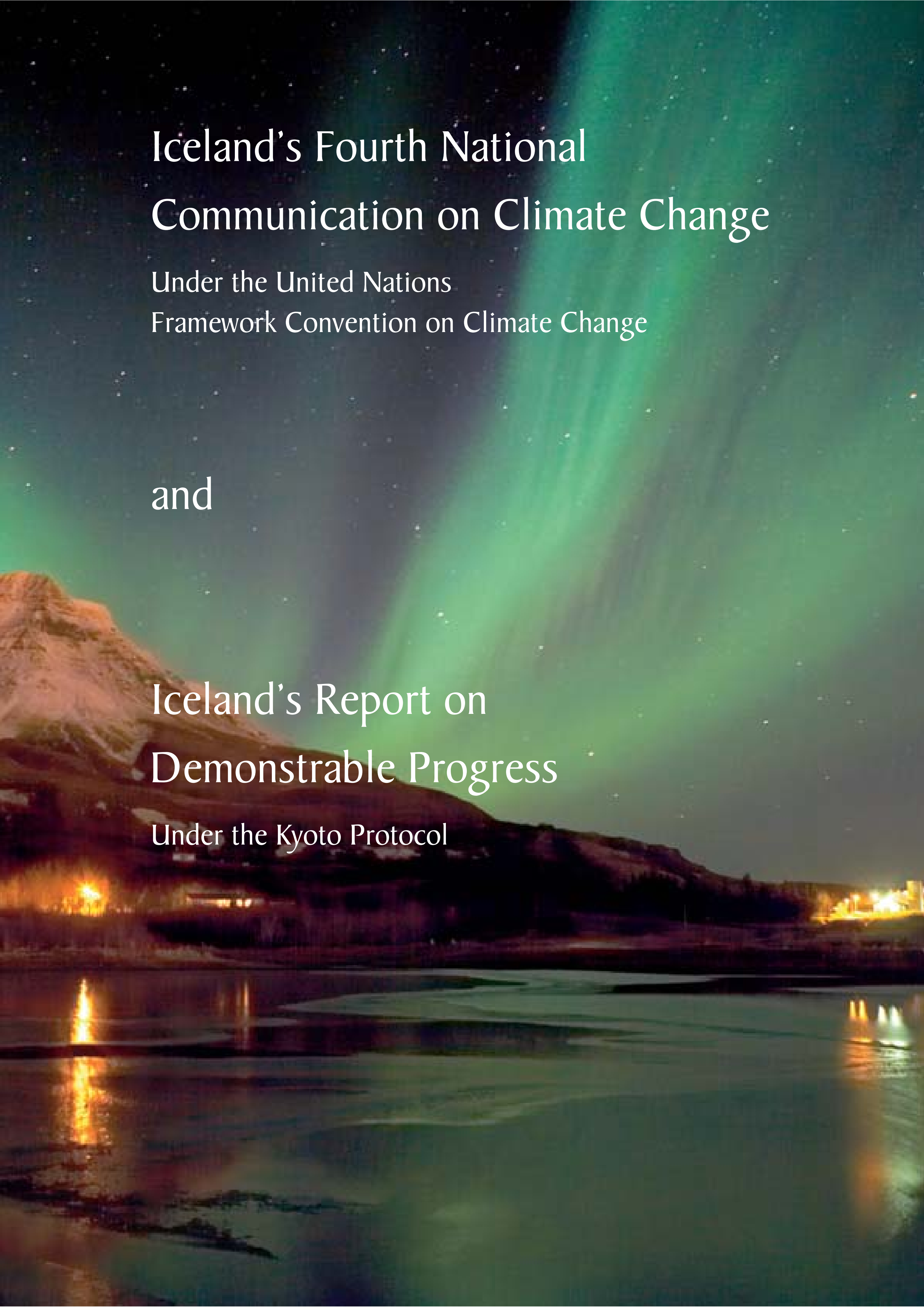

Iceland's Fourth National Communication on Climate Change

Under the United Nations
Framework Convention on Climate Change

and

Iceland's Report on Demonstrable Progress

Under the Kyoto Protocol

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INTRODUCTION

Iceland's Fourth National Communication to the United Nations Framework Convention on Climate Change describes the trends in greenhouse gas emissions in Iceland, policies and measures to curb emissions and their effect, and other relevant information in line with the guidelines of the Convention. This report also, for practical reasons, includes Iceland's Report on Demonstrable Progress, which is intended to show how Iceland has aimed to fulfill its commitment under Article 3 of the Kyoto Protocol.

Total greenhouse gas emissions in Iceland increased by 8% in the period 1990 to 2003. Emissions per capita, however, decreased by 5% in the same period, and emissions per GDP decreased by 20%.

Total emissions are expected to increase significantly in the next few years. The main reason for this is the operationalization of a new aluminum smelter in 2007, and other possible new energy-intensive projects. Such projects have a big impact on total emission levels in Iceland, despite the fact that they use only renewable energy, and are required to use best available technology to minimize emissions from industrial processes, because of the small size of the Icelandic economy. In line with decision 14/CP.7, Iceland will report emissions of carbon dioxide from such new projects since 1990 separately. By applying this decision, it is projected that Iceland will meet its commitments under the Kyoto Protocol despite the predicted increase in overall emissions. The aluminum and ferrosilicon industries are export industries, and Iceland has argued that expansion of such energy-intensive industry in the country is beneficial from the perspective of climate change mitigation, because their use of renewable energy and best available technology ensures that emissions are as low as possible from a global perspective.

Iceland believes that it has achieved demonstrable progress towards fulfilling its commitment under Article 3 of the Kyoto Protocol. Progress has been especially noticeable to date in the decrease of emissions of fluorocarbons from the aluminum industry, and in increased sequestration of carbon from the atmosphere due to increased government funding to afforestation and revegetation. Carbon sequestration is a key factor in Icelandic climate policy, because it complements the high political emphasis on revegetation and afforestation of eroded lands. Results to date have been less obvious in the transport and fisheries sectors, which together produce almost half of emissions. Important policy steps have, however, been taken in these sectors, that should have a growing impact in curbing emissions. Tariffs on non-polluting and low-polluting vehicles have been lowered and the tax system altered to make small diesel-powered cars more competitive than before. New energy-saving technology has been introduced in government-owned ships, and significant gains in reducing emissions from ships are seen as a possibility. In the longer term, hydrogen is seen as a potential energy carrier for cars and ships, and research and demonstration projects in the field of hydrogen technology have been conducted, with the view to speed up the process towards widespread use of hydrogen.

The single most striking feature with regard to Iceland and climate change mitigation is the fact that over 70% of its energy – and practically speaking all stationary energy – comes from renewable resources, hydro and geothermal. This means that Iceland has almost no chance to reduce greenhouse gas emissions from the production of electricity and spatial heating, as Iceland had already almost abolished the use of fossil fuels for these purposes in 1990. On the other hand, in perhaps no other field has Iceland a greater potential to contribute to global climate change mitigation than by the export of know-how in the fields of renewable energy and climate-friendly technology. Efforts in this respect have been ongoing for decades – exemplified by the running of the UN University´s Geothermal Programme – and have been strengthened in recent years.

Iceland's Fourth National Communication on Climate Change

Under the United Nations

Framework Convention on Climate Change

EXECUTIVE SUMMARY

National circumstances

Iceland is a parliamentary democracy. Most executive power rests with the Government, which is headed by a prime minister. The population of Iceland is 300,000, with almost two-thirds of the population living in the capital, Reykjavík, and surrounding areas.

Iceland has an area of 103,000 km, and is the second largest island in Europe after Great Britain. Glaciers cover more than 10% of the area. Soil erosion and desertification is a problem, and more than half of the country's vegetation cover is estimated to have disappeared due to erosion since the settlement period. The country is situated just south of the Arctic Circle but the mean temperature is considerably higher than might be expected at this latitude. Relatively mild winters and cool summers characterize the climate. Iceland is an industrialized country with a high living standard. The country consistently ranks among the top 10 states in the UNDP Human Development Index. Iceland is very dependent upon international trade, and the generation of foreign revenue is highly dependent on natural resources. The fishing industry relies on the rich fishing grounds in Icelandic waters, the aluminum and ferrosilicon industry on hydropower and geothermal energy and the tourism industry on nature and natural beauty. The use of energy is very high per capita, but the proportion of domestic renewable energy in the total energy budget is 70%, which is a much larger share than in most other countries. The use of fossil fuels for stationary energy is almost nonexistent but fossil fuels are used for transport on land, sea and in air. Three features stand out that make the Icelandic greenhouse gas emissions profile unusual. First is the high proportion of renewable energy of the total amount of energy used. Second, emissions from the fishing fleet are about one-fourth of total emissions. The third distinctive feature is the fact that individual sources of industrial process emissions have a significant proportional impact on emissions at the national level, due to the small size of the economy.

Greenhouse gas inventory information

The Environment and Food Agency compiles and maintains the greenhouse gas inventory. In 1990, the total emissions of the six greenhouse gases covered by the Kyoto Protocol were 3,282 Gg of CO_2 equivalents. In 2003, total emissions were 3,534 Gg, excluding LUCF. If emissions falling under Decision 14/CP.7 on the Impact of Single Projects on Emissions in the Commitment Period are excluded, emissions were 3,083 Gg in 2003. This means that total greenhouse gas emissions in Iceland were about 8% above 1990 level in 2003. In that period, carbon dioxide emissions increased by 4%; methane emissions increased by 14%: and nitrous oxide emissions fell by 16%. Removals of CO_2 from direct human-induced revegetation and reforestation since 1990 are estimated to be 207 Gg in 2003. Industry, transport and fisheries are the three main sources of GHG emissions, but other sources include agriculture and waste.

Policies and measures

Iceland is a party of the UNFCCC, and Iceland ratified the Kyoto Protocol on May 23, 2002. Earlier that year, the government adopted a new climate change policy that was formulated with close cooperation between several ministries. The aim of the policy is to curb emissions of greenhouse gases so that they will not exceed the limits of Iceland's obligations under the Kyoto Protocol. A second objective is to increase the level of carbon sequestration resulting from reforestation and revegetation programs. A review of this policy was started in 2005, and is due to be concluded in 2006. Key issues in the climate change policy include changes in taxation creating incentives to use small diesel cars and consultation with aluminum smelters on how to minimize PFC emissions, in addition to carbon sequestration. The fishing industry will be further encouraged to increase energy efficiency, and emissions from waste disposals will be curbed.

Projections and the total effect of measures

A new projection for GHG emissions until 2020 is included in this report. Two scenarios are provided in the projections, depending on the level of increase in new energy-intensive industry in Iceland in that period. The first scenario assumes no additions to energy-intensive industries other than those enlargements already in progress in 2004/2005. The second scenario is based on the assumption that all projects which currently have an operational license will be built. If emissions are in accord with projections, Iceland will be able to meet its obligations for the first commitment period of the Kyoto Protocol in both scenarios. Discussions are under way about the construction of two additional new aluminum smelters in Iceland. If a decision to build them is made, it will be necessary to consider additional measures to ensure that Iceland will meet its Kyoto committments.

Impacts and adaptation measures

It is uncertain what impact climate change will have in Iceland. Natural fluctuations in temperature are greater in the North Atlantic than in most other oceanic areas, so the impact of increasing temperatures due to the greenhouse effect will differ depending on the direction of the short-term natural fluctuation. An increase in temperature could have some positive effects on marine resources and fish stocks. However, more insects could increase risks of disease in both plants and humans, which would be a negative impact. A worst-case scenario for Iceland would be if climate change would lead to major disruptions in ocean circulation that would inter alia have negative impact on fish stocks.

Financial assistance and technology transfer

The Icelandic government has been increasing their Official Development Assistance (ODA) in recent years, and in 2004 ODA had reached 0.19% of GDP. Sustainable development is one of the central themes in Icelandic development cooperation. Especially noteworthy in relation to climate change is the UN University's Geothermal Training Program in Iceland, which has been strengthened in recent years. In addition to ODA, the Icelandic government also provides financial assistance to environmentally related projects in other countries through their participation in various international agreements. Iceland has also made voluntary contribution to the UNFCCC and to the IPCC.

Research and systematic observation

Funds allocated to research and development were 1% of GDP in 1990 but had reached around 3% of GDP in the year 2003, making Iceland fourth among OECD countries in R&D spending per GDP. Icelandic scientists are involved in a number of climate-related research projects. The Icelandic Meteorological Office (IMO) is involved in climate system studies and does some work on modeling and prediction. Paleoclimatological work has mainly taken place within the University of Iceland. Icelandic scientists and research institutions are involved in several projects that study the impact of future global climate changes, including the recently concluded Arctic Climate Impact Assessment (ACIA) and the Climate, Water and Energy (CWE) program, which the Hydrological Institutes of the Nordic countries are responsible for. Important research projects deal with technical aspects of mitigation, including on renewable energy, hydrogen and other climate-friendly technology, and methods to increase carbon sequestration. The two institutions most important in relation to observation of climate change are the IMO and the Marine Research Institute (MRI). Research affects policy making in various ways, a recent example being results showing drained wetlands being a significant and previously unrecognized emission source, which has led authorities to include wetland reclamation as a climate policy emphasis in a draft sustainable development strategy review.

Education, training and public awareness

Environmental education in schools has increased in the past decade. The University of Iceland now offers a Master's degree in environmental studies, where climate change is an integral subject. Many upper secondary schools offer courses in the same, or place special emphasis on environmental issues in their curriculum. Studies of environmental issues in primary schools are included in many subjects, especially natural sciences. As renewable energy is used for both space heating and electrical production, public information campaigns aimed at energy efficiency are less relevant for the purpose of reducing GHG emissions in Iceland than in many other countries, although efforts to reduce emissions from transport by this means could be strengthened.

NATIONAL CIRCUMSTANCES

1.1 Government structure

Iceland has a written constitution and is a parliamentary democracy. A president is elected by direct popular vote for a term of four years, with no term limit. Most executive power, however, rests with the Government, which must have majority support of Althingi, the Parliament. Althingi has 63 members, and parliamentary elections are held every four years. The government is headed by a prime minister, and the executive branch is currently divided among 12 ministers. Judicial power lies with the Supreme Court and the district courts, and the judiciary is independent.

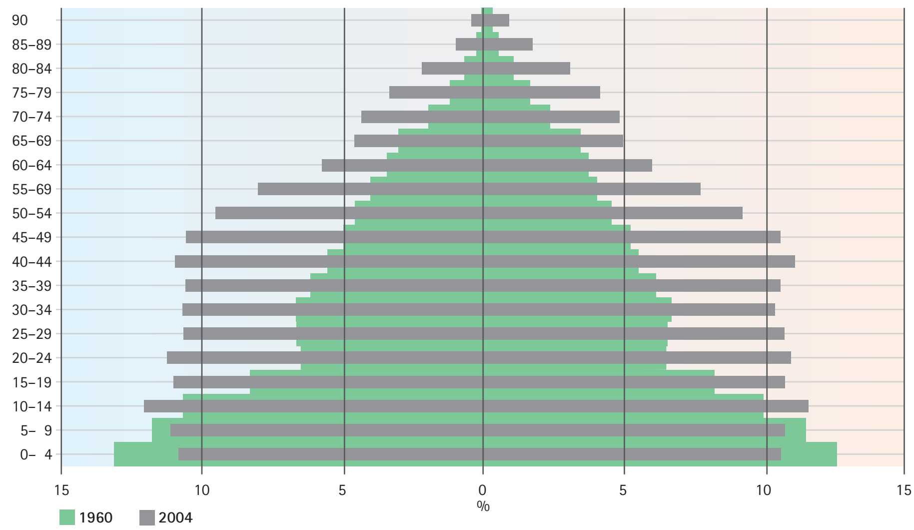
The country is divided into 101 municipalities, and local authorities are elected every four years. The largest municipality is the capital, Reykjavík, with 113,730 inhabitants, but the greater capital area has over 180 thousand inhabitants in 8 municipalities. The smallest municipality has only 38 inhabitants. In 1990 the number of municipalities was 204, but in the last decade an attempt has been made to unite small municipalities, and this has resulted in fewer, but more populous, municipalities. This trend is likely to continue since the tasks of local authorities have grown increasingly complex in recent years. The local authorities have their own sources of revenue and budgets and are responsible for various areas that are important with regard to greenhouse gas emissions. This includes physical planning, granting industry licenses and the design and operation of public transport. Municipalities also play an important role in education.

The Ministry for the Environment is responsible for the implementation of the UNFCCC and coordinated national climate change policymaking in close cooperation with the Ministries of Agriculture, Industry and Commerce, Transport and Communications, Fisheries, Finance, Foreign Affairs and the Prime Minister's Office. Several public institutions and public enterprises, operating under the auspices of these ministries, also participated directly or indirectly in preparing the national implementation policy.

1.2 Population

The population of Iceland is 300,000. The population is projected to grow by about 12% over the next two decades, reaching around 325,000 in 2020. Settlement is primarily along the coast. More than 60% of the nation lives in the capital, Reykjavik, and surrounding areas. In 1990 this same ratio was 57%, demonstrating higher population growth in the capital area than in smaller communities and rural areas.

Iceland is the most sparsely populated country in Europe. The population density is less than three inhabitants per square kilometer. Given the large percentage of the population living in and around the capital, the rest of the country is



Population by sex and age 1960 and 2004

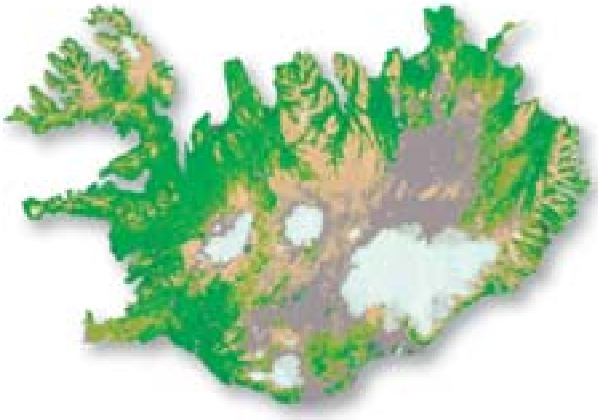
even more sparsely populated, with less than one inhabitant per square km. Almost four-fifths of the country are uninhabited and mostly uninhabitable, the population therefore being concentrated in a narrow coastal belt, valleys and the southwest corner of the country. The dispersed settlement of the country results in relatively high emissions of greenhouse gases due to transport. Emissions from space heating are, however, much lower than what might be expected, keeping in mind the cool climate. This is because the majority of the population relies on non-emitting renewable energy sources for district heating, as will be explained in more detail in the energy chapter.

1.3 Geography

Iceland is located in the North Atlantic between Norway, Scotland and Greenland. It is the second-largest island in Europe and the third largest in the Atlantic Ocean, with a land area of some 103 thousand square kilometers, a coastline of 4,970 kilometers and a 200-nautical-mile exclusive economic zone extending over 758 thousand square kilometers in the surrounding waters. Iceland enjoys a warmer climate than its northerly location would indicate because a part of the Gulf Stream flows around the southern and western coasts of the country. In Reykjavík the average temperature is nearly 11°C in July and just below zero in January.

Geologically speaking, the country is very young and bears many signs of still being in the making. Iceland is mostly mountainous and of volcanic origin. Glaciers are a distinctive feature of Iceland, covering about 11% of the total land area. The largest glacier, also the largest in Europe, is Vatnajökull in Southeast Iceland with an area of 8,300 km^2. Glacial erosion has played an important part in giving the valleys their present shape, and in some areas, the landscape possesses alpine characteristics. Regular monitoring has shown that all glaciers in Iceland are presently receding.

Rivers and lakes are numerous in Iceland, covering about 6% of the total land area. Freshwater supplies are abundant, but the rivers flowing from the highlands to the sea also provide major potential for hydropower development. Geothermal energy is another domestic source of energy.

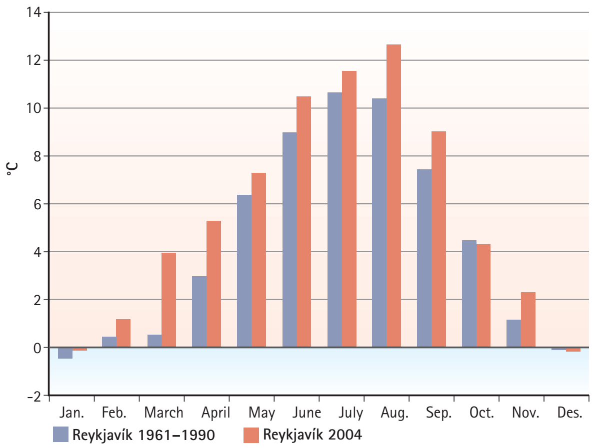


Soil erosion and desertification is a problem in Iceland. More than half of the country's vegetation cover is estimated to have disappeared because of erosion since the settlement period. This is particularly due to clearing of woodlands and overgrazing, which have accelerated erosion of the sensitive volcanic soil. Remnants of the former woodlands now cover less than 1,200 km^2, or only about 1% of the total surface area. Arable and permanent cropland amounts to approximately 1,300 km^2 . Systematic revegetation began more than a century ago with the establishment of the Soil Conservation Service of Iceland, which is a governmental agency. Reforestation projects have also been numerous in the last decades, and especially noteworthy is the active participation of the public in both soil conservation projects and reforestation projects.

Iceland has access to rich marine resources in the country's 758,000-km^2 exclusive economic zone. The abundance of marine plants and animals results from the influence of the Gulf Stream and the mixing of the warmer waters of the Atlantic with cold Arctic waters. Approximately 270 fish species have been found within the Icelandic 200-mile exclusive economic zone; about 150 of these are known to spawn in the area.

1.4 Climate

Iceland is situated just south of the Arctic Circle. The mean temperature is considerably higher than might be expected at this latitude. Relatively mild winters and cool summers characterize Iceland's oceanic climate. The average monthly temperature varies from -3 to +3 °C in January and from +8 to +15 °C in July. Storms and rain are frequent, with annual precipitation ranging from 400 to 4000 mm on average annually, depending on location. The mild climate stems from the Gulf Stream and attendant warm ocean currents from the Gulf of Mexico. The weather is also affected by polar currents from East Greenland that travel southeast towards the coastline of the northern and eastern part of Iceland.



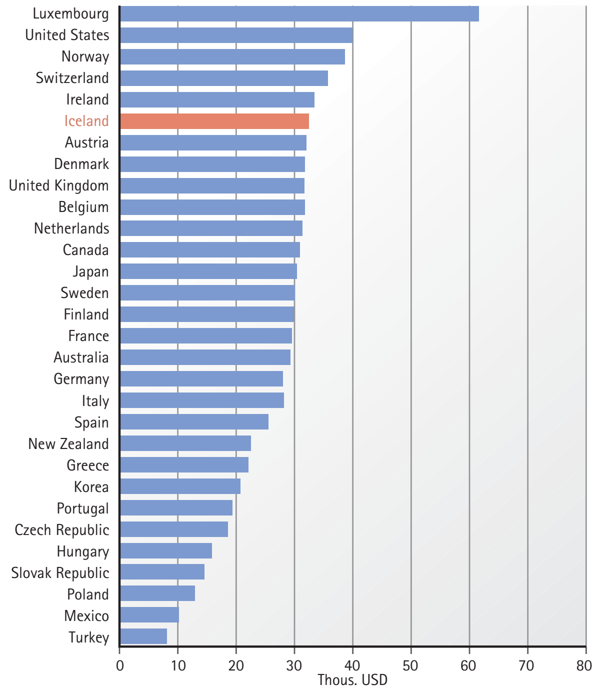
Mean temperature in Reykjavík 1961–1990 and 2004

The amount of daylight varies greatly between the seasons. For two to three months in the summer there is almost continuous daylight; early spring and late autumn enjoy long twilight, but from November until the end of January, the daylight is limited to only three or four hours.

1.5 The economy

Iceland is endowed with abundant natural resources. These include the fishing grounds around the island, within and outside the country's 200-mile EEZ. Furthermore, Iceland has abundant hydroelectric and geothermal energy resources

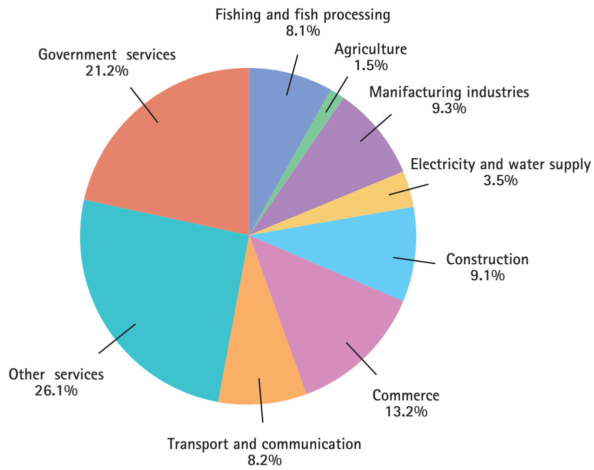
Policies of market liberalisation, fiscal consolidation, privatisation and other structural reforms were implemented in the late 1980s and 1990s, including membership of the European Economic Area by which Iceland was integrated into the internal market of the European Union. Economic growth started to gain momentum by the middle of the 1990s, rekindled by replenishing fish stocks, a global economic recovery, a rise in exports and a new wave of investment in the aluminum sector. During the second half of the 1990s, the liberalisation process continued, competition increased, the Icelandic financial markets and financial institutions were restructured and the exchange rate policy became more flexible. Iceland experienced one of the highest growth rates of GDP among OECD countries.



Gross national income per capita in OECD countries 2004

The large-scale investment projects in the aluminum and power sectors which commenced in 2003 are now well under way. When these projects are completed in late 2008, the total production capacity of aluminum smelters in Iceland will be 765,000 tons per year, up from 270,000 in 2005 and 90 thousand in 1995. Power capacity needs to be stepped up by 130% to accommodate the increase. Relative to the size of the Icelandic economy these investment projects are very large.

The Icelandic economy is the smallest within the OECD, reflecting the small population size, generating

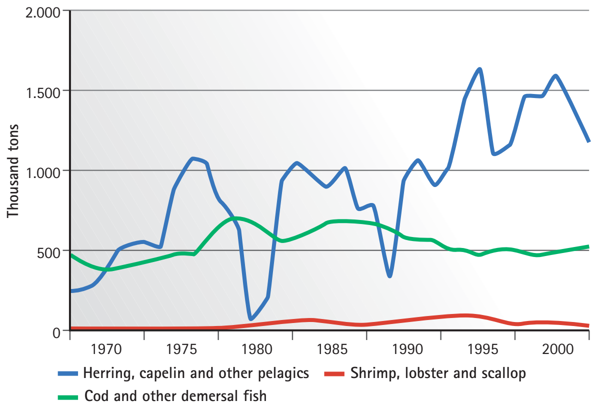


Breakdown of GDP by sector 2004

GDP of €10.2 billion in 2004. GNI per capita measured in terms of Purchasing Power Parities amounted to 32.4 thousand USD in 2004, the ninth highest in the world and the sixth highest among the OECD countries.

