Institute (MRI) were active in developing both national and multinational projects focusing on the analyses of climate data. The MRI was involved in conducting research on the marine environment around Iceland and its living resources. The MRI runs five laboratories in important fishing ports around the Icelandic coast, as well as shore-based facilities performing systematic observations of marine environment. The UNU Fisheries Training Programme is operated under the supervision of the MRI and through the Icelandic Development Agency. Scientists from the MRI were involved in fisheries developments in developing countries.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

79. In recent years climate change issues have been widely discussed in Iceland, including the provision of information to the public through the media and the Internet (over 80 per cent of the Icelandic population has Internet access). Iceland's participation in UNFCCC activities provides a framework for future developments in environmental education and training.

80. The main focus was on education and disseminating information to the public, for example with regard to fuel use in cars and possible ways of reducing emissions of GHGs from households. The government has used pamphlets as a means of increasing public awareness. It planned, for example, to translate some of the pamphlets prepared by the UNFCCC secretariat into Icelandic. The transport sector has voluntarily published a pamphlet describing the benefits of environmentally friendly and fuel-saving driving skills.

IX. CONCLUSIONS

81. The review team noted that the NC3 contained limited information on the activities of Iceland in dealing with climate change. Discussions with government officials during the review team's visit helped to fill numerous gaps and added to the transparency of the information provided. The review team also noted that the NC3 generally followed the requirements of the UNFCCC guidelines for the preparation of national communications by Annex I Parties and welcomed the intention of the officials to further improve the presentation of information in the fourth national communication.

82. The review team welcomed the submission of the GHG inventory in the CRF format as of 2000 and encouraged national experts to further improve the system for GHG reporting. In particular, the review team noted that excluding CO_2 emissions covered by COP decision 14/CP.7 from reported trends, as of 2000, made interpretation of the trends less transparent.

83. Because its electricity production is based on renewable energy, Iceland is among the few Annex I countries that faces particular difficulties in identifying and implementing cost-effective mitigation policies and measures. Given these special national circumstances, Iceland has assumed a leadership role in shifting towards hydrogen as a fuel for the transport sector, which is the main CO_2 emitter in Iceland.

84. Projections based on policies and measures already in place and planned seem to indicate that Iceland is on track to fulfil its commitments under the Kyoto Protocol. However, the level of uncertainty cannot be assessed. The review team shared the view of the government officials that it is essential to develop a consultative, transparent and responsive mechanism to regularly monitor the impacts of adopted policies and measures and the progress made towards meeting the emission targets.

85. During preparation of the next national communication, more needs to be done to improve financial development assistance reporting by sectors as indicated in the UNFCCC guidelines (FCCC/CP/1999/7).

86. Climate processes, climate system studies and impacts of climate change constitute most of the climate-related research in Iceland. It is uncertain, however, what impact climate change will have on Iceland, particularly in relation to changes in oceanic currents. It may have both positive and negative effects Iceland's society, national economy and ecosystems.

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