1.6 Fisheries

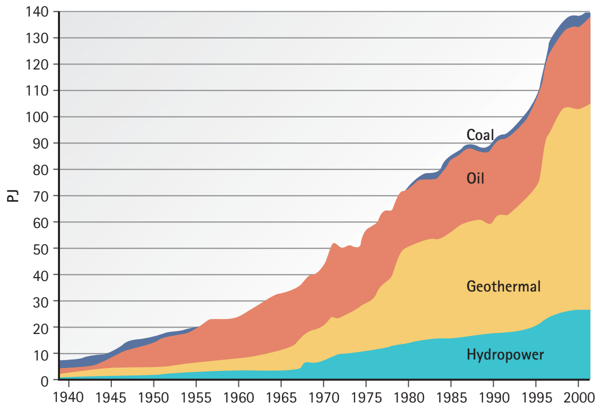
Iceland is the 12. largest fishing nation in the world, exporting nearly all its catch. The marine sector is still one of the main economic sectors and the backbone of export activities in Iceland although its importance has diminished over the past four decades. In 2004, fishing and fish processing contributed 60% of total merchandise exports, compared with around 90% in the early 1960s. A comprehensive fisheries management system based on individual transferable quotas has been developed to manage fish stocks and promote conservation and efficient utilisation of the marine resources. All commercially important species are regulated within the system. In addition to the fisheries management system there are a number of other explicit and direct measures to support its aims and reinforce the conservation measures.



Fish catch by Icelandic vessels 1970–2004

1.7 The energy sector

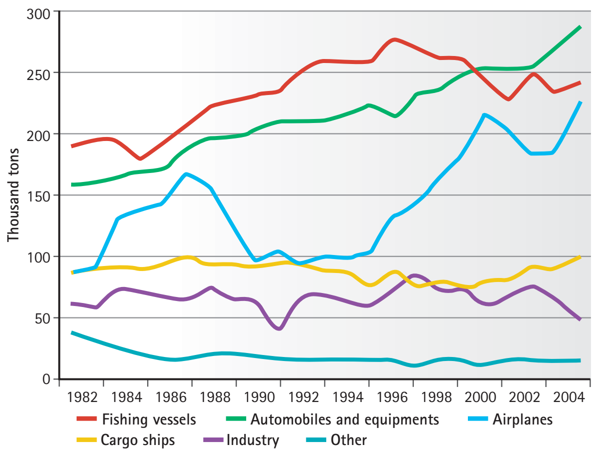
Iceland has extensive domestic energy sources in the form of hydro and geothermal energy. The development of the energy sources in Iceland may be divided into three phases. The first phase covered the electrification of the country and harnessing the most accessible geothermal fields, especially for spatial heating. In the second phase, steps were taken to harness the resources for power-intensive industry. This began in 1966 with the signing of agreements on the building of an aluminum plant, and in 1979 a ferro-silicon plant began production. In the third phase, following the oil crisis of 1973–74, efforts were made to use domestic sources of energy to replace oil, particularly for spatial heating. Oil has almost disappeared as a source of energy for spatial heating in Iceland, and domestic energy has replaced oil in industry and in other fields where such replacement is feasible and economically viable.



Primary energy consumption in Iceland 1940–2004

Iceland ranks first among OECD countries in the per capita consumption of primary energy with 8.6 tons per capita, followed by the US with 8.1 tons per capita. Electricity consumption per capita in Iceland is one of the highest in the world at some 29,400 kWh per capita in 2004. A cool climate and sparse population calls for high energy use for heating and transport. Also, key export industries, such as fisheries and aluminum production, are energy-intensive. The increase in the use of electricity in the last decade is largely due to an expansion of energy-intensive industry. Large-scale industry uses around 65% of the total electricity produced in Iceland, the remaining 35% is for public use.

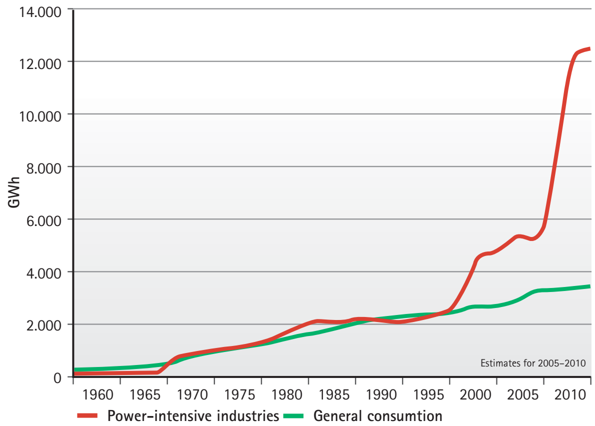
The energy profile for Iceland is in many ways unique. The use of fossil fuels for stationary energy is almost non-existent in Iceland. The fishing and transportation sectors use 86 per cent of the oil consumed in Iceland. If the oil used by Icelandic companies for international transportation is included, this figure is 90 per cent.



Consumption of petroleum products in Iceland 1982–2004

The proportion of energy consumption provided by renewable energy sources is greater in Iceland than in any other country. Today geothermal heat and hydropower account for more than 70 per cent of the country's primary energy consumption. In 2004, the total installed hydropower was 1,154 MW in 31 power plants with a capacity of 7,130 GWh per year. Installed geothermal power in six steam turbine plants now amounts to 202 MW or 1,483 GWh per year. Iceland is a world leader in the use of geothermal energy for domestic and industrial purposes other than generating electricity. Some 90% of all homes in Iceland are heated with geothermal energy, for less than one third of the comparable cost of fossil fuels or electrical heating.

Three large-scale power stations are now under construction. Landsvirkjun, the National Power Company, is building a hydropower plant at Kárahnjúkar in east Iceland with a capacity of 690 MW to supply energy to the new Alcoa aluminum smelter at Reyðarfjörður. Reykjavík Energy and Suðurnes Heating have three geothermal power stations under construction and one plant in southwest Iceland is being expanded.



Electricity production in Iceland 1960–2010

Hydro power developments can have various environmental impacts. The most noticeable is usually connected with the construction of reservoirs which may be necessary to store water for the winter season. Such reservoirs affect the visual impact of uninhabited wilderness areas in the highlands, and may inundate vegetated areas. Other impacts may include disturbance of wildlife habitats, the disappearance or alteration of waterfalls, reduced sediment transportation in glacial rivers downstream from the reservoirs and changed conditions for fresh-water fishing. Geothermal developments may also have environmental impacts, among them the drying up of natural hot springs. Development of high-temperature fields may cause some air pollution by increasing the natural H_2S emission from the fields.

1.8 Industry

The largest manufacturing industries in Iceland are power-intensive industries which produce almost exclusively for export. There has been a considerable increase in manufacturing exports in recent years. In 2004, manufactured products accounted for 36% of total merchandise exports, up from 22% in 1997. Power-intensive products, mainly aluminum, amounted to 21% of total merchandise exports in 2004 but 12% in 1997. A number of small and medium-size enterprises have emerged in export-oriented manufacturing in recent years, in areas such as medical equipment, pharmaceuticals, capital goods for fisheries and food processing. These emerging industries now account for approximately 2/5 of manufactured goods exports.

The largest manufacturing facility at present in Iceland is an aluminum smelter located near Reykjavík, owned and operated by Alcan Inc. Its total capacity is now 178 thousand tons per year. Another aluminum smelter is operated by Norðurál at Grundartangi with a capacity of 92 thousand tons per year. Icelandic Alloys Ltd. is a ferrosilicon plant with an annual capacity of 120 thousand tons per year. A new aluminum smelter, owned by Alcoa, is being built on the east coast of Iceland. It is due to open in late 2007, producing 346 thousand tons per year at full capacity. The Norðurál plant is also being expanded from 92 to 260 thousand tons per year by late 2008. When both these projects materialise, the total production capacity of the aluminum industry in Iceland will be 785 thousand tons per year, or nearly three times the present level.

1.9 Transport

The domestic transportation network consists of roads, air transportation and coastal shipping. Car ownership is widespread. In 2004, Iceland had 612 passenger cars per 1,000 inhabitants, the third highest ratio among OECD countries. The road system totals 13,000 km, of which 4,300 km are primary roads.

Three international airlines operate in Iceland, all fully privately owned. Domestic air travel is an important mode of transport, with 750,000 passengers in 2004. Iceland has numerous harbours large enough to handle international ship traffic, which are without exception free of ice throughout the year. The two main shipping lines operate regular liner services to the major ports of Europe and the US.

1.10 Agriculture, land management and forestry

Approximately one fifth of the total land area of Iceland is suitable for fodder production and the raising of livestock. Around 6% of this area is cultivated, with the remainder devoted to raising livestock or left undeveloped. Production of meat and dairy products is mainly for domestic consumption. The principal crops have been hay, potatoes and other root vegetables. Cultivation of other crops, such as barley and oats, has increased rapidly in the last 10 years and they are now becoming one of the staples. Vegetables and flowers are mainly cultivated in greenhouses heated with geothermal water and steam.

In Iceland the human impact on ecosystems is strong. The entire island was estimated to be about 65% covered with vegetation at the time of settlement in the year 874. Today, Iceland is only about 25% vegetated. This reduction in vegetative cover is the result of intensive land and resource utilization by a farming and agrarian society over 11 centuries. Estimates vary as to the percentage of the island originally covered with forest and woodlands at settlement, but a range of 25 to 30% is plausible.

Organised forestry is considered to have started in Iceland in 1899. Afforestation through planting has increased considerably since 1990 to over 6 million seedlings in 2004, which corresponds to an increase in planted area of 1000–1500 ha per year. Planting of native birch has been increasing proportionate to the total, comprising as much as 30% of seedlings planted in some years. From its limited beginnings in 1970, state supported afforestation on farms has become the main channel for afforestation activity in Iceland, comprising about 80% of the afforestation effort today. In the late 1980s semi-natural forest and woodland vegetation covered only about 1.3% of Iceland amounting to about 117,000 hectares of native birch woodland and 15–20,000 hectares of plantations.

The Soil Conservation Service of Iceland, an agency under the Ministry of Agriculture, was founded in 1907. The main tasks of the agency is combating desertification, sand encroachment and other soil erosion, the promotion of sustainable land use and reclamation and restoration of degraded land. A pollen record from Iceland confirms the rapid decline of birch and the expansion of grasses between 870–900 AD, a trend that continued to the present. As early as 1100 more than 90% of the original Icelandic forest was gone and by 1700 about 40% of the soils had been washed or blown away. Vast gravel-covered plains were created where once there was vegetated land. Ecosystem degradation is one of the largest environmental problem in Iceland. Vast areas have been desertified after over-exploitation and the speed of erosion is magnified by volcanic activity and harsh weather conditions.

1.11 Waste

Almost 470,000 tons of waste was generated in 2004, compared to 315,000 tons in 1995. Today, 71% the waste is disposed of in landfills, 25% is recycled for purposes other than energy production, 3% is incinerated for energy production and the remaining 1% is incinerated without energy recovery. Per capita waste has steadily increased in the last decade. Growing consumption seems to be the main explanation for this trend. The increase is greater among companies than households. Waste was responsible for 6% of the total greenhouse gas emissions in Iceland in the year 2003. Most of these emissions is methane from landfills, but carbon dioxide emissions from incineration do also contribute. Although the total amount of waste has been increasing, greenhouse gas emissions from the waste sector have declined due to more recycling and technological advances in the handling of waste.

1.12 Other circumstances

The greenhouse gas emissions profile for Iceland is in many regards unusual. Three features stand out. First, emissions from the generation of electricity and from spatial heating are essentially non-existent since they are generated from renewable non-emitting energy sources. Second, more than 80% of emissions from energy come from mobile sources (transport, mobile machinery and fishing vessels). The third distinctive feature is that individual sources of industrial process emissions have a significant proportional impact on emissions at the national level. Most noticeable in this regard is abrupt increases in emissions from aluminum production associated with the expanded production capacity of this industry. This last aspect of Iceland's emission profile made it difficult to set meaningful targets for Iceland during the Kyoto Protocol negotiations. This fact was acknowledged in Decision 1/CP.3 paragraph 5(d), which established a process for considering the issue and taking appropriate action. This process was completed with Decision 14/CP.7 on the Impact of Single Projects on Emissions in the Commitment Period (see Annex B).

The problem associated with the significant proportional impact of single projects on emissions is fundamentally a problem of scale. In small economies, single projects can dominate the changes in emissions from year to year. When the impact of such projects becomes several times larger than the combined effects of available greenhouse gas abatement measures, it becomes very difficult for the party involved to adopt quantified emissions limitations. It does not take a large source to strongly influence the total emissions from Iceland. A single aluminum plant can add more than 15% to the country's total greenhouse gas emissions. A plant of the same size would have negligible effect on emissions in most industrialized countries.

Decision 14/CP.7 sets a threshold for significant proportional impact of single projects at 5% of total carbon dioxide emissions of a party in 1990. Projects exceeding this threshold shall be reported separately and carbon dioxide emissions from them not included in national totals to the extent that they would cause the party to exceed its assigned amount. Iceland can therefore not transfer assigned amount units to other Parties through international emissions trading. The total amount that can be reported separately under this decision is set at 1.6 million tons of carbon dioxide. The scope of Decision 14/CP.7 is explicitly limited to small economies, defined as economies emitting less than 0.05% of the total Annex I carbon dioxide emissions in 1990. In addition to the criteria above, which relate to the fundamental problem of scale, additional criteria are included that relate to the nature of the project and the emission savings resulting from it. Only projects, where renewable energy is used, and where this use of renewable energy results in a reduction in greenhouse gas emissions per unit of production, are eligible. The use of best environmental practice and best available technology is also required. It should be underlined that the decision only applies to carbon dioxide emissions from industrial processes. Other emissions, such as energy emissions or process emissions of other gases, such as PFCs, will not be affected.

Paragraph 4 of Decision 14/CP.7 requests any Party intending to avail itself of the provisions of that decision to notify the Conference of the Parties, prior to its eighth session, of its intention. The Government of Iceland notified the Conference of the Parties with a letter, dated October 17. 2002, of its intention to avail itself of the provisions of Decision 14/CP.7. Iceland has already initiated preparations for the implementation of these special reporting provisions. This was done to facilitate evaluation of the emission trends in Iceland and the policies and measures being implemented or planned. It was considered more consistent with the intent of 14/CP.7 to use this approach to reporting also for the period leading up to the commitment period rather than to introduce an abrupt change in the reporting approach in 2008. In the CRF for the year 2003 submitted in May 2005 three projects fall under the single project definition and are reported in accordance to Decision 14/CP.7.

GREENHOUSE GAS INVENTORY INFORMATION

2.1 Key developments

- In 1990, the total emissions of greenhouse gases in Iceland were 3.282 Gg of CO_2- equivalents. In 2003 total emissions, excluding emissions falling under Decision 14/CP.7, were 3,083 Gg CO_2-equivalents. This is a decrease of 6% over the time period.
- When all emissions are included, the emissions from 1990 to 2003 have increased by 8%. Total emissions show a decrease between 1990 and 1994, with an exception in 1993, and an increase thereafter.
- So far, 1999 has been the year with the highest emissions recorded.
- Between 1990 and 2003 carbon dioxide emissions increased by 4%; methane emission increased by 14%, and nitrous oxide emissions fell by 16%.

2.2 National system for preparing the greenhouse gas inventory in Iceland

2.2.1 Institutional arrangement

The Environment and Food Agency of Iceland (EFA), an agency under the Ministry for the Environment, compiles and maintains the national greenhouse gas inventory. The LULUCF part of the inventory is an exception though, as it is compiled by the Agricultural University of Iceland (AUI). EFA reports to the Ministry for the Environment, which reports to the Convention. Figure 2.1 illustrates the flow of information and allocation of responsibilities.

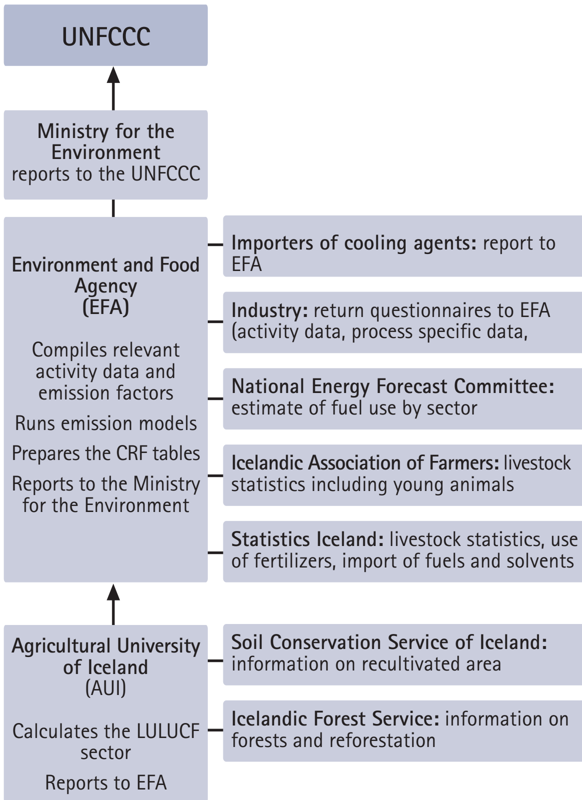


Figure 2.1.1

2.2.2 Process of inventory preparation

EFA collects the bulk of data necessary to run the general emission model, i.e. activity data and emission factors. Activity data is collected from various institutions and companies, as well as by EFA directly. AUI receives information on recultivated area from the Soil Conservation Service of Iceland and information on forests and reforestation from the Icelandic Forest Service. The National Energy Forecast Committee (NEFC) collects annual information on fuel sales from the oil companies. Since sales statistics were not provided by all the oil companies for the year 2003, fuel use by sector has been estimated by the NEFC. The Icelandic Association of Farmers (IAF), on the behalf of the Ministry of Agriculture, is responsible for assessing the size of the animal population each year. On request from the EFA the IAF also accounts for young animals that are mostly excluded from national statistics on animal population. Statistics Iceland provides information on imports of solvents, use of fertilizers in agriculture and imports/exports of fuels. EFA collects various additional data directly. Annually a questionnaire is sent out to the industry in regard to imports, use of feedstock, and production and process specific information. Importers of HFCs submit reports on their annual imports by different types of HFCs to the EFA. EFA also estimates activity data with regard to waste. Emission factors are mainly taken from the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, since limited information is available from measurements of emissions in Iceland.

2.2.3 Planned and implemented improvements

In 2004 the UNFCCC secretariat coordinated an in-country review of the 2004 greenhouse gas inventory submission of Iceland, in accordance with decision 19/CP.8 of the Conference of the Parties. The expert review team concluded that the Icelandic emissions inventory is largely complete and mostly consistent with the UNFCCC reporting guidelines. However, the expert review team noted some departures from the UNFCCC guidelines and a lack of more formal national inventory procedure. Based on the in-country review report, some important improvements have already been implemented, and a work plan has been established for improvements that will inevitably take longer time than one year to implement.

Implemented improvements:

- N_2O and CH_4 emissions from fuel combustion of various combustion sources have been estimated.
- N_2O emissions from solvent and other product use have been estimated.

Planned improvements:

- Iceland has until now not prepared a national energy balance. Following the recommendations from the In-country review team, Iceland will now start preparing annually a national energy balance.
- The Ministry for the Environment, in close co-operation with other relevant ministries will be establishing a comprehensive institutional and legal framework to further strengthen the Icelandic climate change policy. This will include an improved framework for fulfilling the reporting requirements under the UNFCCC. This work has already started and is due to be adopted by the Icelandic Parliament in 2006.

In the Fourth National Communication, the results for the period 1990–2003 are presented in the form of summary tables in Appendix A.

2.3 Greenhouse gas emissions inventory and trends

2.3.1 Emissions trends for aggregated greenhouse gas emissions

The total amount of greenhouse gases emitted in Iceland during the period 1990 – 2003 is presented in the following tables, expressed in terms of contribution by gases and by sources. Emissions falling under Decision 14/CP.7 are not included in this discussion unless specifically noted.

Table 2.2 presents emissions figures for all direct greenhouse gas, expressed in CO_2-equivalents along with the percentage change indicated for both the time period 1990 – 2003 and 2002 – 2003.

Gas	1990	2002	2003	Changes 90–03	Changes 02–03
CO_2	2084	2241	2175	4%	-3%
CH_4	413	473	472	14%	-0,3%
N_2O	360	308	302	-16%	-2%
HFC 32		0	0		138%
HFC 125		16	26		68%
HFC 134a		4	13		254%
HFC 143a		16	29		88%
HFC 152		0	0		147%
CF_4	355	61	51	-86%	-18%
C_2F_6	65	11	9	-86%	-18%
SF_6	5	5	5	0%	0%
Total	3282	3136	3083	-6%	-2%
CO_2 emissions fulfilling 14/CP.7		441	451		2%
Total emissions, including CO_2 emissions fulfilling 14/CP.7	3282	3577	3534	8%	-1%

Table 2.3.1. Emissions of greenhouse gas in Iceland during the period 1990–2003 (without LUCF). Empty cells indicate emissions not occurring. Units: Gg CO_2-eq

In 1990, the total emissions of greenhouse gases in Iceland were 3,282 Gg of CO_2- equivalents. In 2003 total emissions were 3,083 Gg CO_2-equivalents, excluding emissions falling under Decision 14/CP.7. This is a 6% decrease in greenhouse gas emissions over the period 1990–2003. Iceland is on track to meet the emissions target set for Iceland under the Kyoto Protocol. When all emissions are included, the total emissions of greenhouse gases in Iceland have increased by 8% during that same period. Total emissions show a decrease between 1990 and 1994, with an exception in 1993, and an increase thereafter. So far, 1999 has been the year with the highest emissions recorded.

Iceland has experienced economic growth since 1990, which explains the general growth in emissions. This has resulted in higher emissions from most sources, but in particular from transport and industrial processes.

Since 1990 the number of private cars has been increasing much faster than the population. Also the number of passengers using the public transport system has declined. More traffic is thus not mainly due to population growth, but much rather because a larger share of the population owns and uses private cars for their daily travel. During the late nineties large-scale industry expanded in Iceland. The existing aluminum plant and ferroalloy plant were both enlarged in 1997 and 1999 respectively. In 1998 the second aluminum plant was built and at this stage in time the third one is under construction. As mentioned before industrial process carbon dioxide emissions from a single project falling under decision 14/CP.7 are to be reported separately and are therefore not included in national totals. Today three projects, the two aluminum plants and the ferroalloy plant, do fall under the single project definition and are reported in accordance with Decision 14/CP.7.

Methane emissions have increased between 1990 and 2003 mainly due to increasing amount of landfilled waste. Nitrous oxide emissions have, however, decreased since 1990, despite the fact that nitrous oxide emissions from road transport have increased. This is due to a decrease in animal livestock and because fertilizer production in Iceland was terminated in 2001.

Before 1992 there were no imports of HFCs, but since then, imports have increased rapidly in response to the phase-out of CFCs and HCFCs. The potential emissions of HFCs have risen from 0.5 Gg CO_2-equivalent in 1990 to 69.3 Gg CO_2-equivalent in 2003.

The increasing emissions of carbon dioxide from transport and industrial processes and increasing methane emissions from landfilled waste has to some extent been counteracted by decreased emissions of PFCs. This decrease is caused by improved technology and process control in the aluminum industry.

2.3.2 Emissions trends by gas

Figure 2.3.2a illustrates that the largest greenhouse gas contributor in Iceland is CO_2, followed by CH_4 and N_2O, and finally the three fluorinated gases PFCs, HFCs and SF_6. Figure 2.3.2b illustrates the percentage change in emissions of greenhouse gases by gas in Iceland from 1990 to 2003.

Carbon dioxide (CO_2)

Fisheries, road transport and industrial processes are the main sources of CO_2 emissions in Iceland. Emissions from the generation of electricity and from spatial heating are essentially non-existent, since they are generated from renewable non-emitting energy sources. Therefore, emissions from stationary combustion are dominated by industrial sources in Iceland. 'Other sources' consist mainly of emissions from the construction industry. Figure 2.3.2c illustrates the distribution of CO_2 emissions by source categories, and figure 2.3.2d shows the percentage change in emissions of CO_2 by source from 1990 to 2003.

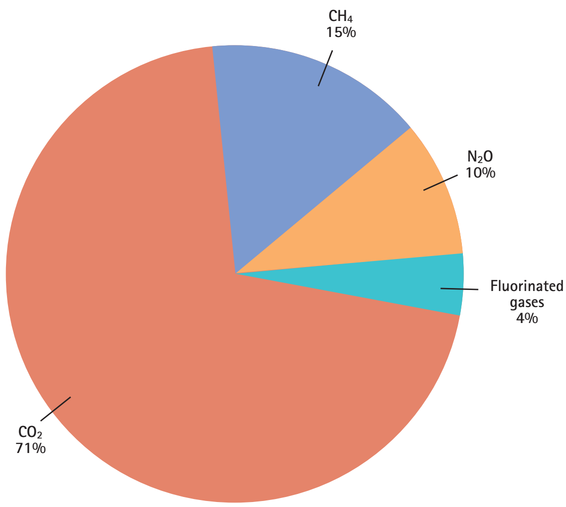


Figure 2.3.2a. Distribution of emissions of greenhouse gases by gas in 2003

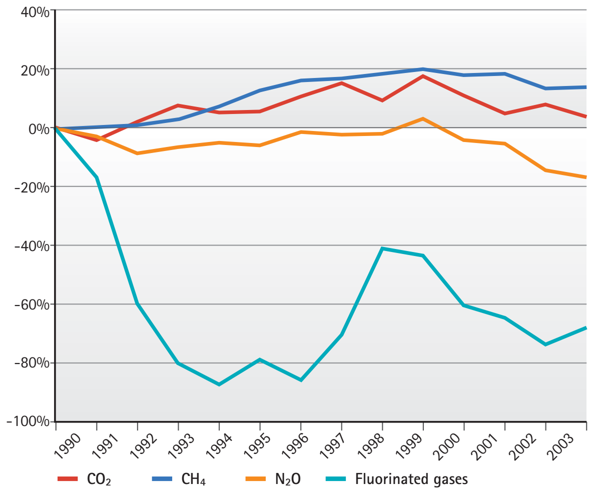


Figure 2.3.2b. Percentage change in emissions of greenhouse gases by gas 1990–2003

In 2003 the total CO_2 emissions in Iceland, excluding emissions falling under Decision 14/CP.7, were 2,175 Gg. This is a decrease of about 3% from the preceding year but an increase of about 4% from 1990. The decrease in emissions between 2002 and 2003 can be explained by a 6% decrease in emissions from fisheries and 17% decrease from stationary combustion. Emissions from road vehicles increased by 4% between 2002 and 2003. The increase in CO_2 emissions between 1990 and 2003 can be explained by increased emissions from road trans-

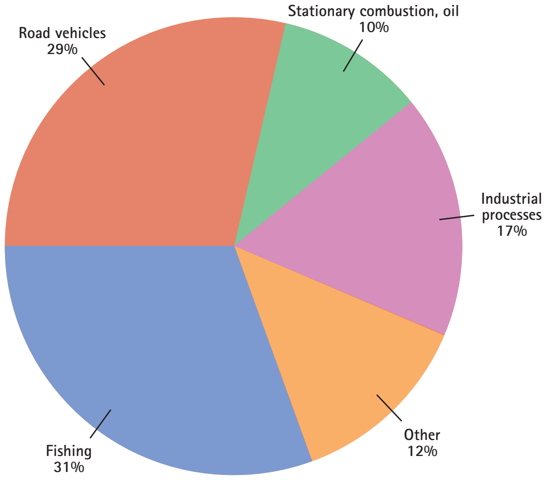


Figure 2.3.2c. Distribution of CO_2 emissions by source in 2003

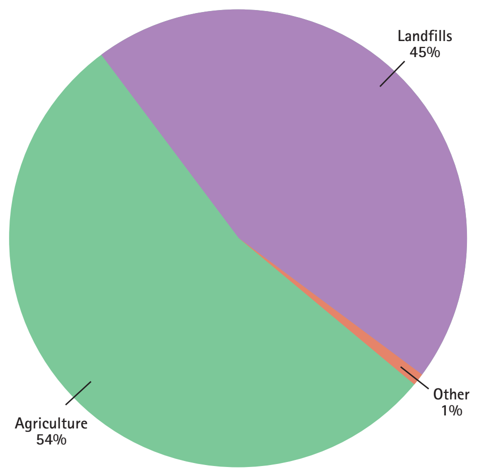


Figure 2.3.2e. Distribution of CH_4 emissions by source in 2003

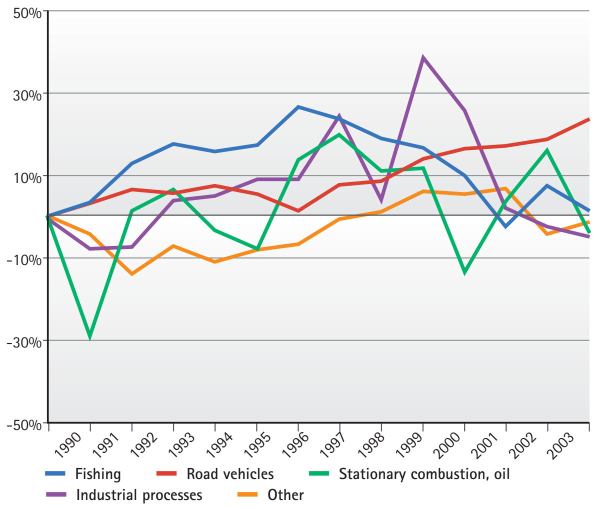


Figure 2.3.2d. Percentage changes in emissions of CO_2 by major sources 1990–2003

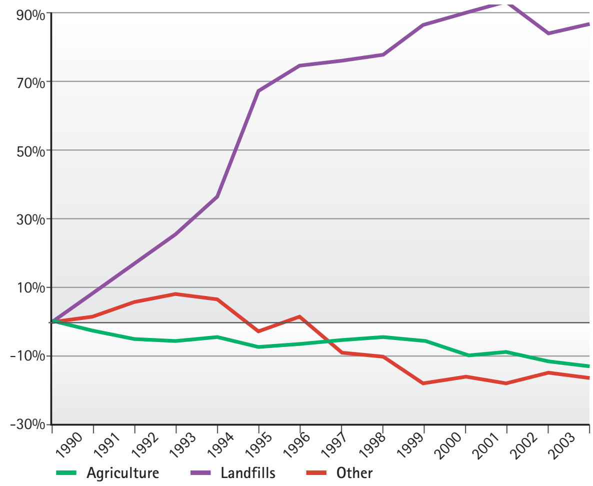


Figure 2.3.2f. Percentage changes in emissions of CH_4 by major sources 1990–2003

port. In the 1990s the number of road vehicles in Iceland nearly doubled and emission of CO_2 increased by 23% during the same period. Emissions from fishing in 2003 were at the same level as in 1990 and emissions from other sources as well as industrial processes declined from 1990 to 2003. The total CO_2 emissions from industrial processes have increased by 110% from 1990 to 2003, when emissions falling under Decision 14/CP.7 are included.

Methane (CH_4)

Figure 2.3.2e shows that emissions of methane originate from waste treatment and agriculture respectively. Figure 2.3.2f shows the percentage change in emissions of CH_4 by source from 1990 to 2003. The emissions from agriculture have decreased. Emissions from waste treatment show a steady increase from 1990 to 2001. This is due to an increased amount of waste generated and increased ratio of landfilled wastes in managed waste disposal sites. The emissions from landfills have been decreasing since 2001 due to increased methane recovery from landfill sites. In the same way the overall emissions of methane gradually increase from 1990 to 1999 but decrease thereafter.

Nitrous oxide (N_2O)

Figure 2.3.2g shows that agriculture accounts for around 80% of N_2O emissions in Iceland, with agricultural soils as the largest contributor. The second most important source is road transport, which has increased rapidly after the use of catalytic converters in all new vehicles became obligatory in 1995. The overall N_2O emissions decreased by 15% from 1990 to 2003, due to a decrease in the number of animal livestock and because fertilizer production in Iceland was terminated in 2001.

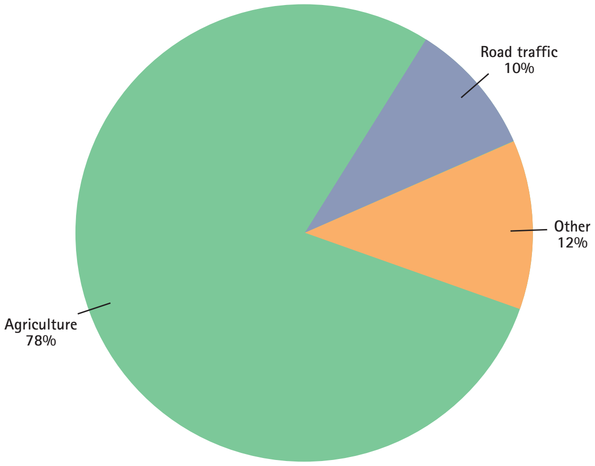


Figure 2.3.2g. Distribution of N_2O emissions by source in 2003

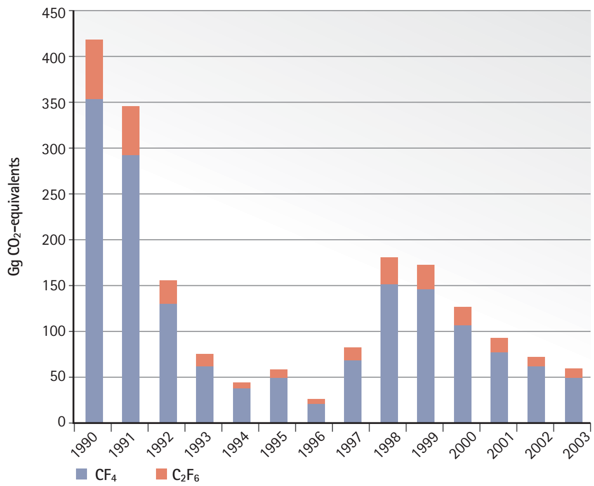


Figure 2.3.2h. Emissions of PFCs from 1990 to 2003

Perfluorocarbons (PFCs)

The emissions of the perfluorocarbons, tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) from the aluminum industry were 50.6 and 9.2 Gg CO_2-equivalents respectively in 2003. The total emissions of PFCs decreased by 86% in 1990 – 2003. Emissions decreased steadily from 1990 to 1996 with the exception of 1995. In 1997 and 1998 the emissions increased again due to the enlargement of the existing aluminum plant in 1997 and the establishment of a new aluminum plant in 1998. From 1998 the emissions show again a steady downward trend. PFCs emissions reduction is caused by improved technology and process control, which has led to a 95% decrease in the amount of PFCs emitted per ton of aluminum produced during the period of 1990 – 2003.

Hydrofluorocarbons (HFCs)

The total potential emissions of HFCs, used as substitutes for ozone depleting substances, amounted to 69.3 Gg CO_2-equivalents in 2003. The import of HFCs started in 1992 and increased until 1998. Since then annual imports have ranged been between 30 and 70 Gg CO_2-equivalents. Sufficient data is not available to calculate actual emissions. This means that only the potential emissions, based on imports, are estimated. The potential method is likely to overestimate emissions, since the chemicals tend to be emitted over a period of several years. The application category refrigeration, contributes by far the largest part of HFCs emissions in Iceland.

Sulphur hexafluorid (SF_6)

Sulphur hexafluorid emissions are not estimated but held constant over the whole time series. The largest source of SF6 emissions is thought to be leakages from electrical equipment.

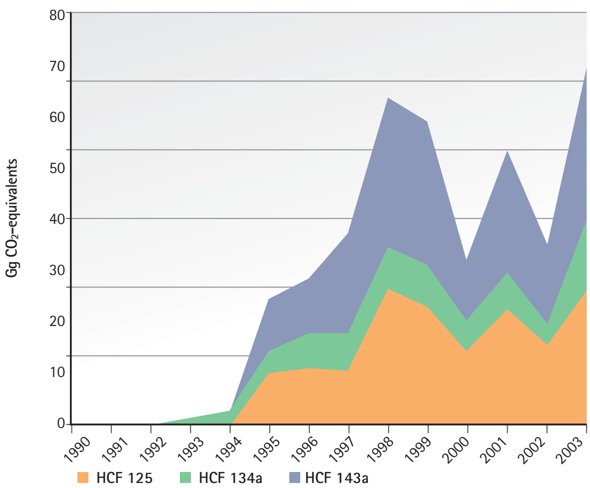


Figure 2.3.2i. Emissions of HFCs from 1990 to 2003

	1990	2002	2003	Changes 90-03	Changes 02-03
Energy	1704	1916	1861	9	-3
Industrial Processes	867	495	509		3
Emissions fulfilling 14/CP.7*		441	451		2
Solvent Use	6	4	4	-33	0
Agriculture	571	503	489	-14	-3
LUCF	-8	-193	-208		8
Waste	134	217	220	64	1
Total emissions (without lucf)	3282	3136	3083	-6	-2
Total net emissions (with lucf)	3274	2943	2876	-12	-2

* Industrial process carbon dioxide emissions fulfilling decision 14/CP.7 are not included in national totals

Table 2.3.3. Total emissions of greenhouse gases by sources and CO_2 removals from LUCF in Iceland, 1990–2003. Gg CO_2-equivalents

2.3.3 Emissions trends by source

The largest contributor of greenhouse gas emissions in Iceland is the energy sector, followed by industrial processes, agriculture, waste and solvent and other product use. From 1990 to 2003 the contribution of the energy sector to the total net emissions increased from 52% to 60%. At the same time the contribution from industrial processes decreased from 26% in 1990 to 17% in 2003. If all industrial process emissions in 2003 are included, that is including emissions falling under Decision 14/CP.7, the contribution of industrial processes to total emissions is 27% and the contribution of the energy sector is 53%.

Figure 2.3.3a illustrates the distribution of greenhouse gas emissions by UNFCCC sector categories in 2003, excluding emissions falling under Decision 14/CP.7. Emissions from the energy sector account for 60% of the national total emissions and industrial processes and agriculture account for 17% and 16% respectively. The waste sector accounts for 7% and solvent and other product use for 0.1%.

Figure 2.3.3b illustrates the distribution of greenhouse gas emissions by UNFCCC sector categories in 2003, including emissions falling under Decision 14/CP.7. In this case the emissions from the energy sector account for 53% of the national total emissions, industrial processes account for 27% and 14% originates from agriculture. The waste sector accounts for 6% and solvent and other product use for 0.1%.

Energy

The energy sector in Iceland is unique in many ways. In 2000 the per capita energy use was close to 500 MJ. Energy use per capita is high in Iceland, even in comparison with other industrial countries. The proportion of

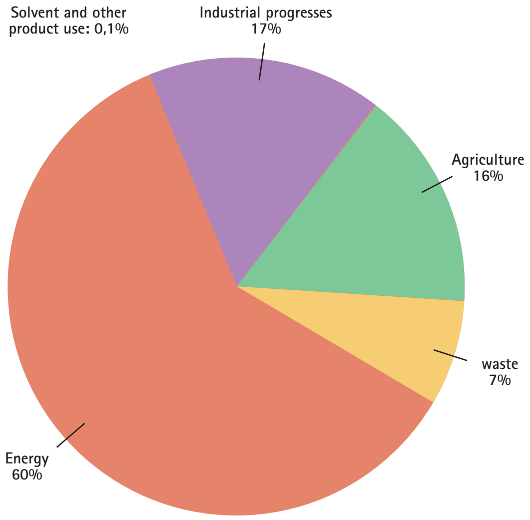


Figure 2.3.3a. Emissions of greenhouse gases by UNFCCC sector categories in 2003, excluding emissions falling under Decision 14/CP.7

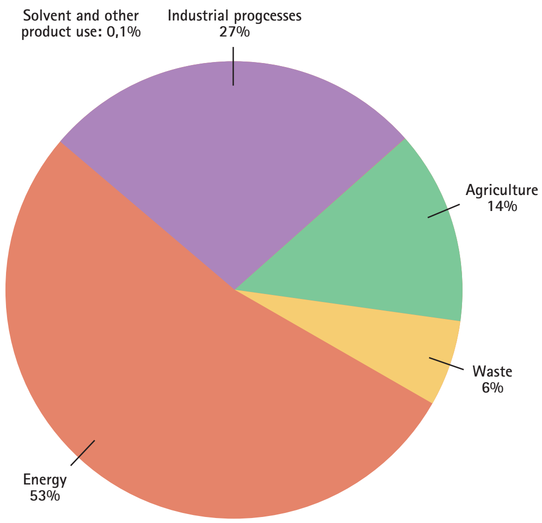


Figure 2.3.3b. Emissions of greenhouse gases by UNFCCC sector categories in 2003, including emissions falling under Decision 14/CP.7

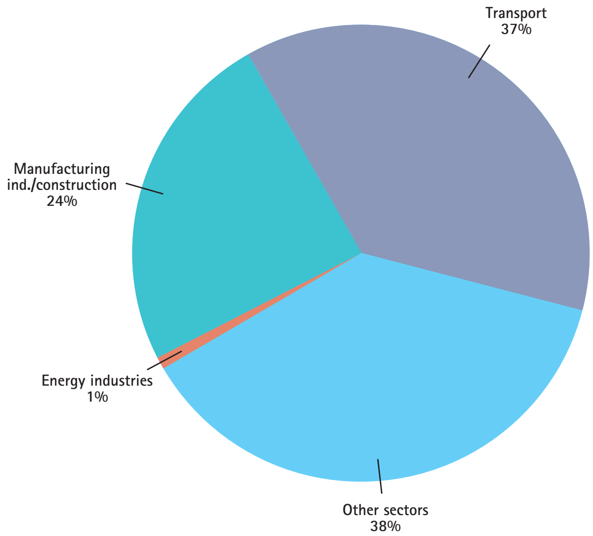


Figure 2.3.3c. Greenhouse gas emissions in the energy sector in 2003, distributed by source categories

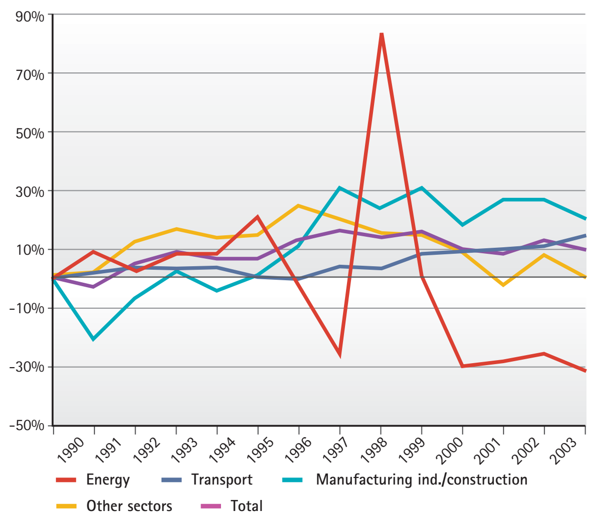


Figure 2.3.3d. Percentage changes in emissions in various source categories in the energy sector, 1990–2003

domestic renewable energy in the total energy budget is on the other hand also high or 70%. This is much higher level of renewable energy than in any other industrialized country. The cold climate and sparse population calls for high energy use for spatial heating and transport. Iceland relies heavily on geothermal energy for spatial heating and on hydropower and geothermal for electricity production. Figure 2.3.3c shows the distribution of emissions in 2003 in different source categories. The percentage changes detected in the different source categories in the energy sector between 1990 and 2003, compared with 1990 are illustrated in figure 2.3.3d.

Emissions from all source categories except energy industries and the sector 'other sources' have increased during the period. The peak in the energy industries in 1998 was due to unusual weather condition during the winter of 1997/1998, which led to unfavorable water conditions for the hydropower plants reservoirs. This created shortage of electricity, which was compensated by using oil for electricity and heat production. Increased emissions from the manufacturing industries and construction source category are explained by the increased activity in the construction sector during the period.

Fisheries dominate the 'other sector'. Emissions from fisheries rose from 1990 to 1996 because a substantial portion of the fishing fleet was operating in distant fishing grounds. From 1996, the emissions decreased again reaching 1990 levels in 2001. Emissions increased again by 10% between 2001 and 2002. In 2003 emissions reached again the 1990 level. Annual changes in emissions reflect the inherent nature of the fishing industry.

In the 1990s the vehicle fleet in Iceland almost doubled. This has led to increased emissions from the transport sector, a trend that is still ongoing. Furthermore, the latest trend has been towards larger passenger cars, which consume more fuel. Since 1999 the average fuel consumption of newly registered passenger cars has increased by over 6%. A decrease in ship transport and aviation has however compensated the effect of rising emissions from road transport to some extend.

Industrial processes

Production of raw materials is the main source of process related industrial emissions for both CO_2 and other greenhouse gases such as N_2O and PFCs. The industrial process sector accounts for about 17% of the national greenhouse gas emissions, excluding emissions falling under Decision 14/CP.7 and about 27% of the total national greenhouse gas emissions. As can be seen from figure 2.3.3e emissions decreased from 1990 to 1996, mainly because of decrease in PFC-emissions. During the late nineties large-scale industry expanded in Iceland. The existing aluminum plant and the ferroalloys industry experienced enlargement in 1997 and 1999, and in 1998 another aluminum plant was built. This led to an increase in industrial process emissions. As mentioned before industrial process carbon dioxide emissions from a single project falling under Decision 14/CP.7 are to be reported separately and are not included in national totals. Industrial process emissions, excluding emissions fulfilling decision 14/CP.7, have decreased since 1999.

Metal production is the dominating category within the industrial process sector, accounting for 88% of the sector's emissions in 1990 and 81% in 2003. Aluminum production is the main source of emission within the metal production, accounting for 39% of the total industrial process emissions, excluding emissions falling under Decision 14/CP.7, and 48% including all industrial process emissions. The production technology in the aluminum plants in Iceland is based on prebaked anode cells. The main energy source is electricity, and industrial process CO_2 is mainly resulting from the anodes during the electrolysis. In addition, the production of aluminum gives rise to emissions of PFCs. From 1990 to 1996 PFC emissions decreased by 94%. Because of the enlargement

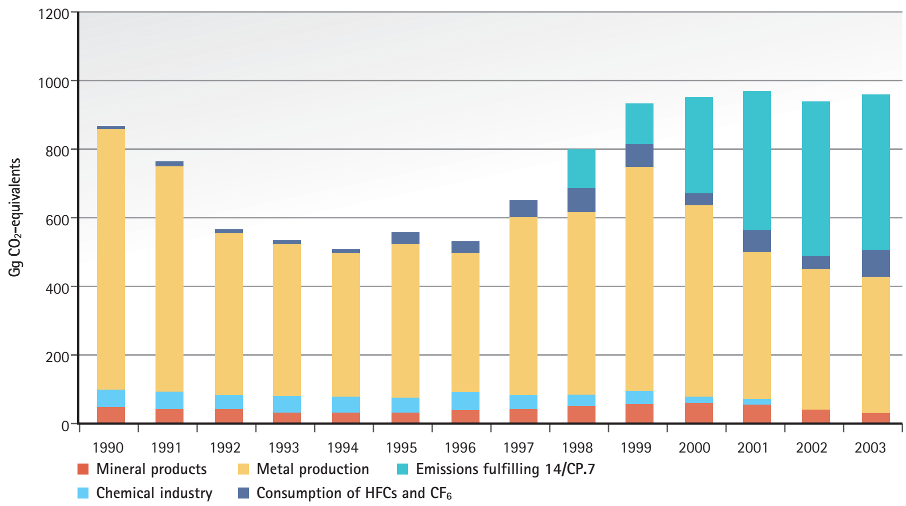


Figure 2.3.3e. Total greenhouse gas emissions in the industrial process sector, 1990–2003

of the existing aluminum plant in 1997 and the establishment of a new aluminum plant in 1998 emissions increased again from 1997 to 1999, but have decreased since. In 2003 the emissions had decreased by 86% from the 1990 level. The reduction in PFC emissions was effectuated by improved technology and process control. PFC emissions per ton aluminum produced went from 4.78 tons CO_2-equivalents, in 1990, to 0.22 tons CO_2-equivalents in 2003. Production of ferroalloys is another major source of emission within the metal production. The use of coal and coke as reducing agents and the use of electrodes is the main source of CO_2 emission from the production. In 1998 a power shortage caused a temporary closure of the ferroalloy plant, resulting in exceptionally low emissions that year. In 1999, however, the existing plant was expanded and emissions have therefore increased considerably. These emissions fall under Decision 14/CP.7 and are reported separately.

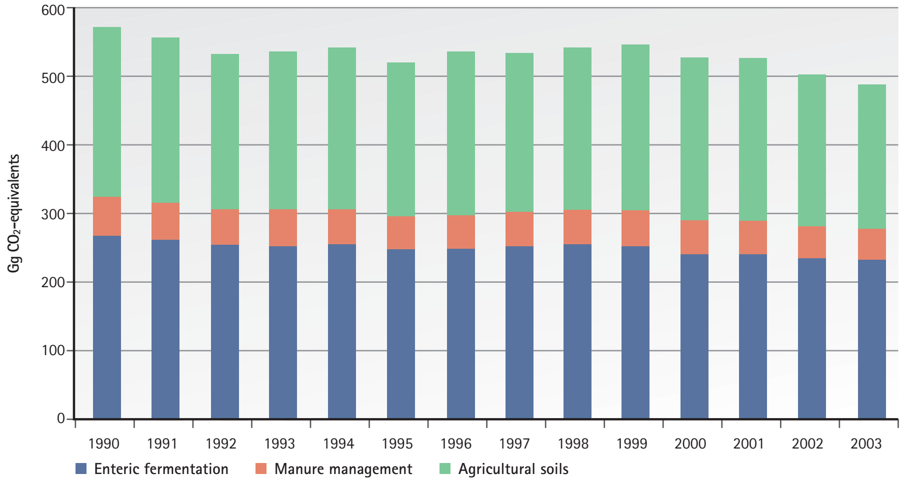


Figure 2.3.3f. Total greenhouse gas emissions from agriculture, 1990–2003

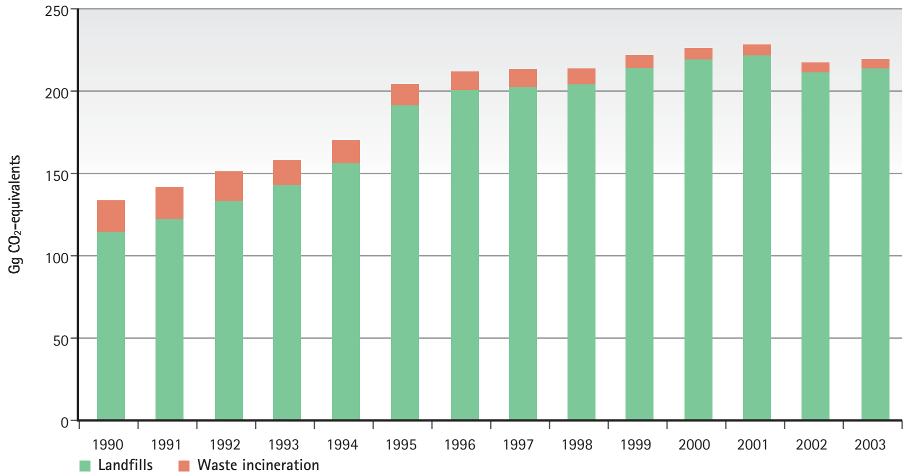


Figure 2.3.3g. Emissions of greenhouse gases in the waste sector, 1990–2003

Production of minerals is the sector's second most important category, accounting for 7% of the emissions in 2003. Cement production is the dominant contributor. Cement is produced in one plant in Iceland, emitting CO_2 derived from carbon in the shell sand used as raw material in the process. Emissions from the cement industry reached a peak in 2000 but have declined since, partly due to increased imports of cement. Production of fertilizers used to be the main contributor to the process emissions from the chemical industry. The production was terminated in 2001.

Agriculture

Greenhouse gas emissions from agriculture in Iceland comprise emissions of methane and nitrous oxide. The greenhouse gas emissions from the agricultural sector accounted for 16% of the overall greenhouse gas emissions in 2003. The largest sources for agricultural greenhouse gas emissions are CH_4 from enteric fermentation and N_2O from agricultural soils. Emissions from agriculture have been relatively stable over the last couple of years, with emissions levels of around 500 Gg CO_2-equivalents per year. From 1990 – 2003 emissions decreased by 11%, mainly due to decreasing number of livestock.

Waste

The emissions of greenhouse gases (CH_4) from landfills increased by 62% from 1990 to 2003. There are two main reasons for this. First, increasing amount of waste is being landfilled and second, a larger percentage of that waste is landfilled in managed waste disposal sites. The amount of landfilled waste increased by 39% over the period. The percentage of waste in managed waste disposal landfill sites increased from 39% in 1990 to being close to 100% in 2003. Since methane production rate is higher for managed waste disposal sites than for unmanaged sites, the emissions have increased. The emissions from landfills show a decrease from 2001 to 2003, due to increasing amount of methane recovered. Methane recovery was initiated in 1997 and the annual amount recovered has increased steadily since. Emissions from waste incineration have decreased constantly since 1990 since the total amount of waste being incinerated has been decreasing. Also, since a higher percentage of incinerated waste has concurrently been incinerated with energy recovery it is reported under public electricity and heat production.

POLICIES AND MEASURES

3.1 Iceland's commitments and climate change strategy

In March 2002, the Icelandic Government adopted a new climate change strategy, aimed at ensuring that Iceland would meet its obligations according to the Kyoto Protocol. In April, the Icelandic Parliament approved a motion authorizing the government to ratify the Kyoto Protocol. Iceland deposited its instruments of ratification of the Kyoto Protocol on May 23, 2002. Iceland's obligations according to the Kyoto Protocol are as follows:

- For the first commitment period, from 2008 to 2012, greenhouse gas emissions shall not increase more than 10% from the level of emissions in 1990.
- For the first commitment period, from 2008 to 2012, the mean annual carbon dioxide emissions falling under decision 14/CP.7 on the "Impact of single project on emissions in the commitment period" shall not exceed 1,600,000 tons.

3.2 Policy development process

The Ministry for the Environment formulated the 2002 climate change strategy in close collaboration with the ministries of Transport and Communications, Fisheries, Finance, Agriculture, Industry and Commerce, Foreign Affairs and the Prime Minister's Office. The aim of the strategy is to curb emissions of greenhouse gases so that they do not exceed the limits of Iceland's obligations under the Kyoto Protocol. A second objective is to increase the level of carbon sequestration resulting from reforestation and revegetation programs. The strategy was to be reviewed in the year 2005, "if deemed necessary". In 2005, an interministerial consultative committee on climate affairs began a review of the climate change strategy, with a view to draft a new strategy with a broader mandate, focusing not only on meeting Kyoto targets, but also to address such issues as adaptation and long-term focus on cutting emissions and increasing carbon sequestration.

Iceland's current strategy for sustainable development, "Welfare for the Future", was approved by the government in July 2002. It provides a framework for sustainable development for the next two decades, setting up seventeen key long-term objectives, planned short-term measures to implement those objectives, and indicators to measure success. One key objective is mitigating climate change, and another is to increase further the share of renewable energy in the energy mix. The strategy is to be reviewed every four years, with the indicators and the short-term measures to be updated. In November 2005, Iceland's fourth Environmental Assembly, a national gathering of stakeholders in the field of the environment and sustainable development, reviewed the strategy and discussed a draft plan for priorities in the period 2006–2009.

Iceland has two administrative levels, and local authorities work alongside the central government in implementing many of the climate-related policies. In some fields, like waste management, the local governments have a key role. In recent years Icelandic municipalities have done considerable work in forming their own sustainable development policy under the label of Local Agenda 21.

3.3 Key measures in emissions reduction

This section gives an overview of the policies and measures listed in the 2002 Climate Change Strategy, and aims to give a qualitative indication of the effect they have had, or will likely have, to decrease emissions of greenhouse gases and increase carbon sequestration.

3.3.1 The energy sector

Iceland's energy situation is quite different than is the case in most developed countries. Almost all stationary energy is produced from renewable sources, and over 70% of the total primary energy supply. Most GHG emissions from energy come from mobile sources (transport on land and fishing vessels), where cuts in emissions are generally considered more difficult to achieve than from stationary energy sources. Iceland's 2002 strategy for sustainable development, Welfare for the future, states the goal of decreasing the share of fossil fuels even further in coming decades. The aim is that transport will use energy from renewable energy resources as soon as it is technologically and economically feasible to do so.

3.3.2 The transportation sector

Transportation is a growing source of greenhouse gas emissions in Iceland. In 2003 the transport sector was responsible for 20% of total GHG emissions in the country, while it was 19% in 1990.

One of the main measures listed in the Icelandic climate change policy is a change in the taxation system that will provide added incentives for the use of small diesel cars. Diesel-powered jeeps are common in Iceland, but almost all smaller cars use gasoline. As of recently, owners of diesel cars paid a special tax every year, depending on the weight of their vehicle, with a choice of paying a fixed tax or a mileage tax. In July 2005, this system was scrapped in favour of a simple tax on diesel fuel, which was set at a level so that it would lower the tax for the average owner of a diesel car. This change is expected to result in a transfer of around 10% of current gasoline use to the use of diesel fuel, resulting in a decrease in GHG emission by 2010, given the fact that diesel-powered cars emit on average about 14% less CO_2 than gasoline-powered cars of the same size. The change from the weight tax to fuel tax has not been seen to have a big initial effect to stimulate the buying of diesel cars. Part of the explanation is seen to be that the price of diesel fuel was unusually high at the time of the introduction of the fuel tax, reducing the incentive to switch from gasoline to diesel, even if the Ministry of Finance actually reduced the fuel tax rate from initial plans due to the high market price. News stories focused on the price hike of diesel fuel, and rarely mentioned the scrapping of the weight tax instead, so that many got the impression that the effect of the change was to discourage the buying of diesel-powered cars, rather than the opposite. The general trend in Iceland has also recently been in the direction of buying bigger cars with less fuel economy, suggesting that fuel efficiency is not a prime concern for buyers. Nevertheless, it is projected that in the long run the change will have the effect of encouraging the buying of diesel cars.

Another measure listed in the 2002 strategy is the reduction of import fees on vehicles using low-pollution engines. This has been implemented in two steps, the second one occurring in 2005. Today, vehicles that are totally or almost pollution-free, such as electric vehicles or hydrogen-powered vehicles, are exempted from paying import fees, which are 45% on most passenger cars. This exemption is valid until 2008, and can be renewed at that date. Vehicles with hybrid engines and methane-powered vehicles pay 240,000 ISK (around US$ 3,000) less in import fees than other cars, a rebate valid at least until the end of 2006. To date, these actions have not led to a big increase in the use of such vehicles. The import of hybrid cars is controlled by a quota by producers, so that any effect of the economic incentives would come in the future. Few electric vehicles are on the road in Iceland, and only about 50 methane-powered vehicles. Hydrogen-powered cars and buses have been imported and used in research projects, but they are not commercially competitive yet. The effect on emissions has thus been negligible to date, and for the sake of caution, no effect of this measure has been estimated in the future. Nevertheless, this is an important symbolic step, which could produce meaningful and measurable results in some years. A continuation of the lower rates for low-pollution and pollution-free cars should lead to a quicker introduction of such vehicles when they become more easily available and commercially competitive.

Other transportation-related policies are listed in the climate change strategy. In several instances distances between places have been decreased with the construction of new roads and tunnels; this has the effect of reducing emissions per trip, but this can possibly be cancelled out by increased traffic due to the reduced travel-time. It is difficult to calculate the net effect of these measures, and no estimates on emission reductions have been made. As for measures to strengthen public transport in Iceland, the abandoning of the weight-tax on diesel-powered vehicles in favour of a fuel tax should be beneficial to buses used in public transport. Public transport in the Reykjavik metropolitan area has, however, seen steadily declining ridership, despite efforts to improve and rationalize the route system. The main explanation for this seems to be that in the fast-growing economy in recent years there has been a great increase in the number of passenger cars, with a corresponding decline in the use of other forms of transport. The Icelandic Road Authority has done work in increasing coordination of traffic lights, which has a small but positive effect in reducing emissions; this is however not estimated or included in calculations on emission reductions.

3.3.3 The fisheries sector

The fisheries sector is one of the biggest sectors in terms of GHG emissions in Iceland. The use of fossil fuels for fishing vessels was responsible for 19% of total GHG emissions in the year 2003, and had decreased by 1% from 1990. Use of HFCs in cooling systems onboard fishing vessels is also a source of GHG emissions. As is the case with transport on land, reductions in emissions from fishing vessels are difficult to achieve. The fishing industry points to the fact that it is not subsidised, unlike fisheries in many European and other countries, and that this means that there is a greater incentive to save fuel and minimize emissions per ton or value-unit of fish. The system of individual transferable quotas in the Icelandic fishing industry also contributes to fuel-saving and lower emissions, it is claimed, as each company aims to get its quota in the most economical way; while time limitation of fisheries, to take an example of another common way of fisheries management, has a built-in incentive for vessels to spend as much time at sea as possible in the time allocated. While these arguments have a certain logic, there is a lack of comparable studies of fishing industries in different countries, and fishing management systems, to back them up with concrete facts, such as emissions per ton or value-unit in shared or comparable fisheries.

As for measures to reduce emissions from the fishing sector, there has been government support, through research funding and public procurement, for the development and introduction of a fuel-saving system for fishing vessels and other ships, that has been developed by an Icelandic company. This fuel-saving system has inter alia been set up in a new research vessel of the Marine Research Institute, and will also be set up in a new coast guard ship. Early results show that savings of 10% or more in fuel use and emissions are possible with the fuel-saving system. In general, the renewal of the fishing fleet tends to lead to new energy-efficient ships replacing older ones; this trend, however, is driven by economic concerns by the industry rather than government measures.

The processing of fish and seafood on land is a relatively small source of greenhouse gas emissions in Iceland, with the exception of the fishmeal industry, which uses oil along with electricity generated from renewable energy sources. There have been limited government measures to reduce emissions from the fishmeal industry, but there has been a steady trend towards lowering emissions, largely because of investment by the industry itself in better and cleaner technology. In 1990, about 60 tons of oil were used to process each ton of fish, but in 2003, only 35 tons of oil were used on average. This was partly achieved by the fact that the government-owned national power company allowed the fishmeal factories to buy electricity – generated by hydro and geothermal energy – at special prices, encouraging the substition of oil burners by electrical heaters. A new law from 2003 on electricity generation and distribution make such special arrangements more difficult, because of the introduction of European Economic Area competition rules. Some fishmeal companies have reacted by investing in new and more fuel-efficient technology.

Currently the use of HFCs is banned in Iceland, with the exception of use for cooling systems and in certain medical applications. The fisheries and fish processing industries are the main users of HFCs. Many larger processing plants use NH3 as a cooling agent, but smaller plants and ships commonly use HFCs.

3.3.4 Industrial processes

Industrial processes in energy-intensive industries accounted for 27% of total GHG emissions in Iceland in the year 2003, but had accounted for 26% in 1990. This includes CO_2 emissions from two projects that would meet the criteria of falling under Decision 14/CP.7. Excluding these emissions, the share of industrial processes was 17% in 2003, with 451 Gg of CO_2 falling under Decision 14/CP.7.

PFC emissions from energy-intensive industries do not fall under Decision 14/CP.7, and climate-related policies in the industrial sector are primarily focused on limiting PFC emissions. Herein is the greatest success story so far in reducing GHG emissions in Iceland. The 2002 climate change strategy sets the goal of PFC emissions from aluminum smelters at 0.14 tons of CO_2 equivalents. The aluminum plants have achieved their goal by improving technology in continuing production, and by introducing Best Available Technology in new production. This can be seen as an ambitious goal, since the results of the 2003 analysis by the International Aluminium Institute show that the median PFC emissions level for aluminum smelters is 0.38 tons of CO_2 equivalents, and the average number is still higher. The 2003 survey is the sixth in a series of surveys conducted by the International Aluminium Institute, covering anode effect data from global aluminum producers over the period from 1990 through 2003. PFC emissions from the aluminum smelter in Straumsvík have decreased by over 40% from 1990 to 2003, despite production increasing at the same time by more than 70%. PFC emissions from the Nordurál smelter in Hvalfjörður, which started production in 1998, were quite high at the start, as is normally the case, but are today less than 0.14 tons of CO_2 equivalents per ton of aluminum.

It is difficult to estimate how much lower emissions are today than they would have been with business-as-usual. One way would be to use the PFC emissions per ton of aluminum from the Straumsvik plant in 1990, and continue to use that rate for later years for both that plant and new plants, and compare it with actual data. This would yield a huge calculated benefit. This method would, however, be questionable, as emissions per ton would most probably have decreased because of new technology and demands for reduced emissions because of health concerns. It is doubtful, though, that the reductions would have been as great as is the case without the climate change policy. One way to estimate emissions savings is to compare the median emission levels from the 2003 analysis by the International Aluminium Institute with the Icelandic data from 2003 and estimates of PFC emissions in 2008–2012. These calculations show a net saving of 65 Gg in 2005 and projected 161–187 Gg in annual net reduction of emissions in 2008–2012.

3.3.5 The waste sector

GHG emissions from the waste sector were 6% of total GHG emissions in 2003, but were 4% in 1990. Most of these emissions are methane from landfills.

The total amount of waste has been increasing in recent years. The most important measure to reduce GHG emissions from waste is the collection of methane from the largest landfill in the country, serving all of the greater Reykjavík area, which started in 1997. The government climate change policy states the goal of further reducing waste disposal, especially in terms of organic waste. Icelandic Waste Management Law and regulations on waste treatment transpose the following targets into Icelandic law (the baseline is 1995): i) to reduce the total weight of organic household waste to be landfilled by 25 per cent no later than January 2009, by 50 per cent no later than June 2013, and by 65 per cent no later than June 2020; ii) to reduce the total weight of other organic waste, such as biodegradable organic waste to be landfilled, by 25 per cent no later than January 2009, by 50 per cent no later than June 2013 and by 65 per cent no later than June 2020. A second objective of the climate change policy is to increase the collection of landfill gas for energy recovery and environmental control. Currently, SORPA, an independent waste management firm owned by seven municipalities, collects methane from Reykjavik-area landfill. The methane is either flared, processed for car fuel, or burned for electricity production. About 50 vehicles are run on methane from the landfill, but it is estimated that the gas from the landfill could power 4,000–6,000 cars annually.

3.3.6 The agriculture sector

The 2002 climate change strategy does not contain goals for emission reductions in agriculture, which was seen as a relatively minor source of emissions. In 2004, however, agriculture emissions were reestimated, as some data were corrected and calculation methods improved. This yielded the results that emissions from agriculture were considerably greater than previously thought, and that they were some 17% of total emissions in 1990 and 14% in 2003. As of yet, measures to reduce these emissions have not been identified, but the current review of the climate change strategy will address possible measures in agriculture in light of the improved knowledge of their contribution.

Recent research indicates that drained wetlands for agriculture are a significant source of CO_2-emissions. These emissions have not been included in calculations of annual anthropogenic emissions from Iceland, as they result, with a few exceptions, from activities undertaken before 1990, even if some of the land is currently used for crop cultivation or animal grazing. The discovery of this apparently significant emission source indicates that the reclamation of wetlands can help stop the emission of CO_2, and even sequester carbon in vegetation and soil. In the draft update of Iceland's national strategy on sustainable development, increased reclamation of wetlands is listed as a priority measure for the mitigation of climate change in the period 2006–2009.

3.4 Carbon sequestration

Revegetation and reforestation is a high priority in Iceland, and there is significant potential to enhance carbon sequestration beyond the present level. In 1996 the Icelandic government announced its decision to allocate ISK 450 million for a four-year program of revegetation and tree planting to increase the sequestration of carbon dioxide in the biomass. This program was implemented in 1997–2000. The stated goal was an increase of 22,000 tons in carbon sequestration. Assessment of the results of the program indicates that the total additional sequestration was 27,000 tons. Although this four-year program is over, efforts to increase the annual carbon sequestration rate resulting from reforestation and revegetation programs will continue in the future. A new strategic plan for soil conservation and revegetation, adopted by the Icelandic Parliament in the spring of 2002, lists carbon sequestration as one of the four main objectives of the strategy. The strategic plan covers the period of 2003 to 2014. The parliament has also adopted a five year plan of action for the forestry sector, where attention is given to carbon sequestration. The Ministry of Agriculture is responsible for implementation is this area.

3.5 Research and development

The government policy on climate change emphasizes the importance of research and development and specifically lists the following actions:

- Emphasis on improving methods to estimate carbon sequestration and to create a reporting system to improve both inventory and projection estimates.
- Research and development to increase the use of environmentally friendly energy.
- Exploring ways to curb emissions from the transport sector.
- Experiments with alternative energy that could replace fossil fuels will continue, as well as research on fuel cells and hydrogen as energy carrier.

Implementation of policies related to research and development is a joint responsibility of all ministries. Discussion on research and development is provided in more detail in Chapter 7.

3.6 Information and public awareness

Increased emphasis on information and public awareness is one of the seven main components of the Icelandic climate policy. The government policy stresses the need to inform the public about options available to reduce greenhouse gas emissions on a day-to-day basis by minimizing waste, altering travel habits and increasing fuel efficiency. The government already supports some projects organized by environmental NGOs, whose aim is to encourage environmentally responsible behavior. Information about ways consumers can reduce GHG emissions in their everyday lives is integrated into these projects. The ministries are jointly responsible for encouraging education and increasing awareness. Further discussion about public education is to be found in Chapter 8.

3.7 Other measures

In addition to measures specifically taken to limit GHG emissions domestically, the Icelandic climate policy discusses other commitments, such as inventory information for carbon sequestration, emissions trading, and financial support to developing countries. According to the climate policy, a nationwide inventory system on carbon sequestration should be implemented no later than 2007, as called for in the Kyoto Protocol. The Kyoto Protocol also deals with emissions trading. Iceland's intention to take advantage of Decision 14/CP.7, limits its options for participating in emissions trading with other countries. Each country is free to decide whether a domestic system of emissions trading is a feasible option. In the Icelandic case, this is not considered an attractive option for the time being. Financial support to developing countries is another important aspect of the UNFCCC. Relevant in this respect is a declaration from a group of states (the EU, Canada, New Zealand, Norway and Iceland) that they would be willing to provide additional support to developing countries equal to USD 410 million no later than 2005. Financial assistance will be discussed in more detail in Chapter 6.

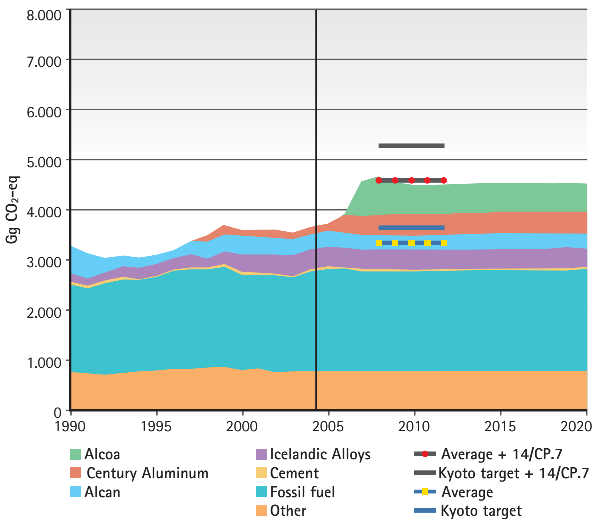
CHAPTER 4

PROJECTIONS AND THE TOTAL EFFECT OF MEASURES

4.1 Introduction

Projections for greenhouse gas emissions until 2020 have been made, taking into account the climate change strategy adopted by the Icelandic Government in 2002. The climate change strategy from 2002 is aimed at ensuring that Iceland will meet its obligations according to the Kyoto Protocol. The projections are "with measures", while no projections "with additional measures" have been made as Iceland expects to meet its commitments under the Kyoto Protocol.

The lead agency in producing the projections is the Environment and Food Agency, which is also responsible for Iceland's greenhouse gas emissions inventory. The Environment and Food Agency cooperated with the Energy Forecast Committee during the preparation of the projections. The Energy Forecast Committee is responsible for making projections about energy consumption in Iceland and has representatives from companies, institutions and organizations involved in the energy sector. The greenhouse gas emissions projections are based on the energy forecast for fossil fuels that was published in September 2005. Two scenarios are described in this chapter, depending on the level of increase in new energy-intensive industry in Iceland until 2020. Both scenarios are calculated excluding estimations on carbon sequestration by afforestation and revegetation.



Scenario 1	Gg CO_2-eq	Kyoto target
Average emissions of greenhouse gas, 2008–2012	4,519	13% under
Average emissions of greenhouse gas not including emissions falling under Decision 14/CP.7, 2008-2012	3,294	9% under
Total emissions in 2012	4,481	37% increase from the 1990 level
Emissions in 2012, not including emissions falling under Decision 14/CP.7	3,249	1% decrease from the 1990 level
Total emissions in 2020:	4,519	38% increase from the 1990 level

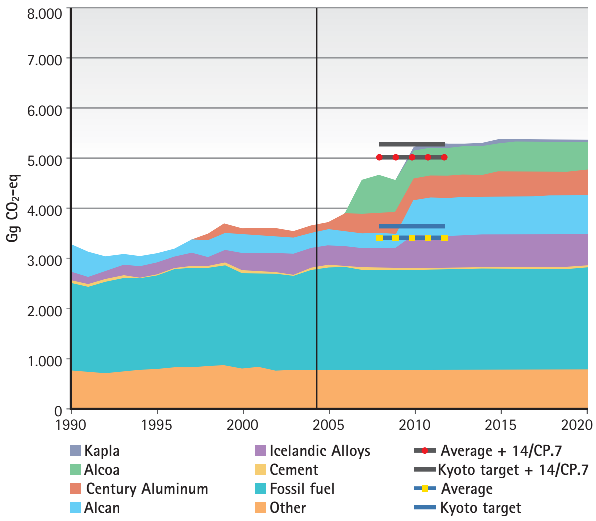
4.2 Scenarios and key assumptions

Scenario 1 assumes no additions to energy-intensive industries other than those already in progress in 2004/2005, meaning the enlargement of the Century Aluminum plant in Hvalfjörður and the building of the Alcoa aluminum plant in Reyðarfjörður.

Scenario 2 is based on the assumption that all energy-intensive projects which currently have an operational license will be built, which means four new projects in addition to the two projects already included in scenario 1. This includes an enlargement of the Alcan aluminum plant in Straumsvík, an enlargement of the Icelandic Alloys ferrosilicon plant in Hvalfjörður, a further enlargement of the Century Aluminum plant, and the building of Kapla, an anode production plant in Hvalfjörður. It should be noted that the fact that these projects do have an operational license does not automatically mean that they will be built.

4.3 Projections and aggregate effects of policies and measures

If emissions are in accord with projections, Iceland will be able to meet its obligations for the first commitment period of the Kyoto Protocol, even with the planned expansion in energy-intensive industries in Scenario 2. The scenarios are calculated excluding estimations on carbon sequestration by afforestation and revegetation. In 1996 the Icelandic government announced its decision to allocate ISK 450 million for a four-year program of revegetation and tree planting to increase the sequestration of carbon dioxide in biomass. This program was implemented in 1997–2000. The stated goal was an increase of 22,000 tons in carbon sequestration. Assessment of the results of the program indicates that the total additional sequestration was 27,000 tons. Although this four-year program is over, efforts to increase the annual carbon sequestration rate resulting from reforestation and revegetation programs will continue in the future. It is estimated that measures taken will increase annual carbon sequestration by about 207 Gg annually in the first commitment period 2008–2012.



Scenario 2	Gg CO_2-eq	Kyoto target
Average emissions of greenhouse gas, 2008–2012	4,959	5% under
Average emissions of greenhouse gas not including emissions falling under Decision 14/CP.7, 2008–2012	3,360	7% under
Total emissions in 2012	5,236	60% increase from the 1990 level
Emissions in 2012, not including emissions falling under Decision 14/CP.7	3,344	2% increase from the1990 level
Total emissions in 2020:	5,335	63% increase from the 1990 level

It should be noted that discussions are under way about the construction of two additional new aluminum smelters in Iceland. These smelters do not, as of yet, have an operational license, and no decision has been taken on their construction. If it is decided that they shall be built, it will be necessary for the government to consider additional measures to ensure that Iceland will meet its Kyoto commitments. It is estimated that Iceland will actually meet its target for the first commitment period 2008–2012, even if these smelters are built, but they could bring Iceland very close to the target, and caution will have to be employed.

4.4 Methodology and sensitivity analysis

The greenhouse gas emissions projections are based on four key estimations: i) The forecast for fossil fuels that was published in September 2005. As was mentioned earlier Iceland's energy situation is quite different than is the case in most developed countries. Most greenhouse gas emissions from energy come from mobile sources, transport on land and fishing vessels; ii) Estimations for emissions from industry and industrial processes; iii) Estimations for emissions from agriculture and iv) Estimations for emissions from waste.

The forecast for fossil fuels is based on several key elements, including: i) Gross domestic product (GDP), which is based on estimates from the Ministry of Finance issued in April 2005 as well as estimates from the Icelandic banks on the same matter. In these estimations GDP is expected to increase by 2,4% in 2007; ii) Population growth is based on estimations from Icelandic Statistics; iii) The Marine Research Institute provides estimations for future annual allocation of the total allowable catch within the Icelandic economic zone; iv) Aluminum projects are expected to increase during the projected period and will automatically result in increased use of fossil fuel during the construction phase as well as after the production begins. This will also result in increased shipping traffic to and from Iceland; v) The number of vehicles in Iceland are expected to increase by 1,2% annually over the projected period. As the number of vehicles increases, the average use of private cars is expected to go down. In 2004 the average private car was driven some 12.600 km per year. This number is expected to have fallen down to 12.200 km per year at the end of the projected period; vi) The level of transportation of goods on roads is expected to increase during the projected period; vii) The proportion of diesel cars in the vehicle fleet is expected to increase from 27% in 2003 to 38% at the end of the projected period.

There are several key elements included in the projected emissions from industry and industrial processes, including: i) Emissions from cement production are estimated to be the same during the projected period as the average emissions during the five previous years; ii) Emissions from the Icelandic Alloys ferrosilicon plant in Hvalfjörður are estimated to be the same per produced ton during the projected period as the average emission per produced ton of ferrosilicon during the three previous years; iii) Emissions of CO_2 from the aluminum plants is the same during the projected period as the average emission per produced ton of aluminum during the five previous years; iv) Emissions of PFCs from the aluminum plants are estimated to be 0.14 tons of CO_2 equivalents per produced ton of aluminum. In the case of the enlargement of the Century Aluminum and Alcan aluminum plants this number is higher in the year of the enlargement, or 0.28 tons of CO_2 equivalents per produced ton of aluminum. During the startup phase for the Alcoa aluminum plant, emissions of PFCs are expected to be 2.5 tons of CO_2 equivalents per produced ton of aluminum in the first year and then linearly decreasing to 0.14 tons of CO_2 equivalents during the next three years.

Emissions from agriculture have been decreasing over the past few years but are expected to stay the same during the projected period as they where in 2004. The same applies to emissions from waste.

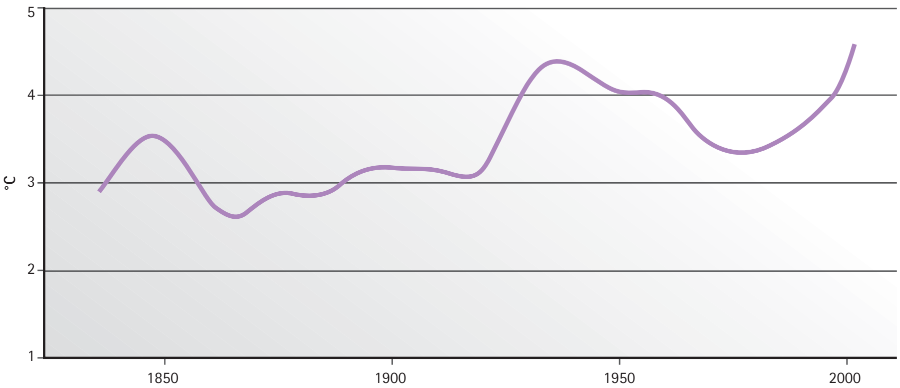
The effects of the key measures included in the government climate policy (see Chapter 3) are already integrated into the projections for both scenarios. Sensitivity analysis was undertaken to estimate the emissions if three of the measures did not have the expected effects. The assumptions were changed as follows: i) Transport: The fossil fuel forecast expects a 10% reduction in gasoline use with an equal increase in the use of diesel oil, as a consequence of a change in taxation. How much would the emissions increase if the relative share of gasoline and diesel oil remained unchanged? ii) Industry: The projections assume that both existing and new aluminum industries will succeed in limiting PFC emissions at 0.14 tons of CO_2 equivalents per each ton of produced aluminum. The results of the 2003 analysis by the International Aluminium Institute show that the median emission level for aluminum smelters is 0.38 tons of CO_2 equivalents, and the average number is still higher. The 2003 survey is the sixth in a series of surveys conducted by the International Aluminium Institute, covering anode effect data from global aluminum producers over the period from 1990 through 2003. How much would the emissions increase if the PFC emissions from the Icelandic aluminum industry would have been 0,38 tons of CO_2 equivalents? iii) Waste: Collection of landfill gas for flaring and energy recovery. How much would the emissions increase if the gas is not collected?

Given these changes in assumptions, annual emissions for the period 2008–2012 would increase by 200 Gg CO_2 equivalent for Scenario 1, bringing the annual average up to 4,719 Gg CO_2 equivalent, which falls within the allocated amount. For Scenario 2 the total annual emissions would increase by 226 Gg CO_2 equivalent, bringing the annual average up to 5,185 Gg CO_2 equivalent, which also falls within the allocated amount, but would be very close to exceeding the allocated amount of 5,202 Gg CO_2 equivalent for the first commitment period of the Kyoto Protocol.

IMPACTS AND ADAPTATION MEASURES

5.1 Impacts on climate

Time series of temperature change in Iceland since the 19th century show a period of rapid warming following the 1920s. Similar warming is observed in global averages, but in Iceland the temperature change was greater and more abrupt. From the 1950s temperatures in Iceland had a downward trend with a minimum reached during the Great Salinity Anomaly, when sea ice was prevalent during late winter along the north coast. There is another cold period in the late 1970's with 1979 being the coldest year of the 20th century in Iceland. Since the 1980's, Iceland has experienced considerable warming, and early in the 21st century temperatures reached values comparable to those observed in the 1930s. Both in Reykjavík and Stykkishólmur the three warmest years in the instrumental record are currently 1939, 1941 and 2003, with only small differences between these years.



Mean annual temperature at Stykkishólmur 1820–2004

Comparison of the spatial pattern of the warming in the 1920s and 1930s with temperature changes in the last 20 years shows systematic differences. Recent warming has spatial characteristics that show that in the last decades of the 20th century, all of the country warmed, but the warming was greatest in the north-eastern part. The warming had a so called SW– NE character to it. The rapid warming in the early part of the 20th century is clearly greater compared with more recent warming and it is greater along most of the north shore than along the south shore. This warming thus had a N–S character to it. The N–S pattern may be due to the climatic influences of sea ice. The SW–NE pattern may on the other hand be linked to the fact that air temperature in Iceland is greatly influenced by advection of warmer air from the south. The different warming patterns can be linked to differences in the large scale ocean and air circulation patterns.

The Arctic Climate Impact Assessment (ACIA) was presented at the Fourth Arctic Council Ministerial Meeting in Reykjavik in November 2004. It reports on the evaluation of Arctic climate change and its impacts for the region and for the world. Observations indicate that the climate of the Arctic is changing markedly. For example, air temperatures are generally higher, the extent and duration of snow and sea ice are diminishing, permafrost is thawing and precipitation has increased. Owing to natural variations and the complex interactions of the climate system, the observed trends show variations within each region. Although some regions have cooled slightly, the overall trend for the Arctic is a substantial warming over the last few decades.

5.2 Impacts on oceanic currents

The climate of Europe and the North Atlantic is much milder than it is at comparable latitudes in Asia, Canada and Alaska. This is due to the heat transport from the south with air and water masses. A key process in this respect is the so called thermohaline circulation in the ocean. It is based on the sinking of seawater, mainly due to cooling and ice formation, at certain positions at high latitudes. After sinking this water is called deep water and it subsequently flows to lower latitudes. In the North

Atlantic huge amounts of deep water is formed, e.g. in the Arctic Ocean, the Greenland Sea, the Iceland Sea and the Labrador Sea. The deep water that is formed north of the Greenland-Scotland Ridge flows over the ridge on both sides of Iceland and also through the Faroe-Shetland Channel.

Many numerical models predict that the production of deep water will be reduced as a result of increasing greenhouse gas emissions. This happens when more fresh water is introduced to the Nordic Seas because of melting of glaciers and thawing of permafrost that will make the surface layer fresher and therefore reduce the likelihood of convection. This in turn would lead to reduced deep water flow over the Greenland-Scotland ridge and a compensating reduction of flow of warm currents into the Nordic Seas thus inducing a cooling in the area. Ice core data from the Greenland Ice Sheet seem to indicate that this can happen rather quickly or within decades. Research projects measuring changes in the deep water fluxes over the ridges have succeeded in obtaining a time series of the flux of Atlantic water as well as of the deep water. With the time series available now it is however not possible to conclude that the flow of deep water is decreasing.

5.3 Impacts on marine ecosystems and fish stocks

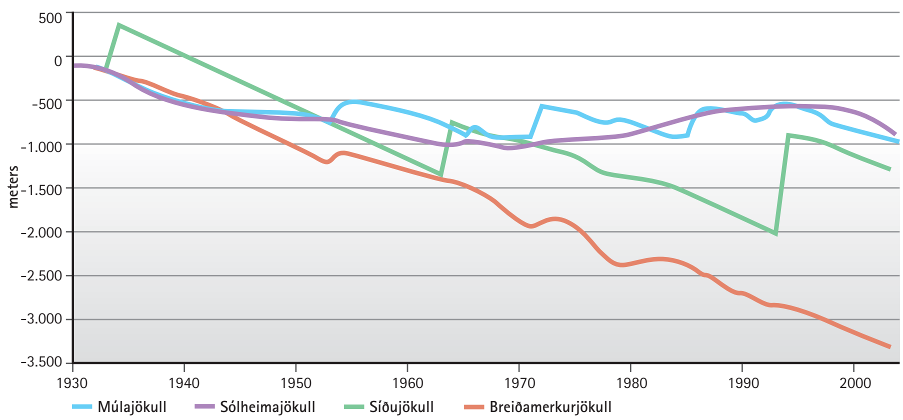
To project the effects of climate change on marine ecosystems is a challenging task. Available evidence suggests that, as a general rule, primary and secondary production and thereby the carrying capacity of the Icelandic marine ecosystem is enhanced in warm periods, while lower temperatures have the reverse effect. Within limits, this is a reasonable assumption since the northern and eastern parts of the Icelandic marine ecosystem border the Polar Front. In cold years the Polar Front can be located close to the coast. During warm periods it occurs far offshore, when levels of biological production are enhanced through nutrient renewal and associated mixing processes, resulting from an increased flow of Atlantic water onto the north and east Icelandic plateau.

Over the last few years the salinity and temperature levels of Atlantic water south and west off Iceland have increased. At the same time, there have been indications of increased flow of Atlantic water onto the mixed water areas over the shelf north and east of Iceland in spring and, in particular, in late summer and autumn. This may be the start of a period of increased presence of Atlantic water, resulting in higher temperatures and increased vertical mixing over the north Icelandic plateau. The time series is still too short though to enable firm conclusions. However, there are many other parameters which can affect how an ecosystem and its components, especially those at the upper trophic levels, will react to changes in temperature, salinity, and levels of primary and secondary production. Two of the most important are stock sizes and fisheries, which are themselves connected.

It is unlikely that the response of commercial fish stocks to a warming of the marine environment around Iceland, similar to that of the 1920s and 1930s, will be the same in scope, magnitude, and speed as occurred then, mainly because most spawning fish are now fewer, younger and smaller than at that time. Nevertheless, a moderate warming is likely to improve survival of larvae and juveniles of most species and thereby contribute to increased abundance of commercial stocks in general. The magnitude of these changes will, however, be no less dependent on the success of future fishing policies in enlarging stock sizes in general and spawning stock biomasses in particular, since the carrying capacity of Icelandic waters is probably about two to three times greater than that needed by the biomass of commercial species in the area at present.

5.4 Impacts on glaciers

Glaciers are a distinctive feature of Iceland, covering about 11% of the total land area. The largest glacier is Vatnajökull in southeast Iceland with an area of 8,200 km^2. Climate changes are likely to have a substantial effect on glaciers and lead to major runoff changes in Iceland. Changes in glacier runoff are one of the most



Retreat of four selected outlet glaciers, 1930–2004 important consequences of future climate changes in Iceland. The expected runoff increase may, for example, have practical implications for the design and operation of hydroelectric power plants.

Rapid retreat of glaciers does not only influence glacier runoff but could include implications such as changes in fluvial erosion from currently glaciated areas, changes in the courses of glacier rivers, which may affect roads and other communication lines, and changes that affect travelers in highland areas and the tourist industry. In addition, glacier changes are of international interest due to the contribution of glaciers and small ice caps to rising sea level. Regular monitoring shows that today, all non-surging glaciers in Iceland are receding.

Many glaciers and ice caps in Iceland are projected to essentially disappear over the next 100–200 years. In two resent Nordic research projects, a dynamical ice flow model coupled to a degree-day mass balance model was applied to the Hofsjökull ice cap and the southern part of the Vatnajökull ice cap in Iceland. Future climate change is assumed to result in more warming during winter than summer. Runoff from these glaciers is projected to increase by about 30% with respect to present runoff by 2030. Both glaciers will according to the model computations have almost disappeared within 200 years from now.

Although glaciers and ice caps in Iceland constitute only a small part of the total volume of ice stored in glaciers and small ice caps globally, studies of their sensitivity to climate changes have a general significance because these glaciers are among the best monitored glaciers in the world. Field data from glaciated regions in the world are scarce due to their remote locations and difficult and expensive logistics associated with glaciological field work. Results of monitoring and research of Icelandic glaciers are therefore valuable within the global context, in addition to their importance for evaluating local hydrological consequences of changes in glaciated areas in Iceland.

5.5 Impacts on forests, land management and agriculture

Climatic factors, such as temperature, precipitation and wind, greatly influence plants and vegetation cover, and therefore have an impact on agriculture. Research on climatic fluctuation in the past has shown that the grassland production increased 11% for each rise in temperature of 1°C. The impact of a temperature increase will be even greater on barley production. Negative impacts of climate change on terrestrial ecosystems include increasing risks of plant diseases. Climate changes will make the cultivation of many areas more feasible and new species like barley previously difficult to grow more profitable. This might cause a shift in utilization of cultivated land and/or increase pressure on cultivating new areas.

An analysis of the possible impact of climate change on agriculture, forestry and land use has been made, using a scenario derived from a Nordic study on climate change in the North Atlantic region, assuming that in the year 2050 the mean temperature has increased by 1.5°C in the summertime and 3.0°C over wintertime, and that precipitation has increased 7.5% in summer and 15% in winter. The following paragraphs describe changes that could occur, given these assumptions.

The production of hey could increase significantly, up to 64%. This would partly be due to greater concentration of carbon dioxide in the atmosphere, but mostly to higher temperatures and less damage by frost on grasses. The effects of climate change would be greatest on cereals. Iceland has a short history of growing barley since weather conditions limit the possibility of such production. However, new variations of barley have made it possible to experiment with this kind of agriculture. The harvest of barley could increase by 1.5 tons per hectare up to 2050. An increase of average summer temperatures by 1.5°C could open up the possibility of growing oats and wheat in Iceland, even rye.

Increased precipitation and cloud coverage would lead to less light in greenhouses, so cost of lighting would increase. Harvest of potatoes, turnips, carrots and other vegetables grown outdoors in Iceland today, would increase, and several new species could be grown. Pests and plant diseases would become a bigger problem than currently, and the use of pesticides would increase. This could hurt the image of Icelandic produce as unpolluted high-quality foodstuffs.

Impacts of climate change on animal husbandry would mostly be positive. In addition to increased production of crops for fodder, the time available for grazing would increase and the need for sheltering livestock would decrease.

Increase in summer temperatures will undoubtedly increase growth rates and coverage of forests in Iceland. New pests could emerge and cause damage to trees. An increase in winter temperatures could also do more damage than good. Wild grazing plants should benefit from higher summer temperatures and increased precipitation. The latter could, however, lead to increased water erosion of soils. Milder winters could lead to increase in winter grazing, which is more damaging to vegetation than summer grazing.

5.6 Impacts on terrestrial ecosystems

Effect of warmer climate on terrestrial ecosystems in Iceland are not expected to differ in general from changes in other parts of the arctic and sub-arctic areas as described e.g. in ACIA 2005 report. Iceland's terrestrial ecosystems can be roughly divided to four main categories; grasslands, wetlands, woodlands and barren or sparsely vegetated areas. With warmer climate growing season is likely to be extended and start earlier in the spring, although precipitation patterns might halt growth in early spring. Higher winter temperature is also likely to stimulate decomposition of litter and soil organic matter and mineralization of nutrients with more available for plant growth. These changes will have effects on function, structure and distribution of terrestrial ecosystems.

Firstly, many areas in Iceland have suffered from extensive soil erosion due to, among other factors, heavy grazing and periods of cold climate. The grazing pressure on many areas has decreased and one effect of warmer climate is to enhance reestablishment of former vegetation and productivity of many of these areas. (Again depending on precipitation pattern). Vegetation on sparsely vegetated or barren areas should also benefit from warmer climate. As a result of more vigorous growth in most areas a shift in land cover is likely to occur with sparsely vegetated areas turned to grassland and grassland turned to woodland. These changes in land cover will affect distribution and diversity of both flora and fauna, and some species might become endangered.

Secondly, warmer winters will in general increase decomposition of organic matter in terrestrial ecosystems both litter and soil organic matter. This increased decomposition will affect the greenhouse gas budget of these areas and presumably shift at least temporally the annual budget towards more release of all GHG (CO_2, CH_4 and N_2O). Some of this efflux might be counteracted by increased photosynthesis due to longer growing season and increased nutrient availability.

Thirdly, changes in proportional size of and turnover rates of C-storages within terrestrial ecosystems are likely to occur due to increased respiration, nutrient availability and longer growing season.

Fourthly, in Iceland there are discontinuous permafrost areas which might disappear and the habitats for plants and as breeding ground for birds disappear as well. Thawing up of soils makes soil organic matter now practically unavailable to decomposition become available.

5.7 Impacts on society

It is uncertain what impacts climate change will have on society in Iceland. Any impacts on the fishing industry though, are likely to have some impacts on the society especially in some of the smaller communities in Iceland. From an economic point of view, climate change may impact the fishing industry in at least two ways. First by altering the availability of fish stocks and by changing the market price of fish products. Although both may be initiated by climate change, the issue of fish stock availability is a more direct consequence of climate change. The possible impact of climate change on fish stock availability may occur through changes in the size of commercial fish stocks, changes in their geographical distribution, and changes in their catchability. These changes, if they occur, will affect the availability of fish stocks for commercial harvesting. The impact is however uncertain. It may be negative, and so reduce the maximum sustainable economic yield from the fish stocks, or positive, and so increase the maximum sustainable economic yield from the fish stocks. Also, the impact may vary between fish stocks and regions. Irrespectively, it is very likely that climate change will, at least temporarily, cause instability or fluctuations in harvesting possibilities while ecosystems adjusts to new conditions. The adjustment period may be long, and may even continue after the period of climate change has ended. The same applies to changes in economic value.

If the change in the fishing industry is gradual and the economic impacts relatively small it is unlikely that the accompanying social and political impacts will be noticeable at a national level. In the long run, social and political impacts will undoubtedly occur, but whether these will be large enough to be distinguished from the impact of other changes is uncertain. Regionally, however, the situation may be very different. In some parts of Iceland the economic and social role of the fishing industry is far above the national average. In these areas, the economic, social, and political impact of an expansion or contraction in the fishing industry will be much greater than for Iceland as a whole and in some areas undoubtedly quite dramatic.

The main conclusion to be drawn is that the changes in fish stock availability that seem most likely to be induced by climate change over the next 50 to 100 years are unlikely to have a significant long-term impact on GDP in Iceland and, consequently, on social and political conditions in Iceland. Also, it appears that any impact, small as it may be, is more likely to be positive than negative. If on the other hand, climate change results in sudden rather than gradual changes in fish stock availability, the short-term impact on GDP and economic growth rates may be quite significant. Over the long term, the impact on GDP of a sudden change in fish stocks will be indistinguishable from the effects of more gradual changes.

The impact that climate change could have on human health is likely to be less in Iceland than in many other countries. Direct and indirect impacts on human health in Iceland are possible in relationship to changes in the frequency or intensity of natural disasters or extreme weather events. In small remote locations this is further accentuated by a challenged capacity to respond to these events because of the isolated nature of communities. The variability of such events is not however expected to increase with climate changes in the future. Changes in temperature have the potential to influence health in both negative and positive ways. Considering the low mean annual temperature in Iceland, the likelihood of heat events having large impacts on public health is low. Fewer colder days associated with winter warming may in fact have several positive health impacts.

Climate change is likely to have profound effects on biota which can in turn, affect human health in northern communities and elsewhere in the world. Infectious diseases of plants, animals and humans are also affected by climatic changes. Due to the indirect nature of these influences, predictions of their likelihood are not possible; however. The potential impacts on human health related to these changes clearly warrant further research and monitoring attention.

The potential effects of climate change include increased magnitude and variability in precipitation, and increased melting of glaciers. These changes may temporarily increase the potential for hydropower production in the country. They may also increase the frequency and severity of river and coastal flooding and erosion.

5.8 Adaptation measures

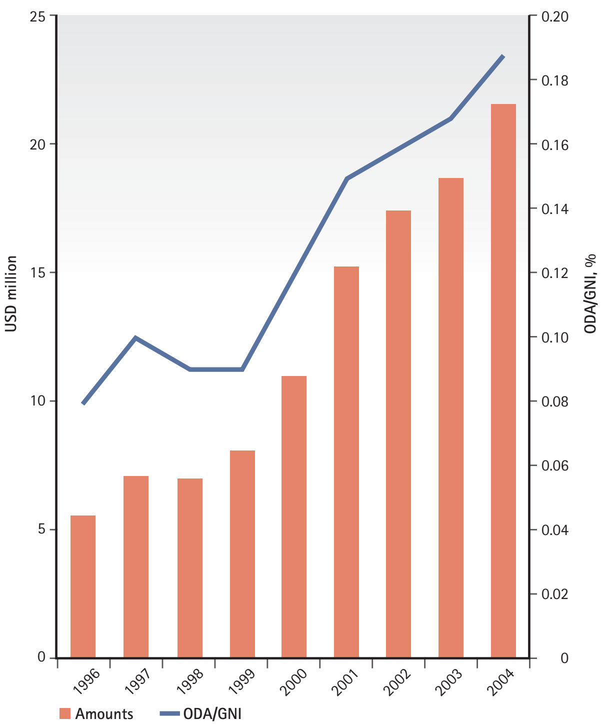
Most climate change measures adopted in Iceland aim at curbing emissions of greenhouse gases, and emphasis on adaptation measures has been minimal. The IPCC predicts that the rise in sea level will be 21 cm during the period 1990–2050 (3.5 mm per year), and 29 cm from 2050 to 2100 (5.8 mm per year). The most important adaptation measures are likely to involve changes in the design and/or operation of hydropower stations, dams, harbours, bridges and other structures that are affected by changes in the flow of rivers and a rise in sea level. Expected sea level rise has already been taken into account in the design of new harbours in Iceland.

FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

6.1 Official Development Assistance

Development co-operation is an important aspect of Icelandic foreign policy. Increased participation in this area represents Iceland's fulfillment of its political and moral obligations as a responsible member of the international community.

The coming years will see a significant increase in official allocations to development co-operation. The Government of Iceland decided in April 2004 that official development assistance (ODA) as a proportion of Gross Domestic Product (GDP) should rise from 0.19% in 2004 to 0.35% in 2009. When this target is achieved, Iceland's contributions to development co-operation will have increased from 0.09% to 0.35% of GDP in ten years, which represents a fourfold increase. This underlines the intent of the Government of Iceland to contribute to the achievement of the UN Millennium Development Goals and to shoulder the responsibilities laid down in the Monterrey Consensus.



6.2 The four pillars of Icelandic development co-operation

The Government of Iceland supports the Millennium Declaration of the United Nations, and Iceland's development co-operation will be conducted in the spirit of the summit declarations on sustainable development, financing for development and the UN Millennium Development Goals.

Development is a complex issue which needs to be addressed simultaneously on numerous fronts. Owing to its small size, Iceland cannot participate actively in all the tasks which are relevant to international development work. Nevertheless, it is important for Iceland's development policy to be based on a comprehensive vision, and for this reason Iceland's development co-operation in the coming years will rest on four principal pillars. They are:

Human and Economic Development, and Equality
Democracy, Human Rights and Good Governance
Peace, Security and Development
Sustainable Development

Iceland's development co-operation will focus on reducing poverty and on the promotion of the Millennium Development Goals. Over 70% of the assistance provided by the Icelandic International Development Agency (ICEIDA) has gone to countries which rank among the poorest developing countries in the world, and support for the International Development Agency (IDA), which directs its efforts principally at assisting this group of countries, has been at the core of Iceland's multilateral development activities. Iceland will continue to channel the largest share of its development assistance to the poorest countries.

Through international co-operation, and ratification of international agreements, the Government of Iceland has committed itself to contribute to the sustainable utilisation of natural resources. From the outset, this field has figured prominently in Icelandic development co-operation. For a long time, ICEIDA 's activities were almost exclusively limited to the fisheries sector, i.e. fisheries research, training and, most recently, guidance in quality control for fish products and assistance in the development of the foundations of fisheries control. Fisheries will continue to be among the principal points of focus of ICEIDA, but they will be supplemented, as part of the increased emphasis on sustainable development, by energy development, focusing in particular on renewable energy resources.

In addition to ICEIDA 's bilateral co-operation, the Government of Iceland has supported the developing countries in the area of sustainable utilisation of natural resources through its administration of the UN University Geothermal Training Programme and the UN University Fisheries Training Programme. For over 25 years the Geothermal Training Programme has been building up expertise in the utilisation of geothermal energy, and since 1997 the Fisheries Training Programme has contributed to the promotion of knowledge in fisheries. Increased emphasis will be placed on the activities of the two training programmes through measures which include enabling them to admit a greater number of students.

In addition to strengthening the current Icelandic development co-operation as regards sustainable development, with a special focus on fisheries and geothermal energy, collaboration with international organisations in the same areas will also be increased. Special emphasis will be placed on co-operation with small island developing states (SIDS), where the development of fisheries and energy are important economic factors.

Some of the actions listed in the Icelandic development co-operation strategy, that are especially relevant for the purposes of mitigating and adapting to climate change are:

- Increase its focus on sustainable development, emphasising the sustainable utilisation of natural resources.
- Strengthen the United Nations University Fisheries Training Programme and Geothermal Training Programme by enabling the programmes to admit more students and set up training courses in developing countries.
- Make energy a point of focus in ICEIDA ´s bilateral development co-operation.
- Strengthen collaboration with international institutions, including FAO and the World Bank, in the field of fisheries and renewable energy.
- Increase the emphasis on development cooperation with small island developing states.
- Continue to pursue the policy that Icelandic development assistance is primarily intended for the poorest developing countries in the world.

6.3 Implementation of Iceland's development co-operation

The Ministry for Foreign Affairs is responsible for overall coordination of Iceland's official development co-operation. The implementation of Iceland's development co-operation is conducted for the most part under the auspices of the Ministry, which is responsible for multilateral development co-operation and peace building operations, and under the auspices of ICEIDA, which is responsible for bilateral development co-operation. Also, Icelandic non-governmental organisations involved in development co-operation are steadily growing in strength and increasingly participating in development co-operation projects. In addition, the Icelandic private sector has increasingly been turning the attention to the issues of the developing countries.

Multilateral Development Co-operation

Iceland's participation in international development co-operation has a threefold objective. In the first place, the objective is to seek the best and most efficient ways of providing assistance to developing countries. Bilateral aid provided by ICEIDA is in some cases the appropriate channel, but in other cases multilateral co-operation may be more suitable. In the second place, active participation in multi-governmental co-operation provides opportunities to exert international influence. International co-operation is important to all countries, particularly to smaller countries, since international organisations provide a platform for all countries – big and small, rich and poor – to work toward their common goals on an even footing. Increased globalisation has created a still greater need for strong international co-operation and for this reason the Government of Iceland will place great emphasis in the future on active participation in co-operation of this kind. In the third place, participation in multilateral co-operation is important for the creation of knowledge and the strengthening of Icelandic public administration. In the opinion of the Government, it is important for its development co-operation to be based on professional and sound working methods, taking into account the experience and expertise of other countries and international organisations.

In light of the three-part objectives of Icelandic multilateral development work, the principal emphasis will be placed on participation in the work of the World Bank and its agencies and the principal agencies of the United Nations. Iceland's permanent missions to international organisations play a significant role in Iceland's development co-operation. These missions include the Permanent Mission to the Agencies of the United Nations in New York, Geneva, Paris and Rome, the World Trade Organisation in Geneva, the Organization for Economic Co-operation and Development (OECD) and the Organization on Security and Co-operation in Europe in Vienna.

Bilateral Development Co-operation

This support is based on bilateral development co-operation agreements between the Government of Iceland and the governments of partner countries. With ICEIDA's increasing scale of activities in recent years, its projects have become more varied and the Agency currently works in the social, education and health sectors, in addition to its fisheries projects. ICEIDA will continue to focus on these fields, but has now included the energy sector on its agenda. Thus, the Agency is planning to work in five fields in its partner countries over the coming years.

In order to achieve the maximum possible effectiveness of its development assistance, ICEIDA will continue to concentrate on few partner countries where the need for support is acute. Co-operation with countries other than the current partners, including countries outside Africa, will be implemented in conjunction with the expansion of ICEIDA's scope of activities. The Agency will also explore possibilities of participating in delimited and temporary projects outside the formal partner countries, particularly in fields where Icelandic expertise is most extensive, e.g. in the fisheries or energy sector.

United Nations University in Iceland

One of Iceland's largest undertakings in multilateral development co-operation is the operation of the UN University Geothermal Training Programme and the UN University Fisheries Training Programme. The training programmes provide experts from the developing countries with an opportunity to engage in specialised studies in geothermal energy matters and fisheries in Iceland. The Government of Iceland funds approximately 85% of the activities of the training programmes in Iceland. The policy of the Government is to reinforce both programmes in order to enable them to accept a greater number of students.

Non-governmental Organisations

Non-governmental organisations are important participants in development co-operation and represent a valuable input, both through their own conduct of development projects and through their public discussion of issues related to developing countries and development co-operation. In recent years, the number of NGOs participating in this field has grown in Iceland, and many of them are engaged in extensive activities. Among the strengths of NGOs are their active grassroot work and strong funding campaigns. In addition, many of them are conducting their work in the developing countries, e.g. through affiliation with international NGOs or through co-operation with local NGOs.

It is important that all NGOs should be able to apply for government support on an equal footing and any such cooperation must be subject to allocation rules and criteria to be met by the organisations. With this in mind, the government will formulate a policy and develop comprehensive rules governing co-operation with NGOs. In its co-operation with NGOs, ICEIDA will also emphasise contract-based and clearly defined projects which are carefully prepared and regularly reviewed.

The Private Sector

Private sector development and increased investment in developing countries are the key to increased economic growth and thereby the possibility of reducing poverty. Since the Icelandic private sector is currently in a phase of significant cross-border expansion and Icelandic enterprises have increasingly had their eyes on potential business opportunities in the developing countries, the Government is interested in supporting this aspect of their expansion. The Government is interested in facilitating relations and co-operation between enterprises in partner countries and similar undertakings in Iceland. In order for any such support to take place, both partners have to perceive an advantage in the partnership.

There are various ways available to reinforce the private sector in the developing countries through development co-operation between public and private entities. The Government of Iceland will examine in closer detail any potential opportunities in this area, e.g. through consultation with representatives of the business community, NGOs and universities. At the same time, the Government will explore avenues of mobilising the Icelandic business community in co-operation with international organisations.

Iceland´s Official Development Assistance (ODA)

Thous. US$		2000	2002	2004
Bilateral Assistance		**5,407**	**7,073**	**14,676**
Icelandic International Development Agency		3,797	4,813	6,958
of which:	Malawi	1,027	1,573	2,238
	Mozambique	1,168	1,071	1,177
	Namibia	1,055	1,182	1,264
	Uganda		477	1,145
	Other	545	510	1,135
Post-Conflict Peacebuilding Operations		1,610	2,260	7,718
of which:	ICRU (Kosovo, Sri Lanka, Afganistan)	1,402	2,248	6,129
	Bosnia Herzegovina	208	12	48
	Iraq			1,540
Multilateral Assistance		**3,309**	**3,980**	**4,437**
United nations		496	657	834
of which:	FAO	93	125	63
	UNDP	233	245	260
	UNICEF	121	127	134
	UNIFEM	32	34	36
	UNRWA	8	32	47
	UNESCO			34
	UNFPA		12	14
	UNHCR		66	58
	WFP	5	11	58
	UNVFVT	5	5	
	WHO			112
	ILO			20
The World Bank Group		1,211	1,211	2,273
of which:	IDA	1,211	1,040	2,068
	Icelandic Trust Fund		172	205
Nordic Development Fund		450	613	668
HIPC Trust Fund		865	1,244	428
International Monetary Fund		281	240	
Doha Development Agenda Global Trust Fund			10	13
The Global Fund to Fight AIDS, Tuberculosis and Malaria				214
International Fund for Agriculture Development		6	5	7
Other		**1,447**	**2,824**	**3,175**
UNU Geothermal Training Programme		640	689	960
UNU Fisheries Training Programme		387	535	767
Refugee Assistance		216	301	
Contibutions to NGO´s		75	155	284
of which:	ABC Children´s Aid	20	43	56
	International Red Cross	51	51	
	Save the Children		33	7
	Icelandic Red Cross		27	214
	Icelandic Church Aid		22	7
Emergency Assistance		41	684	93
Administration		89	460	572
Nordic-Baltic Coordination, World Bank				499
Total ODA		10,162	13,877	22,288
ODA/GNI (%)		0.12	0.16	0.19

CHAPTER 7

RESEARCH AND SYSTEMATIC OBSERVATION

7.1 General research policy

Emphasis on research and development (R&D) has grown in Iceland in recent years. Funds allocated to research and development were 1% of GDP in 1990 but had reached around 3% of GDP in the year 2003, making Iceland fourth among OECD countries in R&D spending per GDP. This development is mainly due to increased investment in research by the private sector, but the public sector has also increased its expenditure on research. Total spending on R&D in Iceland in 2003 was 23.7 billion Icelandic krónur, while government R&D spending in 2005 was 9.2 billion krónur.

New legislation on the organization of science and technology policy and the funding of research and technological development in Iceland, went into force in January 2003. A Science and Technology Policy Council was established, with the task of formulating public policy on scientific research and technological development. The Council is headed by the Prime Minister, and consists of ministers, scientists and business representatives.

Environmental change is recognized as an important area in R&D. In 1998 the Icelandic Research Council launched a five-year program with a special fund to support projects in environmental research and research on information technology, which concluded in 2004. Several climate-related projects received grants from this fund. Such projects also get support from other funds of the Icelandic Research Council, but Icelandic scientists are also involved in a number of international climate-related projects funded from sources, such as the European Union and the Nordic Council of Ministers. Research on climate and systematic observation is also part of the mandate of some public institutions, such as the Icelandic Meteorological Office (IMO) and the Marine Research Institute (MRI).

Efforts are under way to coordinate climate-related research better, and to possibly enhance it. The Icelandic Research Council has held three workshops on enhancing research related to the Arctic, including climate change research. The Science and Technology Policy Council has asked the Ministry for the Environment to draft a report by spring 2006 on the state of climate-related research, priorities and suggestions for improvements.

7.2 Climatic research

Most of the climate-related research in Iceland is focused on climate processes and climate system studies and impacts of climate change. Other efforts involve modeling and prediction, and large ongoing projects deal with mitigation measures, but there has been less research on socio-economic analysis.

7.2.1 Climate process and climate system studies

The evaluation of changes and variability of the climate (including sea-ice) is among the basic tasks of the IMO. Although the research is mainly centered on the climate of Iceland, the IMO has also been active in many multinational projects focusing on the analysis of climate data. The mean temperature of the period 1961 to 1990 has been mapped, and the data used is accessible in an on-line data bank, which is useful for research on variability in weather and climate. Methodological work on the mapping of precipitation in Iceland is under way, a part of this work is connected to research on glaciers and change in their extent and thickness. A research project presenting a comprehensive review of temperature and precipitation in Iceland for the last 100–150 years was presented in the International Journal of Climatology in 2004. An ongoing research project is looking at long term cycles in variability of several weather features, inter alia in relation to the North Atlantic Oscillation. A multinational research project on air pressure from 1851, which uses data from Iceland, has finished, resulting in a scientific paper due to be published in the Journal of Climate.

Icelandic scientists have for many years contributed considerably to paleoclimatological work with their participation in many ice and sediment core projects. Most of this work has taken place within the University of Iceland. Some examples of research topics within that field and in related fields at the University include:

- A review of the size of Icelandic glaciers for the last 300 years and an estimate of their contribution to higher sea levels,
- Analysis of seafloor sediment cores from the coastal shelf north of Iceland to reconstruct changes in sedimentation, biota and ocean currents,
- Analysis of Tertiary and Quaternary oceanic paleofauna in order to chart changes in the system of ocean currents in that period,
- Reconstruction of climate change around the North Atlantic in the last 13,000 years by analysis of sedimentation (carbon content, pollen etc.) in lakes and fjords,

7.2.2 Modeling and prediction

The climate modeling work of the IMO has mostly been restricted to physical downscaling experiments and to the effects of mountains on both local climate and the general circulation in the North Atlantic Region. The IMO takes part in the European High- Resolution-Limited-Area-Model (HIRLAM) cooperation and its development and evolution of high-resolution deterministic weather forecasting models, but the model is not in operational use in Iceland. The IMO, in cooperation with the University of Iceland, uses the non-hydrostatic, high-resolution 5th generation Mesoscale Model (MM5) for research projects in dynamic meteorology and for the downscaling of climate simulations. Most of the research projects in dynamic meteorology have emphasized interaction between the terrain and the atmosphere on scales ranging from flow around hills up to synoptic systems. Projects on predictability and sensitivity of forecasts to observations are planned in connection to the upcoming WMO-program THORPEX (The Observation System Research and Predictability Experiment). The IMO, the MRI and the University of Akureyri cooperate on a research project with the goal of understanding the natural variations in oceanic circulation surrounding Iceland, and how climate change might affect this. A model describing the mesoscale variability of the ocean circulation is an important component of this project.

7.2.3 Impacts of climate change

Icelandic research institutions are involved in several projects studying the impact of future global climate changes. A key project in this regard was the Arctic Climate Impact Assessment (ACIA), organized by the Arctic Council, the results of which were presented at the ACIA International Scientific Symposium on Climate Change in the Arctic in Reykjavik, Iceland, 9–12 November 2004. The goal of ACIA is to evaluate and synthesize knowledge on climate variability, climate change, increased ultraviolet radiation and their consequences. The aim is also to provide useful and reliable information to the governments, organizations and people of the Arctic on policy options to meet such changes. ACIA examines possible future impacts on the environment and its living resources, on human health, and on buildings, roads and other infrastructure. More than 250 scientists and six circumpolar indigenous peoples' organisations participated in the ACIA. The main results were presented in two documents: a scientific document, a fully referenced and detailed scientific assessment report and a Synthesis/overview document, a popular version of the scientific document aimed at communicating the science and the traditional knowledge of climate change in the Arctic to the general public. Icelandic scientists, including from the IMO and the MRI, participated actively in the drafting of the ACIA.

Climate and Energy (CE) is a new Nordic research project with funding from the Nordic Energy Research, and follows up a previous project, entitled Climate, Water and Energy (CWE). The CE project has the objective of a comprehensive assessment of the impact of climate change on Nordic renewable energy resources including hydropower, wind power, biofuels and solar energy. This will include assessment of power production and its sensitivity and vulnerability to climate change on both temporal and spatial scales; assessment of the impacts of extremes including floods, droughts, storms, seasonal pattern and variability. These assessments should create an objective base for improved decisions concerning climate change and energy issues within the Nordic region. In addition to participating in this Nordic project, the National Energy Authority and others have also worked on a related research project, Weather and energy (2004–2007), that focuses specifically on the impact of weather and climate on hydro energy in Iceland.

The ITEX-project (International Tundra Experiment) is an international project that commenced in 1990, and aims to research the effects of climate change on Arctic and mountain flora. Two experimental sites were defined in 1995–1996, where regular observation on climate factors and flora have taken place. The Icelandic part of the project is run by the Icelandic Institute of

Natural History (IINH), the Agricultural University of Iceland (AUI) and IMO. SCANNET is an EU-funded project, consisting of a net of research stations on drylands around the North Atlantic, intended to enhance and coordinate research on the impact of climate change in that area; the IINH is part of the project and monitors a site in Iceland as part of the network.

Many other projects are run by IINH, AUI and others, that have the purpose of researching and monitoring the state of flora and fauna in Iceland and Icelandic waters, that are not always primarily intended to research impacts of climate change, but can be used for that purpose. A project monitoring flora, including mosses and lichen, at 100 sites on grazing lands in Iceland, can yield valuable information on the response of flora to both change in grazing patterns and climate change. Another project looks at the impact of afforestation projects on biological diversity, carbon cycles etc. at selected sites. The IINH has organized counting of birds in winter in Iceland since 1952, which gives important information about changes in their numbers and area, which is affected by climate. The University of Iceland hosts a research project on the sensitivity of highland tundra to changes in the environment, including climate. BIOICE, a big research project on benthal fauna in Icelandic waters, run by the IINH, the MRI, the University of Iceland and the township of Sandgerði, has yielded valuable information since its commencement in 1992 on the distribution of benthic fauna in Icelandic waters, which can be used to monitor changes in the future.

The MRI is preparing a research project on the movement of capelin in the waters around and north of Iceland, and how they are influenced by environmental change, such as ocean temperature, salinity etc. and the amount of phytoplankton and zooplankton. This project is considered of practical importance, given the importance of capelin in the Icelandic economy, but it would also be connected to an international research effort (ESSAS) on north-Atlantic ocean ecosystems, that will be part of the upcoming International Polar Year.

7.2.4 Socio-economic analysis

Academic research on how climate change could affect socio-economic factors has not been substantial. The report “Climate Change and its Consequences”, which was published in October 2000, provides some analysis of the possible social effects of climate change. In the year 2000, a government-appointed committee produced a report estimating the economic consequences for Iceland of participating in the Kyoto Protocol.

7.2.5 Carbon cycle and carbon sequestration studies

The Agricultural University of Iceland, Icelandic Forest Research (the research branch of the Iceland Forest Service) and the Soil Conservation Service are involved in studies focusing on carbon sequestration. They include projects on developing methods to estimate how much carbon is being restored with revegetation and afforestation, and research on carbon cycles in Icelandic ecosystems. Part of this research was directly funded by the government in order to estimate the sequestration of carbon in vegetation and soil in afforestation and revegetation projects. The data submitted to the UNFCCC on carbon sequestration in Iceland is largely based on the information gathered by this research.

The AUI has also engaged in several research projects on carbon cycles in natural and semi-natural vegetation areas. CONGAS was a European cooperation project, that analysed the role of wetlands in the balance of CH_4 and CO_2 in the Arctic area, with sample sites from Greenland in the west to central Siberia in the east. The results of the project showed inter alia that Icelandic wetlands emitted considerably less CH_4 than in other sample sites. Euroflux is another European cooperative project, assessing long-term change in the flow of carbon dioxide and water in European forests; the results are available in an international databank (Fluxnet). A three-year project assessed the CO_2 interaction between the most common vegetation types in Iceland and the atmosphere, using measurements on the ground and satellite data. Another project looked at the CH_4 and CO_2 balance of three types of wetlands: untouched, drained and reclaimed. One result of this research was to show that reclaimed wetlands can sequester carbon, while drained wetlands are big emitters of CO_2. An ongoing three year project run by AUI and funded by the National Power Company investigates the effects of reservoirs on GHG fluxes.

Icelandic Forest Research has been involved in a number of research projects on the effect of afforestation on the carbon balance, both on the national and international level. Such studies started in the mid to late 1990s, through cooperation between IFR, the present AUI and foreign universities. At that time, a number of Canadian-Icelandic, Nordic and European research projects took place in an experimental forest in southern Iceland. During 1997–2000, the carbon sequestration potential of the main tree species used in Iceland was evaluated with harvest measurements and soil sampling. This work was a part of a governmental action plan at that time on increased carbon sequestration by afforestation and revegetation. Research and systematic observation on carbon stocks in forests and woodlands in Iceland continues to be carried out by IFR, within the project "Icelandic forest inventory". This project has received direct financial support from the government and parliament of Iceland since 2001. Researchers involved in this project are collaborating with colleagues in this field at the European level (COST-actions) and Nordic level (SNS research networks). The results of this work to date suggest that an equivalent of 5% of the total, current annual GHG emissions from Iceland is annually sequestered in 'Kyoto-forests', i.e. forest sinks established after 1990.

In 2002–2005 IFR led a large national research project, ICEWOODS, where carbon sequestration of both aboveground and belowground was estimated for forest stands of different age (10–50 years) by harvest measurements and soil sampling. This work also became a part of a Nordic Centre of Excellence (NECC; Nordic Centre for Studies of Ecosystem Exchange and its Interactions with the Climate System). Currently, there is ongoing research comparing three different ways to estimate carbon sequestration in afforestation areas: a) direct measurements by eddy covariance technique, b) modeled carbon uptake and efflux by simulation models and c) carbon sequestration estimated by harvest measurements and soil sampling. In 2003–2006 another project was launched in southern Iceland, where the effect of forest management (fertilisation and precommercial thinning) in young forests on carbon stock and carbon sequestration was evaluated.

The University of Iceland and the National Energy Authority, in cooperation with French researchers, have studied the role of river-suspended material in the global carbon cycle, which have been published in the journal Geology. The reaction of Ca derived from silicate weathering with CO_2 in the world's oceans to form carbonate minerals is a critical step in long-term climate moderation. Ca is delivered to the oceans primarily via rivers, where it is transported either as dissolved species or within suspended material. A field study to determine these fluxes was performed on 4 catchments in northeastern Iceland. The results indicate inter alia that chemical weathering in Iceland results in significant sequestration of carbon from the atmosphere.

While the research discussed in the preceding paragraphs is mainly on natural carbon cycles, they can have policy implications. Huge wetland areas in the lowlands in Iceland were drained with government support in the decades after WWII. The draining had almost come to a stop in 1990, but some of the drained wetlands are used for cultivation or grazing, while others have been abandoned by agriculture. A small programme started some years ago aiming to reclaim drained wetlands. Research results on the carbon balance of Icelandic wetlands contributed to a proposal in a draft action plan on sustainable development, due to be adopted in 2006, to increase the government's emphasis on reclaiming wetlands, citing carbon sequestration benefits in addition to biological diversity concerns. This new emphasis on carbon sequestration in reclaimed wetlands will be part of a general emphasis on the enhancement of carbon sinks in Icelandic climate mitigation policy, which is one of the underlying objectives of the current Icelandic government's afforestation and revegetation policy. Carbon sequestration by chemical weathering in Iceland is a natural phenomenon, but the extensive human-induced soil erosion in the past could be a factor in the magnitude of the sequestration. Likewise, hydro projects could possibly affect the role of river-suspended material in the carbon balance. The interaction of natural and human-induced emissions from land and sequestration of carbon continues to be a focus in climate-related research.

The MRI is engaging in the EU-funded project Atlantic Network of Interdisciplinary Moorings And Time series for Europe (ANIMATE), that aims to measure the flux of CO_2 between the atmosphere and the ocean, and to develop the use of buoys for real-time measurement of environmental factors.

7.3 Systematic observation

The two institutions most important for the observation of climate change are the Icelandic Meteorological Office (IMO) and the Marine Research Institute (MRI). Other institutions monitor changes in natural systems that are affected by climate change, notably the Icelandic Institute of Natural History (IINH), which monitors the state of flora and fauna in Iceland.

7.3.1 Atmospheric climate observing systems

The IMO is responsible for atmospheric climate monitoring and observation. The IMO monitors and archives data from close to 200 stations. These stations are either manual (synoptic, climatological and precipitation stations) or automatic. The number of synoptic stations in operation (45) has been relatively constant over the last 40 years. The observations are distributed internationally on the WMO GTS (Global Telecommunication System). The manual precipitation network has been steadily expanding and now consists of about 70 stations measuring precipitation daily in addition to the synoptic stations. The majority of the precipitation stations report daily to the IMO database. The automation of measurements started in Iceland in 1987, and the number of automatic stations has been rapidly growing since then. The IMO now operates about 70 stations and about 35 in addition to this in cooperation with the National Power Company, The Energy Authority and the Maritime Administration. A repository of data from the about 50 stations operated by the Public Roads Administration is also located at the IMO. A majority of automatic stations observe wind and temperature every 10 minutes, a few once per hour, and most transmit data to the central database every hour. Many stations also include humidity, pressure and precipitation observations, and a few observe additional parameters (shortwave radiation and ground temperatures) or observe at more than one level.

The IMO participates in the Global Atmospheric Observing Systems (GAOS). The IMO has participated in the MATCH ozone-sounding program during the winter months since 1990, and the data are reported to the International Ozone Data base at NILU, Norway. The three GAW stations are: the BAPM at Írafoss and Stórhöfði, where tropospheric ozone, carbon dioxide, methane and isotopes of oxygen and carbon are monitored in cooperation with NOAA. Heavy metals and Persistent Organic Pollutants (POPs) in air and precipitation are monitored and reported to AMAP and OSPAR. In Reykjavik, data on global radiation are collected and reported annually to the World Radiation Data Center in St. Petersburg (WRDC).

7.3.2 Ocean climate observing systems

Both the IMO and the Marine Research Institute (MRI) contribute to ocean climate observations. The IMO does not operate any Icelandic drifting or moored buoys, but as members of EGOS (European Group on Ocean Stations), which is an organization operating 50 meteorological drifting buoys and 11 moored buoys in the North-Atlantic at any time, it supports a very important meteorological network. The Marine Research Institute (MRI) is a member of the International Council of Exploration of the Seas (ICES) and through that membership contributes to the GOOS (Global Oceanic Observing System). The MRI maintains a monitoring net of about 100 hydrobiological stations on 12 standard sections (transects) around Iceland. These stations are monitored four times per year for physical and chemical observations (phosphate, nitrate, silicate) and once a year for biological observations (phytoplankton, zooplankton). Some of these stations have been monitored since around 1950. The zooplankton biomass monitoring has demonstrated fluctuations, which to some extent appear to be linked to climate and circulation changes. The MRI has monitored carbon dioxide at selected stations for about 20 years and maintains a grid of about 10 continuous sea surface temperature meters at coastal stations all around the country.

The MRI is involved in several monitoring projects of ocean currents, in cooperation with European and American scientists. These projects include the Meridional Overturning Exchange with the Nordic seas (MOEN), the Arctic-Subarctic Ocean Flux-array for European climate: West (ASOF-W) and the West-Nordic Ocean Climate, which all involve the monitoring of ocean currents strength and other environmental factors. The University of Akureyri is a partner in some of these ocean current research.

7.4 Research on mitigation options and technology

Several research projects deal with issues related to mitigation options and technology. The most important of these involve renewable energy and alternative fuels, notably hydrogen, and carbon sequestration by afforestation, revegetation and wetland reclamation (see above).

Icelandic energy institutions and companies are active in research on renewable energy exploitation and technology. One notable research project on geothermal energy, which could have a potentially great impact on the exploitation of geothermal in Iceland and worldwide, is the Iceland Deep Drilling Project (IDDP). The main purpose of the IDDP project is to find out if it is economically feasible to extract energy and chemicals out of hydrothermal systems at supercritical conditions.

An Icelandic energy consortium was established in the year 2000 around the IDDP. The consortium is composed of three Icelandic energy companies and the National Energy Authority of Iceland. The consortium is preparing the drilling of a 4–5 km deep drill hole into one of its high-temperature hydrothermal system to reach 400–600°C hot supercritical hydrous fluid at a rifted plate margin on a mid-ocean ridge. A feasibility report was completed in May 2003.

ICDP (International Continental Scientific Drilling Program) granted financial supports to organize the scientific program. As a result of two workshops on drilling technology and science IDDP has received approximately 60 active research proposals from the international scientific community, which range from petrology and petrophysics to fluid chemistry, water rock reactions, surface and borehole geophysics and reservoir modeling. The first IDDP candidate well, RN-17, was drilled at Reykjanes in SW-Iceland in 2004–2005 down to 3082 m depth. Preparation is ongoing to deepen this well, or another candidate well at Reykjanes, down to 4 km depth in autumn 2006. The IDDP is a long term research and development project which will take at least a decade to conclude. As yet, IDDP is therefore not an alternative solution to meet energy demand in the near or intermediate future. In the longer term, however, the potential benefits of the IDDP regarding increased use of climate-friendly geothermal energy include:

- Increased power output per well, perhaps by an order of magnitude, and production of higher-value, high-pressure, high-temperature steam,
- Development of an environmentally benign, high-enthalpy energy source below currently producing geothermal fields,
- Extended lifetime of the exploited geothermal reservoirs and power generation facilities, and
- Re-evaluation of the geothermal resource base.

7.4.1 International hydrogen projects

The Icelandic government has offered political support to those interested in developing hydrogen as an energy carrier in the transport sector, which would greatly reduce GHG emissions from mobile sources. In 1997 the Ministry of Industry and Commerce appointed a special committee to explore available options for use of domestic renewable energy. Following this committee's work the government decided to offer Iceland as an international platform for hydrogen research and for that has created a specific policy which has 4 key elements.

- Favourable framework for business and research
- International cooperation
- Education and training
- Hydrogen research

As part of this policy the government has taken some large steps in implementing these policy measures. The government was a founding member of the International Partnership for the Hydrogen Economy (IPHE) and Iceland is also active in the European Hydrogen Platform. The government has also taken direct measures with the unique step of eliminating all import duties and VAT on hydrogen vehicles.

Following the work of the committee in 1997 all key stakeholders established a company called VistOrka to be the unifier of the Icelandic interest in hydrogen. VistOrka then joined forces with Daimler Chrysler, Norsk Hydro and Shell Hydrogen to form Icelandic New Energy which has been the key actor in creating the future hydrogen society. Still stakeholders in VistOrka are very active and currently are working towards establishing a joint Hydrogen Technological Center, which is to provide facilities for researchers, students and others which are currently working on various projects. Iceland is an ideal testing site for hydrogen projects because of the small size of society, the availability of renewable energy and the political commitment of the Icelandic government. These factors have drawn various different academics to do work in Iceland.

Icelandic New Energy (INE), in cooperation with its foreign partners, runs several research projects aiming to make it technologically possible and economically feasible to use hydrogen as an energy carrier in the transport sector and for fishing vessels. The research program of INE has received enormous international attention. The very ambitious overall goal of the program is to create the world's first hydrogen economy. This would mean that Iceland would become independent of imported oil since domestic, renewable energy sources can be used to produce hydrogen. The research program has several phases. The first phase is the ECTOS project. The objective of ECTOS is to implement a demonstration of state-of-the art hydrogen technology by running part of the public transport system in the capital with fuel-cell buses. The only emission from the vehicles is pure water and the whole energy chain is virtually emission free as the energy for the hydrogen productions, electrolysing water, will be almost free of CO_2 emissions because geothermal energy and hydropower will be used. The world's first hydrogen station was part of the program and was opened in April 2003, and the 3 fuel cell buses started in commercial use in October 2003. The partners in the project are extremely happy with the success, as the team has driven roughly 90.000 km, pumped over 17 tons of hydrogen and surveys indicate that more than 90% of the public is very positive towards using hydrogen as the future fuel instead of fossil fuels. Currently the second phase is being prepared which would be to introduce hydrogen private vehicles on the streets of Iceland. Following that the aim is to have an international demonstration project on marine applications of the hydrogen technology. The use of hydrogen is then expected to rise fairly fast in the next decade as the technology reaches maturity and becomes available on the market. Although INE is a private venture, the projects have received funding from public sources, such as the European Union and the Government of Iceland.

CHAPTER 8

EDUCATION, TRAINING AND PUBLIC AWARENESS

8.1 General education policy

The educational system in Iceland is administered by the Ministry of Education, Science and Culture. The Ministry prepares educational policy, oversees its implementation, and is responsible for educational matters at all educational levels. Education has traditionally been organized within the public sector, and there are very few private institutions in the school system. Almost all private schools receive public funding.

The educational system is divided into four levels. Pre-school is the first educational level and is intended for children below the compulsory age for education. Parents are free to decide whether their children attend preschool. In 2003 there were 267 pre-schools operated in Iceland. Compulsory Level is the second educational level. Children and adolescents aged 6-16 must by law attend 10 years of compulsory education. Upper Secondary Level is the third educational level. All those who have completed their compulsory education or equivalent have the right to study at the upper secondary level. This generally incorporates the age group 16–20.

8.2 Environmental education

The public's knowledge and understanding of environmental issues in general is a necessary prerequisite for democratic discussion and decision-making in the field of environmental protection and management. Environmental education in schools has increased in the past decade, from nursery schools to universities. The University of Iceland now offers a Master's degree in environmental studies, and many secondary schools and professional schools offer courses in the field of environmental studies, or place a special emphasis on environmental issues in their curriculum. Studies of environmental issues in primary schools are included in many subjects, especially natural sciences but also in subjects such as life skills and home economics. In addition many schools have shown initiative in harmonizing environmental education and general education. However, it should be noted that environmental education is not a part of the curriculum of primary schools as a separate subject, according to the General Curriculum from 1999. Therefore environmental education in schools can be strengthened further and made more efficient.

The Eco-School Programme is an international project that Landvernd, an Icelandic environmental NGO, participates in and oversees its implementation in Iceland. The preparation for the Eco-School Programme started in September 2000 when a special eco-school working group was established. This working group now acts as the Eco-school steering committee. It has six members, including representatives for the Ministry for the Environment and the National Teachers Association. Twelve schools participated in a pilot programme, which formally started in 2001. Since January 2002 the Programme has been open to all elementary schools in Iceland, as well as kindergartens that are linked to elementary schools. About 40 elementary schools have entered the programme (out of 200 schools in Iceland), 20 kindergartens and 2 high schools. Today, 25 schools have received the Green Flag. The programme is financially supported by the Ministry for the Environment and the Ministry of Education, Science and Culture.

Museums play an important role in education. Museums and exhibitions on natural sciences, culture and industrial structure have been established around the country in recent years, promoting increased public awareness of the relationship between mankind and nature. Regional Environmental Research Institutes have also been established in many places around the country in cooperation between the government and municipalities. These Institutes play a role in education as well as in research. In 2006 the Icelandic Institute of Natural History will set up an exhibition focusing on climate change.

8.3 Public access to resources and information

General discussion of environmental issues, including disseminating information to the public through the media and the Internet, has increased considerably in recent years. The Ministry for the Environment and the Environmental and Food Agency have information on climate change on their websites, including information about greenhouse gas emissions in Iceland as well as a general explanation of the causes and consequences of climate change. The Environmental Education Board, which has representatives from both the environmental and education sector, has initiated a website with links to information in Icelandic about various environmental issues. The Board has also reached an agreement with the University of Iceland to include a special section on the environment on the so-called "Web of Science". This is a website where the public can ask questions, and scientists and researchers at the university provide the answers.

In 2005 a new environmental education website, "My World" was launched. My World has the aim to aid environmental education for students at compulsory level, as well as making environmental information more accessible to the general public. My World has three levels, the first level is for the age group 6–9, the second level is for the age group 10–12 and the final level is for the age group 12–15. My World has over 200 pages of text, pictures and video files on different environmental topics, including waste, energy, environmental protection and climate change. My World is a cooperative project between the Environment and Food Agency and The National Centre for Educational Materials.

8.4 Involvement of non-governmental organizations

Non-governmental organizations play an important role in disseminating information to the public. Environmental NGOs run several projects that are instrumental in raising environmental awareness. One project especially relevant to climate change is "Global Action Plan" (GAP). This is an international project that Landvernd, an Icelandic environmental NGO, participates in and oversees its implementation in Iceland. GAP is a project where small groups of 5–8 people follow a special eight-week program where five subjects are on the agenda. These subjects are: waste, energy, transport, shopping and water. Each group has a leader who has received special training. The goal of the project is to make people aware of how their actions in daily life influence the environment, and how simple changes can make a difference. The Ministry for the Environment supports the project financially.

Iceland's Report on Demonstrable Progress

Under the Kyoto Protocol

SUMMARY

Iceland expects to meet its commitments and targets according to the Kyoto Protocol. Policies and measures undertaken so far to reduce emissions of greenhouse gases are estimated to have led to 95 Gg less emissions in 2005 than business-as-usual, and to lead to 200–226 Gg less emissions than business-as-usual in the first commitment period under the Kyoto Protocol 2008–2012. The most effective measure in curbing GHG emissions so far is the reduction in emissions of PFCs from aluminum smelters, but reductions are also expected as a result of measures to encourage the use of small diesel cars over gasoline cars, and from the collection of methane from the largest landfill in Iceland. The increase in carbon sequestration by afforestation and revegetation since 1990 will amount to 207 Gg in 2005 and an estimated 207 Gg per year in 2008–2012. The total effect of measures is therefore estimated at a net reduction of GHG emissions by 302 Gg in 2005 and 407–433 Gg in 2008–2012. The effect of some other key measures in reducing emissions from domestic transport and the fishing fleet has not been estimated, because of uncertainties of their potential effect. Despite this, it is hoped that these measures will actually contribute to reducing emissions in these sectors in the coming years.

Iceland has been in the process of improving its greenhouse gas inventory. A draft legislation introduced in 2006 is intended to strengthen the inventory further and serve as the basis for a national system, in accordance with the demands of Article 5.1 of the Kyoto Protocol. Iceland has not adopted a national adaptation strategy for climate change, but the design of new harbours takes into account likely rise in sea level, and several research projects have analysed the possible impact of climate change on Icelandic nature, economy and society. Iceland is engaged in the transfer of climate-friendly technology and know-how, notably with the operation of the UN University Geothermal Training Programme, which has been strengthened in recent years.

ICELAND´S CLIMATE POLICY

Iceland is a party of the UNFCCC, and ratified the Kyoto Protocol on May 23, 2002. Iceland's obligations according to the Kyoto Protocol are as follows:

- For the first commitment period, from 2008 to 2012, the greenhouse gas emissions shall not increase more than 10% from the level of emissions in 1990.
- For the first commitment period, from 2008 to 2012, the mean annual carbon dioxide emissions falling under decision 14/CP.7 on the "Impact of single project on emissions in the commitment period" shall not exceed 1,600,000 tons.

In 2002 the government adopted a new climate change policy. The aim of the policy is to curb emissions of greenhouse gases so that they will not exceed the limits of Iceland's obligations under the Kyoto Protocol. A second objective is to increase the level of carbon sequestration resulting from reforestation and revegetation programs. A review of this policy was started in 2005, and is due to be concluded in 2006. It is overseen by an inter-ministerial committee, with members from eight ministries, headed by the Ministry for the Environment.

The current policy lists a number of measures to be implemented. The main elements of the policy are:

- Changes in taxation creating incentives to use small diesel cars.
- Lowering of import fees on no-emission and low-emission vehicles
- Ensuring that PFC emissions from aluminum smelters will be minimized.
- Encouragement for the fishing industry to increase energy efficiency.
- Further reduction of waste disposals, especially in terms of organic waste.
- Increasing annual carbon sequestration.
- Increased research and development.
- Increased emphasis on information and public awareness.

These priorities reflect Iceland's emission profile. As about 70% of Iceland's energy, and virtually all stationary energy production, comes from renewable sources – hydro and geothermal – there is no room to target this sector, which is the main target sector for emissions reduction in many other countries. The emphasis on control of greenhouse gas emissions must primarily focus on the three biggest sources: transport, the fishing fleet and industrial processes.

The first two points deal with the transport sector, source of 19% of emissions in 1990 and 20% of emissions in 2003. They both are economic incentives, that aim to encourage the buying and use of low-emission vehicles over higher-emission vehicles. Owners of diesel cars paid a special tax every year, depending on the weight of their vehicle, with a choice of paying a fixed tax or a mileage tax. In July 2005, this system was scrapped in favour of a simple tax on diesel fuel, which was set at a level so that it would lower the total tax burden for the average owner of a diesel car. The reduction of import fees on vehicles using low-pollution engines has been implemented in two steps, the second one in 2005. Today, low- or no-emission vehicles, such as electric vehicles or hydrogen-powered vehicles, are exempted from paying import fees, which are 45% on most passenger cars. This exemption is valid until 2008, and can be renewed at that date. Vehicles with hybrid engine cars and methane-powered vehicles pay around US$ 3200 less in import fees than other cars, a rebate valid at least until the end of 2006.

The third point relates to the aluminum industry, an important and growing economic sector in Iceland. While the energy used for aluminum production – normally the biggest source of emissions in the process – produces low or almost zero emissions in Iceland, there are emissions of CO_2 and PFCs from the industrial process of aluminum smelting. The emissions of carbon dioxide are a constant factor in the process, and are difficult to limit. Emissions of PFCs, on the other hand, can vary much, depending on the process and efforts to limit so-called anode effects. It is therefore imperative to keep the emissions of PFCs as low as possible. Great progress has been achieved in this area through a co-operative approach between the government and the aluminum industry. The share of industrial process emissions from the aluminum industry and other industrial processes in total GHG emissions in Iceland was 26% in 1990, and 27% in 2003.

The fourth point relates to emissions from the fishing industry. Iceland is the 12. largest fishing nation in the world, exporting nearly all its catch. The marine sector is one of the main economic sectors and the single biggest export sectors in Iceland. The fishing fleet was responsible for 20% of emissions in 1990 and 19% in 2003. The government has supported through its research policy the development of energy-saving technology for ships, and has bought energy-saving systems in two government-owned ships.

Emissions from waste disposal, essentially of methane from landfills, was 4% of total GHG emissions in Iceland in 1990 and 6% in 2003. Methane is collected from the largest landfill in the country, serving all of the greater Reykjavík area, since 1997. Currently, about 50 vehicles are run on methane from the landfill, while the rest is burned, resulting in less GHG emissions than before. A new government waste strategy plans for reduced disposal of waste, especially organic waste, which should further reduce emissions.

Carbon sequestration is a key element of Iceland's climate change strategy. Revegetation and reforestation have been a high priority in Iceland, as the country has suffered from a big soil erosion problem for centuries. There is significant potential to enhance carbon sequestration beyond the present level. In 1996 the Icelandic government announced its decision to allocate ISK 450 allocate million (around US$ 8 million) for a four-year program of revegetation and tree planting to increase the sequestration of carbon dioxide. This program was implemented in 1997–2000.

Some research and development activities aim to encourage low- or no-emissions technology. Included in this are experiments with alternative energy that could replace fossil fuels, as well as research on fuel cells and hydrogen as energy carrier. Iceland's hydrogen project has created significant interest. The development of hydrogen technology in vehicles is mostly in the hands of industries outside Iceland, but there are hydrogen-powered buses running in the Reykjavík area, and Iceland hopes to have the infrastructure in place to take advantage of hydrogen as it becomes commercially viable.

The government supports some projects organized by environmental NGOs, whose aim is to encourage environmentally responsible behavior. Information about ways consumers can reduce GHG emissions in their everyday lives is integrated into these projects, dealing with issues such as minimizing waste, altering travel habits and increasing fuel efficiency.

Other policies in the climate change strategy have less impact, but they include: Shortening of travel distances with the construction of new roads and tunnels; strengthening of public transport in Iceland; and increased coordination of traffic lights.

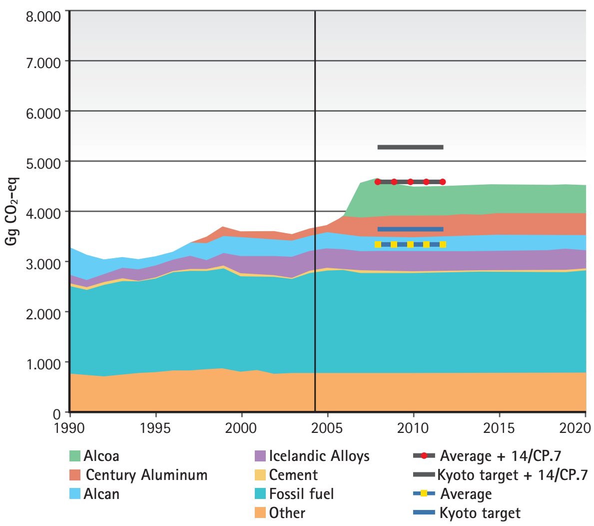
CHAPTER 2

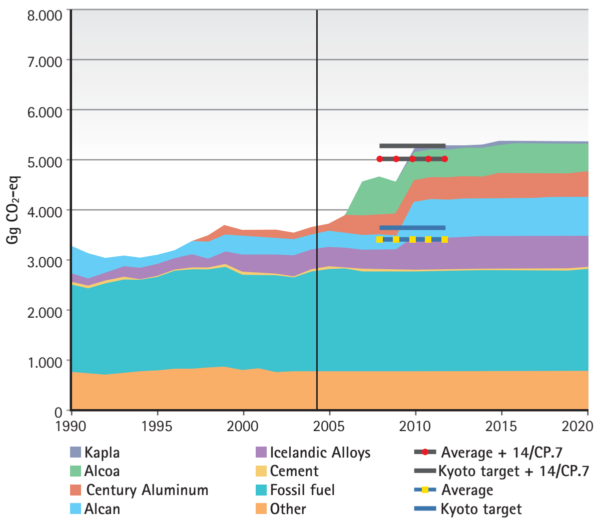
TRENDS AND PROJECTIONS OF GREENHOUSE GAS EMISSIONS

Projections for greenhouse gas emissions until 2020 have recently been produced by the Environment and Food Agency, in cooperation with the Energy Forecast Committee, which represents companies, institutions and organizations involved in the energy sector. The projections described in this chapter are based on the energy forecast for fossil fuels that was published in September 2005. Two scenarios are provided in the projections, depending on the level of increase in new energy-intensive industry in Iceland until 2020.

Scenario 1 assumes no additions to energy-intensive industries other than those already in progress in 2004/2005, meaning the enlargement of the Century Aluminum plant and the building of the Fjarðaál aluminum plant in the eastern part of Iceland.

Scenario 2 is based on the assumption that all energy-intensive projects which currently have an operational license will be built, which means four new projects in addition to the two projects already included in scenario 1: an enlargement of the Alcan aluminum plant in Straumsvík, an enlargement of the Icelandic Alloys ferrosilicon plant in Hvalfjörður, a further enlargement of the Century Aluminum plant, and the building of an anode production plant in Hvalfjörður. It should be noted that the fact that these projects do have an operational license does not automatically mean that they will be built.





Scenario 1	Gg CO_2-eq	Kyoto target
Average emissions of greenhouse gas, 2008–2012	4,519	13% under
Average emissions of greenhouse gas not including emissions falling under Decision 14/CP.7, 2008-2012	3,294	9% under
Total emissions in 2012	4,481	37% increase from the 1990 level
Emissions in 2012, not including emissions falling under Decision 14/CP.7	3,249	1% decrease from the 1990 level
Total emissions in 2020:	4,519	38% increase from the 1990 level

Scenario 2	Gg CO_2-eq	Kyoto target
Average emissions of greenhouse gas, 2008–2012	4,959	5% under
Average emissions of greenhouse gas not including emissions falling under Decision 14/CP.7, 2008–2012	3,360	7% under
Total emissions in 2012	5,236	60% increase from the 1990 level
Emissions in 2012, not including emissions falling under Decision 14/CP.7	3,344	2% increase from the1990 level
Total emissions in 2020:	5,335	63% increase from the 1990 level

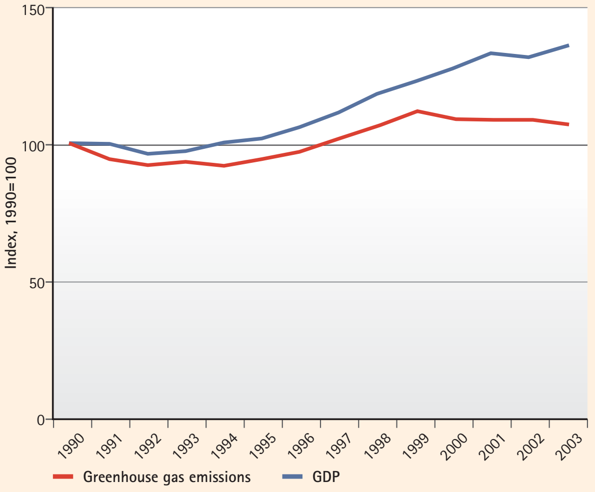
If emissions are in accord with projections, Iceland will be able to meet its obligations for the first commitment period of the Kyoto Protocol, even with the planned expansion in energy-intensive industries in Scenario 2. The scenarios are calculated excluding estimations on carbon sequestration by afforestation and revegetation, which according to predictions will reduce net emissions approximately 207 Gg annually in 2008–2012.

It should be noted that discussions are under way about the construction of two additional new aluminum smelters in Iceland. These smelters do not, as of yet, have an operational license, and no decision has been taken on their construction. If it is decided that they shall be built, it will be necessary for the government to consider additional measures to ensure that Iceland will meet its Kyoto commitments. It is estimated that Iceland will actually meet its target for the first commitment period 2008–2012, even if these smelters are built, but they could bring Iceland very close to the target, and caution will have to be employed.

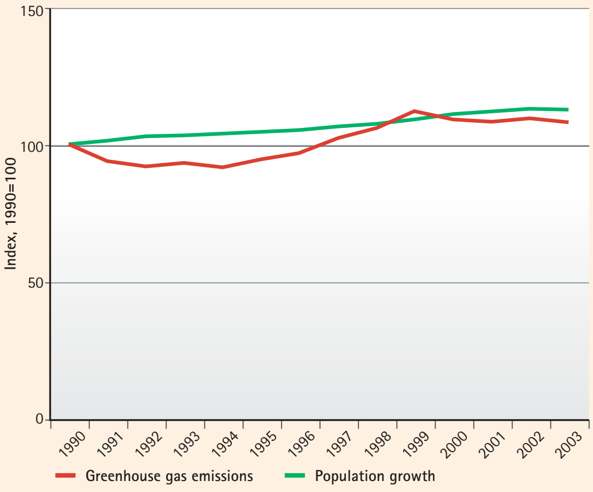
Decoupling greenhouse gas emissions

Total greenhouse gas emissions in Iceland increased by 8% in the period 1990 to 2003. At the same time however, the Icelandic economy experienced substantial growth. Emissions per GDP (gross domestic product) therefore decreased by 20% in the period 1990 to 2003. Economic growth has therefore been decoupled from emissions of greehouse gases.

The population of Iceland increased from 256 thousand to 290 thousand between 1990 and 2003. The total greenhouse gas emissions in Iceland increased by 8% in the same period, but since the population grew, per capita emissions fell from 12.8 to 12.2 tons of carbon dioxide equivalent per person per year between 1990 and 2003, or by 5%. Icelandic emissions per capita are close to average in comparison with other industrial countries, but significantly higher than in many developing countries.



Greenhouse gas emissions and the development of GDP



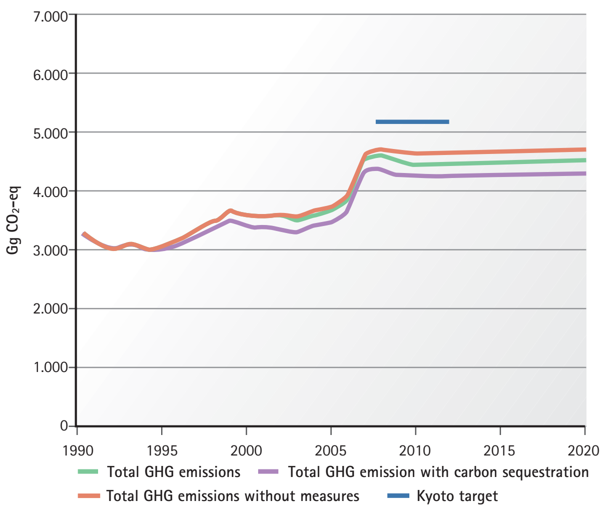
Greenhouse gas emissions and the population growth

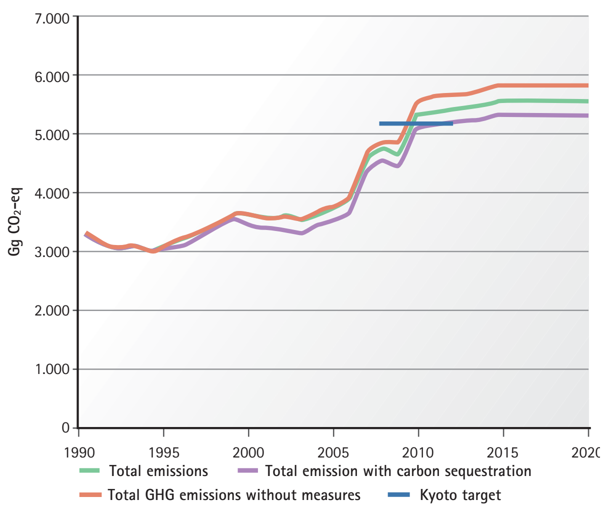
EFFECTS OF POLICIES TOWARDS REACHING KYOTO TARGETS

As shown in Chapter 2, it is expected that Iceland will meet its commitments under the Kyoto Protocol, under both the scenarios presented there. It is difficult to estimate what the contributions of policies and measures to curb GHG emissions and increase carbon sequestration will be in the first commitment period in 2008–2012, as these depend on the assumptions made on how business-as-usual would have been. The margin of uncertainty in such calculations is especially great in the case of emissions of PFCs from aluminum smelting, a big source of GHG emissions in Iceland. An attempt to quantify the effect of policies and measures is presented in the following two graphs and table. The graphs present scenario 1 and 2, with and without carbon sequestration and without measures. This is then further discussed in the following subsections.

3.1 Transport

The effect of the two first measures in the table, creating incentives for people to buy and use lower-emission and no-emission vehicles for transport is very small to date, and is not projected to be great in the first commitment





Measure	Annual net reduction of emissions in 2005, compared to business-as-usual	Annual net reduction of emissions in 2008–2012, compared to business-as-usual
Changes in taxation creating incentives to use small diesel cars	0	9 Gg (from 2010)
Lowering of tariffs on no-emission and low-emission vehicles	Not estimated	Not estimated
Consultation process with aluminum smelters to ensure the minimization of PFC emissions from the aluminum industry	65 Gg	161 Gg (Scenario 1) 187 Gg (Scenario 2)
Encouraging the fishing industry to increase energy efficiency	Not estimated	Not estimated
Further reduction of waste disposals, especially in terms of organic waste	Not estimated	Not estimated
Collection of landfill gas for energy recovery	30	30
Increasing carbon sequestration	207 Gg	207 Gg
TOTAL	302 Gg	407 Gg (Scenario 1) 433 Gg (Scenario 2)

period. Part of the reason for this is that the measures are recent, the change in taxation in diesel only took effect in mid-2005, and can hardly be expected to bring great changes immediately. It is expected to lead to a gradual increase in the use of diesel-powered vehicles at the expense of gasoline-powered vehicles, so that diesel cars will have about 10% greater market share on average during the first commitment period 2008–2020, than they would have had without this measure. This is expected to yield reductions of about 9 thousand tons per year on average in 2008–2012.

No estimate is made with regard to the effect of the other measure in the transport sector, the lowering of import fees on low- and no-emission vehicles. To date, only a few dozens vehicles that fall under the categories of the tax exemptions have been imported to Iceland, yielding very small reductions in GHG emissions. These measures could start having a greater impact in the future, but it has to noted that they are temporary exemptions, due to end in 2006 and 2008, respectively. Of course, it is possible that they will be extended, for example in connection with the review of Iceland's climate policy, due to conclude in 2006. The fact that this is not certain to date, and the difficulty to predict what effect these measure could have in the future if extended, are the reasons that no attempt is made to estimate their effect on lowering emissions in the first commitment period. This is to err on the side of caution, but it is hoped that these measures will actually start to have a measurable effect in the coming years, with a predicted greater supply of low- and no-emission vehicles, the likelihood of continuing high fuel prices, and growing environmental awareness among customers. The fact that no quantitative estimate is made of GHG emissions under this category does not mean that this measure is considered unimportant, or that it is not hoped that it will begin to have a significant positive impact in some years.

3.2 Industrial processes

The 2002 climate change strategy sets the goal of PFC emissions from aluminum smelters at 0.14 tons of CO_2 equivalents. This can be seen as an ambitious goal, since the results of the 2003 analysis by the International Aluminium Institute show that the median emission level for aluminum smelters is 0.38 tons of CO_2 equivalents, and the average number is still higher. The 2003 survey is the sixth in a series of surveys conducted by the International Aluminium Institute, covering anode effect data from global aluminum producers over the period from 1990 through 2003. The 0.14 tons of CO_2 equivalents target has been achieved, following a consultation process between the government and the aluminum industry. The aluminum plants have achieved their goal by improving technology in continuing production, and by introducing Best Available Technology in new production. PFC emissions from the aluminum smelter in Straumsvík has decreased by over 40% from 1990 to 2003, despite production going up at the same time by more than 70%. PFC emissions from the Norðurál smelter in Hvalfjörður, are today less than 0,14 tons of CO_2 equivalents per ton of aluminum.

It is difficult to estimate how much lower emissions are today than they would have been with business-as-usual. One way would be to use the PFC emissions per ton of aluminum from the Straumsvik plant in 1990, and continue to use that rate for later years for both that plant and new plants, and compare it with actual data. This would yield a huge calculated benefit. This method would, however, be questionable, as emissions per ton would most probably have decreased because of new technology and demands for reduced PFC emissions for other reasons than their global warming potential. It is doubtful, though, that the reductions would have been as great as is the case without the climate change policy. One way to estimate emission savings is then to compare the median emission levels from the 2003 analysis by the International Aluminium Institute with the Icelandic data from 2003 and estimates of PFC emissions in 2008–2012. These calculations show a net saving of 65 Gg in 2005 and projected 161–187 Gg in annual net reduction of emissions in 2008–2012.

3.3 Fishing industry

The fishing industry claims that it hardly needs extra incentives to reduce fuel consumption, in the economic circumstances it operates in Iceland. The industry does not receive government subsidies, unlike its competitors in many countries in Europe and elsewhere. Also, the system of individually transferable quotas should lead to fuel-saving and lower emissions, it is argued, as each company aims to get its quota in the most economical way; while time limitation of fisheries, to take an example of another common way of fisheries management, has a built-in incentive for vessels to spend as much time at sea as possible in the time allocated.

The government has in light of this not put great effort into direct actions aimed at lowering emissions from the fishing fleet. There has, however, been government support, through research funding and public procurement, for the development and introduction of a fuel-saving system for fishing vehicles and other ships, that has been developed by an Icelandic company. This fuel-saving system has inter alia been put in a new research vessel of the Marine Research Institute, and will also be introduced in a new coast guard ship. Early results show that savings of 10% or more in fuel use and emissions are possible with the fuel-saving system. This and other technologies thus have a potential to significantly reduce emissions from ships. It is, however, considered too early to make firm estimations on such potential reductions.

3.4 Waste

The most important measure is the collection of methane from the largest landfill in the country, serving all of the greater Reykjavík area, which started in 1997. The government climate change policy states the goal of further reducing waste disposal, especially in terms of organic waste. No estimation has been made on the potential reduction of GHG emissions because of this strategy. A second objective of the climate change policy is to increase the collection of landfill gas for energy recovery and environmental control. Currently, SORPA, an independent waste management firm owned by Reykjavik city and six other municipalities, collects methane from Reykjavik-area landfill and processes it for car fuel, and burns it for electricity production. Currently, about 50 vehicles are run on methane from the landfill, but it is estimated that the gas from the landfill could power 4,000–6,000 cars annually.

3.5 Carbon sequestration

In 1996 the Icelandic government announced its decision to allocate ISK 450 million for a four-year program of revegetation and tree planting to increase the sequestration of carbon dioxide in the biomass. This program was implemented in 1997–2000. The stated goal was an increase of 22,000 tons in carbon sequestration. Assessment of the results of the program indicates that the total additional sequestration was 27,000 tons. Although this four-year program is over, efforts to increase the annual carbon sequestration rate resulting from reforestation and revegetation programs will continue in the future. It is estimated that measures taken will increase annual carbon sequestration by about 200 Gg in the first commitment period 2008–2012.

3.6 Other measures

The effect of other policies and measures than those mentioned above is estimated to be small, and no attempt is made to quantify it. One measure that has attracted some interest in Iceland and beyond is Iceland's research and development projects in the field of hydrogen fuel. The government has decided to offer Iceland as an international platform for hydrogen research. One part of this policy is the ECTOS project, which aims to demonstrate state-of-the art hydrogen technology by running part of the public transport system in the capital with fuel-cell buses. The effect of this project so far in lowering total emissions is small, but the overall aim of Icelandic hydrogen research is not to bring short-term results, but to prepare Iceland for a transition to hydrogen in the long term, when it becomes commercially viable. By demonstrating to the public that using hydrogen-powered vehicles is possible, and by preparing the necessary infrastructure, and by working on various research projects dealing with the production and use of hydrogen, Iceland hopes to be in the forefront of countries utilizing hydrogen in the future.

MEASURES TO MEET OTHER COMMITMENTS UNDER THE KYOTO PROTOCOL

4.1 Greenhouse gas inventory and national system

The Environment and Food Agency of Iceland (EFA), an agency under the Ministry for the Environment, compiles and maintains the national greenhouse gas inventory. EFA reports to the Ministry for the Environment, which reports to the Convention. EFA collects the bulk of data necessary to run the general emission model, i.e. activity data and emission factors. Activity data is collected from various institutions and companies, as well as by EFA directly. The Agricultural University of Iceland (AUI) receives information on recultivated area from the Soil Conservation Service of Iceland and information on forests and reforestation from the Icelandic Forest Service. The National Energy Forecast Committee (NEFC) collects annual information on fuel sales from oil companies. Statistics Iceland provides information on imports of solvents, use of fertilizers in agriculture and imports/exports of fuels. Annually a questionnaire is sent out to the industry in regard to imports, use of feedstock, and production and process specific information. EFA estimates activity data with regard to waste.

In 2004 the UNFCCC secretariat coordinated an in-country review of the 2004 greenhouse gas inventory submission of Iceland. The expert review team concluded that the Icelandic emissions inventory is largely complete and mostly consistent with the UNFCCC reporting guidelines. However, the expert review team noted some departures from the UNFCCC guidelines and a lack of more formal national inventory procedure. Based on the in-country review report, some important improvements have already been implemented, and a work plan has been established for improvements that will inevitably take longer time than one year to implement. Improvements that have already been implemented on the basis of the review include:

- N_2O and CH_4 emissions from fuel combustion of various combustion sources have been estimated.
- N_2O emissions from solvent and other product use have been estimated.

Improvements that are planned include:

- Iceland has until now not prepared a national energy balance. Following the recommendations from the in-country review team, Iceland will now start preparing annually a national energy balance.
- The Ministry for the Environment, in close co-operation with other relevant ministries has drafted a bill on the institutional and legal framework to further strengthen the Icelandic climate change policy. It is hoped that this bill can be adopted as legislation by the Icelandic Parliament in the first half of 2006. This impending legislation is seen as a basis for a national system, in accordance with the demands of Article 5.1 of the Kyoto Protocol.

4.2 Adaptation measures

Climate change measures adopted in Iceland primarily aim at mitigation of climate change, while emphasis on adaptation measures has been minimal. No national strategy for adaptation to climate change in Iceland has been produced to date. One example of an adaptation measure is that expected sea level rise has already been taken into account in the design of new harbours in Iceland. Also, an analysis of likely impacts of climate change on nature and society in Iceland was published in 2003, and some research projects have been conducted to produce such analysis in certain fields.

4.3 Cooperation in research and technology transfer

Iceland is engaged in a number of research activities, as is described in Chapter 7 of Iceland's 4th national communication to the UNFCCC. Iceland most notable contribution in the field of technology transfer is the operation of the UN University Geothermal Training Programme.

Iceland is a leader in the development of geothermal technology and the utilization of geothermal energy, and considers it a priority in its development policy to support the Geothermal Training Programme, along with a corresponding programme in Fisheries. The training programme provides experts from developing countries with an opportunity to engage in specialised studies in geothermal energy matters in Iceland. The Government of Iceland funds approximately 85% of the activities of the training programmes in Iceland. The Government has reinforced this programme in order to enable it to accept a greater number of students. Funds have also recently been provided for the Programme to hold training courses in Africa and Asia.

ANNEX A

Iceland: National greenhouse gas inventory 2003 – summary and trend tables

Excerpt from the Icelandic 2005 greenhouse gas inventory submission to the UNFCCC secretariat. For the full inventory, see http://unfccc.int, National reports, GHG Inventories (Annex I).

TABLE 10 EMISSIONS TRENDS (CO_2)
(Sheet 1 of 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
1. Energy	**0,00**	**1.672,56**	**1.626,52**	**1.751,21**	**1.811,54**	**1.775,22**	**1.776,42**	**1.869,62**	**1.915,47**	**1.877,33**	**1.906,72**	**1.808,95**	**1.781,97**	**1.854,15**	**1.796,72**
A. Fuel Combustion (Sectoral Approach)	0,00	1.672,56	1.626,52	1.751,21	1.811,54	1.775,22	1.776,42	1.869,62	1.915,47	1.877,33	1.906,72	1.808,95	1.781,97	1.854,15	1.796,72
1. Energy Industries		20,70	22,28	21,29	22,35	22,22	24,61	20,00	15,27	37,64	20,64	14,41	14,54	15,13	14,07
2. Manufacturing Industries and Construction		361,05	284,81	337,47	364,58	344,58	356,76	400,10	467,81	441,43	466,69	419,46	451,59	452,83	424,87
3. Transport		600,13	611,43	621,54	622,17	624,79	600,44	590,81	602,47	605,24	626,84	629,42	640,06	643,65	666,71
4. Other Sectors		690,56	707,87	770,13	801,03	783,53	793,00	858,33	829,89	788,06	788,18	741,05	656,26	720,24	675,62
5. Other		0,12	0,14	0,78	1,42	0,10	1,62	0,38	0,03	4,95	4,36	4,61	19,53	22,30	15,45
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**0,00**	**392,66**	**359,37**	**362,43**	**409,86**	**410,71**	**427,14**	**426,21**	**484,91**	**404,98**	**544,02**	**492,73**	**399,23**	**380,97**	**373,52**
A. Mineral Products		52,34	48,71	45,74	39,73	37,45	37,96	41,87	46,64	54,49	61,52	65,57	58,77	40,56	33,08
B. Chemical Industry		0,36	0,31	0,25	0,24	0,35	0,46	0,40	0,44	0,40	0,43	0,41	0,49	0,45	0,48
C. Metal Production		339,96	310,34	316,43	369,89	372,91	388,72	383,94	437,83	350,09	482,06	426,76	339,96	339,96	339,96
D. Other Production		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other															
3. Solvent and Other Product Use		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Enteric Fermentation		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils [2]		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry [3]	**0,00**	**-5,94**	**-14,68**	**-24,69**	**-37,16**	**-47,12**	**-56,34**	**-65,73**	**-80,84**	**-94,00**	**-112,31**	**-131,27**	**-144,98**	**-162,53**	**-207,64**
A. Changes in Forest and Other Woody Biomass Stocks		-2,82	-6,60	-10,56	-14,52	-18,48	-22,00	-25,08	-28,16	-31,68	-35,64	-39,60	-42,68	-47,08	-84,04
B. Forest and Grassland Conversion															
C. Abandonment of Managed Lands															
D. CO_2 Emissions and Removals from Soil															
E. Other		-3,12	-8,08	-14,13	-22,64	-28,64	-34,34	-40,65	-52,68	-62,32	-76,67	-91,67	-102,30	-115,45	-123,60
6. Waste	**0,00**	**18,84**	**18,69**	**18,19**	**15,49**	**14,27**	**12,59**	**11,28**	**10,87**	**9,21**	**7,53**	**7,08**	**6,57**	**6,10**	**5,20**
A. Solid Waste Disposal on Land		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Waste-water Handling		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Waste Incineration		18,84	18,69	18,19	15,49	14,27	12,59	11,28	10,87	9,21	7,53	7,08	6,57	6,10	5,20
D. Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
7. Other (*(please specify)*)	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Total Emissions/Removals with LUCF [4]	**0,00**	**2.078,13**	**1.989,90**	**2.107,13**	**2.199,73**	**2.153,08**	**2.159,81**	**2.241,38**	**2.330,41**	**2.197,52**	**2.345,96**	**2.177,50**	**2.042,78**	**2.078,69**	**1.967,80**
Total Emissions without LUCF [4]	**0,00**	**2.084,07**	**2.004,58**	**2.131,82**	**2.236,89**	**2.200,20**	**2.216,15**	**2.307,11**	**2.411,25**	**2.291,52**	**2.458,27**	**2.308,77**	**2.187,76**	**2.241,22**	**2.175,44**
Memo Items:															
International Bunkers	**0,00**	**318,65**	**259,64**	**263,56**	**293,02**	**307,10**	**380,15**	**395,45**	**440,80**	**514,67**	**527,25**	**626,29**	**498,17**	**517,17**	**509,59**
Aviation		219,65	221,99	203,62	195,64	213,62	236,15	271,51	292,12	338,13	363,37	407,74	349,13	309,85	330,02
Marine		99,00	37,65	59,95	97,38	93,49	144,00	123,95	148,68	176,54	163,88	218,55	149,04	207,32	179,57
Multilateral Operations		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass		**28,26**	**28,04**	**27,28**	**23,23**	**21,41**	**18,88**	**16,92**	**16,31**	**13,67**	**11,17**	**12,38**	**9,85**	**9,15**	**7,76**

TABLE 10 EMISSIONS TRENDS (CH_4)
(Sheet 2 of 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	**0,00**	**19,67**	**19,76**	**19,86**	**20,23**	**20,97**	**22,20**	**22,77**	**22,97**	**23,23**	**23,55**	**23,22**	**23,31**	**22,52**	**22,46**
1. Energy	**0,00**	**0,22**	**0,23**	**0,24**	**0,24**	**0,24**	**0,22**	**0,23**	**0,20**	**0,20**	**0,17**	**0,17**	**0,16**	**0,17**	**0,17**
A. Fuel Combustion (Sectoral Approach)	0,00	0,22	0,23	0,24	0,24	0,24	0,22	0,23	0,20	0,20	0,17	0,17	0,16	0,17	0,17
1. Energy Industries		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Manufacturing Industries and Construction		0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,02
3. Transport		0,15	0,15	0,16	0,16	0,16	0,13	0,13	0,11	0,11	0,08	0,08	0,08	0,08	0,09
4. Other Sectors		0,06	0,06	0,07	0,07	0,07	0,07	0,08	0,08	0,07	0,07	0,07	0,06	0,07	0,06
5. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**0,00**	**0,03**	**0,02**	**0,02**	**0,03**	**0,03**	**0,03**	**0,03**	**0,03**	**0,02**	**0,03**	**0,04**	**0,04**	**0,05**	**0,04**
A. Mineral Products		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Chemical Industry		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Metal Production		0,03	0,02	0,02	0,03	0,03	0,03	0,03	0,03	0,02	0,03	0,04	0,04	0,05	0,04
D. Other Production		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other															
3. Solvent and Other Product Use		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**0,00**	**13,97**	**13,67**	**13,26**	**13,18**	**13,25**	**12,85**	**12,96**	**13,12**	**13,28**	**13,16**	**12,60**	**12,56**	**12,26**	**12,05**
A. Enteric Fermentation		12,85	12,57	12,18	12,11	12,19	11,79	11,90	12,06	12,20	12,09	11,56	11,53	11,27	11,08
B. Manure Management		1,11	1,10	1,08	1,07	1,07	1,06	1,06	1,07	1,08	1,07	1,04	1,03	0,99	0,97
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Changes in Forest and Other Woody Biomass Stocks															
B. Forest and Grassland Conversion															
C. Abandonment of Managed Lands															
D.CO_2 Emissions and Removals from Soil															
E. Other															
6. Waste	**0,00**	**5,45**	**5,83**	**6,33**	**6,78**	**7,44**	**9,10**	**9,56**	**9,62**	**9,73**	**10,19**	**10,41**	**10,54**	**10,05**	**10,20**
A. Solid Waste Disposal on Land		5,45	5,83	6,33	6,78	7,44	9,10	9,56	9,62	9,73	10,19	10,41	10,54	10,05	10,20
B. Waste-water Handling		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Waste Incineration		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Memo Items:															
International Bunkers	**0,00**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**	**0,02**	**0,01**	**0,02**	**0,02**	**0,02**	**0,02**	**0,02**	**0,02**	**0,02**
Aviation		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Marine		0,01	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	0,02	0,01	0,02	0,02
Multilateral Operations		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass															

TABLE 10 EMISSIONS TRENDS (N_2O)
(Sheet 3 of 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	0,00	1,16	1,13	1,06	1,09	1,10	1,09	1,15	1,15	1,14	1,20	1,12	1,10	0,99	0,97
1. Energy	0,00	0,09	0,08	0,08	0,09	0,09	0,12	0,12	0,16	0,16	0,19	0,19	0,19	0,19	0,20
A. Fuel Combustion (Sectoral Approach)	0,00	0,09	0,08	0,08	0,09	0,09	0,12	0,12	0,16	0,16	0,19	0,19	0,19	0,19	0,20
1. Energy Industries		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2. Manufacturing Industries and Construction		0,05	0,05	0,05	0,05	0,05	0,06	0,06	0,07	0,07	0,08	0,08	0,08	0,08	0,08
3. Transport		0,02	0,02	0,02	0,02	0,02	0,04	0,04	0,06	0,06	0,09	0,09	0,09	0,09	0,10
4. Other Sectors		0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
5. Other		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1. Solid Fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	0,00	0,16	0,15	0,14	0,14	0,14	0,14	0,16	0,13	0,12	0,12	0,06	0,05	0,00	0,00
A. Mineral Products		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Chemical Industry		0,16	0,15	0,14	0,14	0,14	0,14	0,16	0,13	0,12	0,12	0,06	0,05	0,00	0,00
C. Metal Production		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Other Production		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other															
3. Solvent and Other Product Use		0,02	0,02	0,02	0,02	0,01	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,01
4. Agriculture	0,00	0,90	0,87	0,82	0,84	0,85	0,82	0,85	0,84	0,85	0,87	0,85	0,84	0,79	0,76
A. Enteric Fermentation		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management		0,11	0,10	0,10	0,10	0,10	0,09	0,09	0,09	0,09	0,09	0,09	0,09	0,08	0,08
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils		0,79	0,77	0,73	0,74	0,76	0,73	0,76	0,75	0,75	0,78	0,77	0,76	0,71	0,68
E. Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
A. Changes in Forest and Other Woody Biomass Stocks															
B. Forest and Grassland Conversion															
C. Abandonment of Managed Lands															
D. CO_2 Emissions and Removals from Soil															
E. Other															
6. Waste	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
A. Solid Waste Disposal on Land		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Waste-water Handling		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Waste Incineration		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
D. Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
7. Other *(please specify)*	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Memo Items:															
International Bunkers	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,01	0,01	0,01
Aviation		0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Marine		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00
Multilateral Operations		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass															

TABLE 10 EMISSION TRENDS (HFCs, PFCs and SF_6)
(Sheet 4 of 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Emissions of HFCs[5] CO_2 equivalent (Gg)	**0,00**	**0,00**	**0,00**	**0,47**	**1,56**	**3,12**	**25,01**	**28,56**	**37,46**	**63,90**	**59,40**	**32,28**	**53,78**	**35,16**	**69,35**
HFC-23															
HFC-32										0,00	0,00	0,00	0,00	0,00	0,00
HFC-41															
HFC-43-10mee															
HFC-125							0,00	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01
HFC-134															
HFC-134a				0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,00	0,01	0,00	0,01
HFC-152a							0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HFC-143															
HFC-143a							0,00	0,00	0,01	0,01	0,01	0,00	0,01	0,00	0,01
HFC-227ea															
HFC-236fa															
HFC-245ca															
Emissions of HFCs[5] CO_2 equivalent (Gg)	**0,00**	**419,63**	**348,34**	**155,28**	**74,86**	**44,57**	**58,84**	**25,15**	**82,36**	**180,13**	**173,21**	**127,16**	**91,66**	**72,54**	**59,78**
CF_4		0,05	0,05	0,02	0,01	0,01	0,01	0,00	0,01	0,02	0,02	0,02	0,01	0,01	0,01
C_2F_6		0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
C_3F_8															
C_4F_{10}															
$c\text{-}C_4F_8$															
C_5F_{12}															
C_6F_{14}															
Emissions of HFCs[5] CO_2 equivalent (Gg)	**0,00**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**	**5,38**
SF_6		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

TABLE 10 EMISSION TRENDS (SUMMARY)
(Sheet 5 of 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)														
Net CO_2 emissions/removals	**0,00**	**2.078,13**	**1.989,90**	**2.107,13**	**2.199,73**	**2.153,08**	**2.159,81**	**2.241,38**	**2.330,41**	**2.197,52**	**2.345,96**	**2.177,50**	**2.042,78**	**2.078,69**	**1.967,80**
CO_2 emissions (without LUCF) [6]	0,00	2.084,07	2.004,58	2.131,82	2.236,89	2.200,20	2.216,15	2.307,11	2.411,25	2.291,52	2.458,27	2.308,77	2.187,76	2.241,22	2.175,44
CH_4	0,00	413,11	414,99	417,09	424,83	440,28	466,16	478,19	482,44	487,88	494,61	487,61	489,50	472,96	471,65
N_2O	0,00	359,97	350,03	328,51	336,57	341,16	338,66	356,19	355,08	353,45	372,88	348,12	341,73	308,27	301,62
HFCs	0,00	0,00	0,00	0,47	1,56	3,12	25,01	28,56	37,46	63,90	59,40	32,28	53,78	35,16	69,35
PFCs	0,00	419,63	348,34	155,28	74,86	44,57	58,84	25,15	82,36	180,13	173,21	127,16	91,66	72,54	59,78
SF_6	0,00	5,38	5,38	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 (with net CO_2 emissions/removals)	**0,00**	**3.276,22**	**3.108,64**	**3.013,85**	**3.042,93**	**2.987,58**	**3.053,86**	**3.134,85**	**3.293,12**	**3.288,26**	**3.451,43**	**3.178,05**	**3.024,83**	**2.973,01**	**2.875,57**
Total (without CO_2 from LUCF) [6] [8]	**0,00**	**3.282,16**	**3.123,32**	**3.038,54**	**3.080,09**	**3.034,70**	**3.110,20**	**3.200,58**	**3.373,96**	**3.382,26**	**3.563,74**	**3.309,32**	**3.169,81**	**3.135,54**	**3.083,21**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)														
1. Energy	0,00	1.703,95	1.657,47	1.782,09	1.844,01	1.807,82	1.818,86	1.912,20	1.968,26	1.930,53	1.970,72	1.872,62	1.844,66	1.916,25	1.861,44
2. Industrial Processes	0,00	866,64	760,40	565,92	536,28	508,68	559,12	535,15	651,81	690,67	818,86	663,11	529,36	495,02	508,96
3. Solvent and Other Product Use	0,00	6,00	4,87	4,77	4,71	3,88	4,71	4,71	4,71	4,96	4,68	4,53	4,03	4,03	3,72
4. Agriculture	0,00	571,16	558,34	533,55	536,35	542,97	523,06	535,92	535,70	542,14	547,50	528,96	525,67	502,78	489,45
5. Land-Use Change and Forestry [7]	0,00	-5,94	-14,68	-24,69	-37,16	-47,12	-56,34	-65,73	-80,84	-94,00	-112,31	-131,27	-144,98	-162,53	-207,64
6. Waste	0,00	134,42	142,24	152,21	158,73	171,36	204,45	212,59	213,48	213,96	221,98	226,10	228,36	217,46	219,64
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removal	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	2.175,44	-207,64	22,46	0,97	69,35	0,00	0,00	59,78	5,38	0,00	26,71	23,15	7,10	8,04
1. Energy	**1.796,72**		**0,17**	**0,20**							**25,01**	**22,90**	**4,98**	**2,34**
A. Fuel Combustion Reference Approach	1.800,71													
Sectoral Approach	1.796,72		0,17	0,20							25,01	22,90	4,98	2,34
1. Energy Industries	14,07		0,00	0,00							0,18	0,05	0,00	0,03
2. Manufacturing Industries and Construction	424,87		0,02	0,08							3,71	1,06	0,46	1,90
3. Transport	666,71		0,09	0,10							4,82	20,16	4,04	0,11
4. Other Sectors	675,62		0,06	0,02							16,26	1,63	0,47	0,15
5. Other	15,45		0,00	0,00							0,04	0,00	0,00	0,15
B. Fugitive Emissions from Fuels	0,00		0,00	0,00							0,00	0,00	0,00	0,00
1. Solid Fuels	0,00		0,00	0,00							0,00	0,00	0,00	0,00
2. Oil and Natural Gas	0,00		0,00	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	**373,52**		**0,04**	**0,00**	**69,35**	**0,00**	**0,00**	**59,78**	**5,38**	**0,00**	**1,68**	**0,24**	**0,09**	**5,69**
A. Mineral Products	33,08		0,00	0,00							0,02	0,05	0,010,03	
B. Chemical Industry	0,48		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,46	0,00	0,000,00	
C. Metal Production	339,96		0,04	0,00				59,78		0,00	1,21	0,19	0,09	5,66
D. Other Production [3]	NE										0,00	0,00	0,00	0,00
E. Production of Halocarbons and SF_6						0,00		0,00		0,00				
F. Consumption of Halocarbons and SF_6					69,35	0,00	0,00	0,00	5,38	0,00				
G. Other	0,00		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.
A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removal	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	0,00			0,01							NE	NE	2,03	NE
4. Agriculture	0,00	0,00	12,05	0,76							0,00	0,00	0,00	0,00
A. Enteric Fermentation			11,08											
B. Manure Management			0,97	0,08									0,00	
C. Rice Cultivation			0,00										0,00	
D. Agricultural Soils	[4]	[4]	0,00	0,68									0,00	
E. Prescribed Burning of Savannas			0,00	0,00							NO	NO	NO	
F. Field Burning of Agricultural Residues			0,00	0,00							0,00	0,00	0,00	
G. Other			0,00	0,00							0,00	0,00	0,00	NO
5. Land-Use Change and Forestry	[5] 0,00	[5] -207,64	0,00	0,00							0,00	0,00	0,00	0,00
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0,00	[5] -84,04												
B. Forest and Grassland Conversion	0,00		0,00	0,00							0,00	0,00	NE	
C. Abandonment of Managed Lands	[5] 0,00	[5] 0,00												
D. CO_2 Emissions and Removals from Soil	[5] 0,00	[5] 0,00												
E. Other	[5] 0,00	[5] -123,60	0,00	0,00							0,00	0,00	NE	NE
6. Waste	5,20		10,20	0,00							0,02	0,01	0,00	0,02
A. Solid Waste Disposal on Land	[6] 0,00		10,20									0,00	0,00	
B. Wastewater Handling			0,00	0,00							0,00	0,00	0,00	
C. Waste Incineration	[6] 5,20		0,00	0,00							0,02	0,01	0,00	0,02
D. Other	0,00		0,00	0,00							0,00	0,00	0,00	0,00
7. Other *(please specify)*	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

[4] According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), CO_2 emissions from agricultural soils are to be included under Land-Use hange and Forestry (LUCF). At the same time, the
Summary Report 7A (Volume 1. Reporting Instructions, Tables.27) allows for reporting CO_2 emissions or removals from agricultural soils, either in the Agriculture sector, under D. Agricultural Soils or in the Land-Use Change and Forestry sector under D. Emissions and Removals from Soil. Parties may choose either way to report emissions or removals from this source in the common reporting format, but the way they have chosen to report should be clearly indicated, by inserting explanatory comments to the corresponding cells of Summary 1.A and Summary 1.B. Double-counting of these emissions or removals should be avoided. Parties should include these emissions or removals consistently in Table8(a) (Recalculation - Recalculated data) and Table10 (Emission trends).
[5] Please do not provide an estimate of both CO_2 emissions and CO_2 removals. "Net" emissions (emissions - removals) of CO_2 should be estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[6] Note that CO_2 from Waste Disposal and Incineration source categories should only be included if it stems from non-biogenic or inorganic waste streams.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removal	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Memo Items: [7]														
International Bunkers	509,59		0,02	0,01							5,79	0,91	0,36	0,76
Aviation	330,02		0,00	0,01							1,40	0,47	0,23	0,42
Marine	179,57		0,02	0,00							4,40	0,44	0,13	0,34
Multilateral Operations	NO		NO	NO							NO	NO	NO	NO
CO_2 Emissions from Biomass	11,99													

[1] Memo Items are not included in the national totals.

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B)
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removal	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	2.17 5,44	-207,64	22,46	0,97	69,35	0,00	0,00	59,78	5,38	0,00	26,71	23,15	7,10	8,04
1. Energy	1.796,72		0,17	0,20							25,01	22,90	4,98	2,34
A. Fuel Combustion Reference Approach[2]	1.800,71													
Sectoral Approach[2]	1.796,72		0,17	0,20							25,01	22,90	4,98	2,34
B. Fugitive Emissions from Fuels	0,00		0,00	0,00							0,00	0,00	0,00	0,00
2. Industrial Processes	373,52		0,04	0,00	69,35	0,00	0,00	59,78	5,38	0,00	1,68	0,24	0,09	5,69
3. Solvent and Other Product Use	0,00			0,01							NE	NE	2,03	NE
4. Agriculture [3]	0,00	0,00	12,05	0,76							0,00	0,00	0,00	0,00
5. Land-Use Change and Forestry	[4] 0,00	[4] -207,64	0,00	0,00							0,00	0,00	0,00	0,00
6. Waste	5,20		10,20	0,00							0,02	0,01	0,00	0,02
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Memo Items:														
International Bunkers	509,59		0,02	0,01							5,79	0,91	0,36	0,76
Aviation	330,02		0,00	0,01							1,40	0,47	0,23	0,42
Marine	179,57		0,02	0,00							4,40	0,44	0,13	0,34
Multilateral Operations	NO		NO	NO							NO	NO	NO	NO
CO_2 Emissions from Biomass	11,99													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.
A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
[1] The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.
[2] For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in document box of Table1.A(c).
Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.
[3] See footnote 4 to Summary 1.A.
[4] Please do not provide an estimate of both CO_2 emissions and CO_2 removals. "Net" emissions (emissions - removals) of CO_2 should be estimated and a single number placed in either the CO_2 emissions or CO_2 removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**1.967,80**	**471,65**	**301,62**	**0,00**	**59,78**	**0,00**	**2.800,85**
1. Energy	**1.796,72**	**3,50**	**61,23**				**1.861,44**
A. Fuel Combustion (Sectoral 2.2 tafla)	1.796,72	3,50	61,23				1.861,44
1. Energy Industries	14,07	0,01	0,24				14,32
2. Manufacturing Industries and Construction	424,87	0,34	25,57				450,78
3. Transport	666,71	1,81	29,76				698,28
4. Other Sectors	675,62	1,33	5,62				682,57
5. Other	15,45	0,01	0,04				15,49
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	0,00	0,00	0,00				0,00
2. Oil and Natural Gas	0,00	0,00	0,00				0,00
2. Industrial Processes	**373,52**	**0,93**	**0,00**	**0,00**	**59,78**	**0,00**	**434,23**
A. Mineral Products	33,08	0,00	0,00				33,08
B. Chemical Industry	0,48	0,00	0,00	0,00	0,00	0,00	0,48
C. Metal Production	339,96	0,93	0,00		59,78	0,00	400,68
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				0,00	0,00	0,00	0,00
F. Consumption of Halocarbons and SF_6				0,00	0,00	0,00	0,00
G. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3. Solvent and Other Product Use	**0,00**		**3,72**				**3,72**
4. Agriculture	**0,00**	**253,06**	**236,39**				**489,45**
A. Enteric Fermentation		232,66					232,66
B. Manure Management		20,40	25,83				46,23
C. Rice Cultivation		0,00					0,00
D. Agricultural Soils [2]	NE	0,00	210,56				210,56
E. Prescribed Burning of Savannas		0,00	0,00				0,00
F. Field Burning of Agricultural Residues		0,00	0,00				0,00
G. Other		0,00	0,00				0,00
5. Land-Use Change and Forestry [1]	**-207,64**	**0,00**	**0,00**				**-207,64**
6. Waste	**5,20**	**214,15**	**0,29**				**219,64**
A. Solid Waste Disposal on Land	0,00	214,15					214,15
B. Wastewater Handling		0,00	0,00				0,00
C. Waste Incineration	5,20	0,00	0,29				5,49
D. Other	0,00	0,00	0,00				0,00
7. Other *(please specify)*	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
							0,00
Memo Items:							
International Bunkers	**509,59**	**0,41**	**4,40**				**514,40**
Aviation	**330,02**	**0,05**	**2,89**				**332,95**
Marine	**179,57**	**0,36**	**1,51**				**181,45**
Multilateral Operations	**NO**	**0,00**	**0,00**				**0,00**
CO_2 Emissions from Biomass	**11,99**						**11,99**

[1] For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[2] See footnote 4 to Summary 1.A of this common reporting format.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES Land-Use Change and Forestry	CO_2 emissions	CO_2 removals	Net CO_2 emissions/removals	CH_4	N_2O	Total emissions
	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	0,00	-84,04	-84,04			-84,04
B. Forest and Grassland Conversion	0,00		0,00	0,00	0,00	0,00
C. Abandonment of Managed Lands	0,00	0,00	0,00			0,00
D. CO_2 Emissions and Removals from Soil	0,00	0,00	0,00			0,00
E. Other	0,00	-123,60	-123,60	0,00	0,00	-123,60
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	**0,00**	**-207,64**	**-207,64**	**0,00**	**0,00**	**-207,64**

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (a)	**3.008,49**
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (a)	**2.800,85**

[a] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry. Note that these totals will differ from the totals reported in Table 10s5 if Parties report non-CO_2 emissions from LUCF.

ANNEX B

Decision 14/CP.7
Impact of single projects on emissions in the commitment period

The Conference of the Parties, Recalling its decision 1/CP.3, paragraph 5 (d),

Recalling also, its decision 5/CP.6, containing the Bonn Agreements on the Implementation of the Buenos Aires Plan of Action,

Having considered the conclusions of the Subsidiary Body for Scientific and Technological Advice at its resumed thirteenth session FCCC/SBSTA/2000/14,

Recognizing the importance of renewable energy in meeting the objective of the Convention,

1. *Decides* that, for the purpose of this decision, a single project is defined as an industrial process facility at a single site that has come into operation since 1990 or an expansion of an industrial process facility at a single site in operation in 1990;

2. *Decides* that, for the first commitment period, industrial process carbon dioxide emissions from a single project which adds in any one year of that period more than 5 per cent to the total carbon dioxide emissions in 1990 of a Party listed in Annex B to the Protocol shall be reported separately and shall not be included in national totals to the extent that it would cause the Party to exceed its assigned amount, provided that:
   (a) The total carbon dioxide emissions of the Party were less than 0.05 per cent of the total carbon dioxide emissions of Annex I Parties in 1990 calculated in accordance with the table contained in the annex to document FCCC/CP/1997/7/Add.1;
   (b) Renewable energy is used, resulting in a reduction in greenhouse gas emissions per unit of production;
   (c) Best environmental practice is followed and best available technology is used to minimize process emissions;

3. *Decides* that the total industrial process carbon dioxide emissions reported separately by a Party in accordance with paragraph 2 above shall not exceed 1.6 million tons carbon dioxide annually on the average during the first commitment period and cannot be transferred by that Party or acquired by another Party under Articles 6 and 17of the Kyoto Protocol;

4. *Requests* any Party that intends to avail itself of the provisions of this decision to notify the Conference of the Parties, prior to its eighth session, of its intention;

5. *Requests* any Party with projects which meet the requirements specified above, to report emission factors, total process emissions from these projects, and an estimate of the emission savings resulting from the use of renewable energy in these projects in their annual inventory submissions;

6. *Requests* the secretariat to compile the information submitted by Parties in accordance with paragraph 5 above, to provide comparisons with relevant emission factors reported by other Parties, and to report this information to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol.

ANNEX C

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