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"GOOD PRACTICES" IN POLICIES AND MEASURES AMONG PARTIES INCLUDED IN ANNEX I TO THE CONVENTION

Policies and measures of Parties included in Annex I to the Convention reported in third national communications

Report by the secretariat

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I. INTRODUCTION

A. Background and mandate

1. Article 4.1 and 4.2 and Article 12 of the Convention require Parties included in Annex I to the Convention, further referred to as Annex I Parties, to communicate information periodically to the Conference of the Parties (COP). By its decision 11/CP.4, the COP requested Annex I Parties to submit third national communications (NC3) by 30 November 2001 (FCCC/CP/1998/16/Add.1). Subsequently, by its decision 4/CP.5, the COP adopted revised UNFCCC guidelines for the preparation of national communications by Annex I Parties (FCCC/CP/1999/7), referred to below as the UNFCCC guidelines, and requested these Parties to use Part II of these guidelines for the preparation of national communications due on 30 November 2001 (FCCC/CP/1999/6/Add.1).

2. By its decision 13/CP.7, the COP requested the secretariat to make available the information on implemented and planned policies and measures related to the work on "good practices" in policies and measures reported by Annex I Parties in their NC3 (FCCC/CP/2001/13/Add.1). In response to this decision, the SBSTA, at its fifteenth session, requested the secretariat to compile information on policies and measures reported by Annex I Parties in their NC3 for consideration at its seventeenth session (FCCC/SBSTA/2001/8, para 35 (c)). Furthermore, the SBSTA at its sixteenth session, requested the secretariat to consider Article 2.3 of the Kyoto Protocol when compiling the above-mentioned information (FCCC/SBSTA/2002/6, para 66 (c)).

3. The current report has been prepared in response to the mandate given to the secretariat by the COP and the SBSTA. It draws upon the NC3 of 23 Parties which submitted their NC3 by end June, 2002.[1] The report therefore includes information from around two thirds of Annex I Parties and the analysis and conclusions should be regarded as preliminary.[2] In the context of this report, all the references to Annex I Parties and to Parties are to the 23 Parties covered by the report only.

B. Approach

4. The analysis presented in the report is based on the information from the NC3, mainly on the chapter on policies and measures. However, it also draws upon information from other chapters, such as those on national circumstances, projections and total effect of policies and measures and, when relevant, from the chapters on research and systematic observation, and education, training and public awareness.

5. In addition, information on greenhouse gas emissions and trends from the 2002 annual inventory submissions by Annex I Parties (FCCC/SB/2002/INF.2) and relevant web-based information (http://unfccc.int/program/mis/ghg) was used to support the analysis.

6. The analysis follows a sectoral approach in accordance with the UNFCCC guidelines. Sectors addressed include: *energy*, *transport*, *industry (*also referred to as *industrial processes)*, *agriculture*, *forestry* (also referred to as *land-use change and forestry (LUCF)*) and *waste management*. Given that energy is the most important sector in terms of emissions for the majority of Annex I Parties and that most of the policies and measures have been identified and reported in this sector, the following subsectors within energy were addressed in accordance with the outcome of the workshop on Annex I national communications (FCCC/SBI/2001/INF.4) and IPCC emission source categories:

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[1] These Parties are Austria (AUT), Belgium (BEL), Canada (CAN), Croatia (HRV), Czech Republic (CZE), Estonia (EST), European Community (EUR), Finland (FIN), France (FRA), Japan (JPN), Latvia (LVA), Liechtenstein (LIE), Monaco (MCO), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Slovakia (SVK), Spain (ESP), Sweden (SWE), Switzerland (CHE), United Kingdom of Great Britain and Northern Ireland (GBR), United States of America (USA).

[2] Some of the large countries with significant impacts on emission trends, such as Australia, Germany, the Russian Federation and Ukraine, are not included in the report, as they had not submitted their NC3 at the time the report was prepared.

energy industries, energy use in industry (includes *energy use in manufacturing industry and construction*), and *energy use in the residential, commercial and institutional sector and "others" sector* (also referred to as *energy use in other sectors*), and *fugitive emissions*. When policies affected more than one sector, they were classified as cross-sectoral, e.g. emissions trading.

7. Within each sector, the analysis covers the implementation of policies and measures, using different types of policy instruments, as defined in the UNFCCC guidelines. These include *economic instruments, fiscal instruments, voluntary agreements, regulations, information, education, and public awareness,* and *research*. When the policy instruments were not specified or did not fit into any of these categories, they were classified as policy processes or others. In addition to sectoral analysis, general tendencies in the implementation of policies and measures are presented, including some relevant aspects of national circumstances, institutional development and some indicators of policy performance.

8. As the third national communications were prepared prior to the request by the SBSTA at its sixteenth session relating to the minimization of adverse effects of policies and measures of Annex I Parties on other Parties, especially developing country Parties, under Article 2.3 of the Kyoto Protocol, they did not include information. Therefore, the secretariat was unable to incorporate any findings in this regard.

9. To facilitate the analysis, the secretariat prepared a database of policies and measures of Annex I Parties from their NC3, referred to below as the database. The database contains mainly information on key policies and measures reported by the Parties in the relevant summary table as required by the UNFCCC guidelines. It also contains policies which have been reported as having a significant impact, or are innovative, or are replicable, or could modify long-term trends or have a negative impact on emission trends. In cases when a Party reported a large number of policies and measures in the summary table of its NC3, a choice of those to be included in the database was made according to the following criteria: policies and measures already implemented or adopted, and clearly on track to be implemented in the near future; policies and measures with a significant effect; and policies and measures at national level.[3] The level of detail in the database broadly corresponds to the requirements of the UNFCCC guidelines for reporting of information on policies in the form of a summary table. While the analysis in this report is strongly linked to policies and measures included in the database, a great deal of information coming directly from the NC3 was also used.

10. A printout from the database is contained in the web-based document, *Policies and measures reported by Parties included in Annex I to the Convention in their third national communications. Database information*. For each country, the document contains its greenhouse gas (GHG) emission profile based on the information from the 2002 annual GHG inventories and key policies and measures.

II. OVERVIEW OF THE POLICIES AND MEASURES OF ANNEX I PARTIES AND SOME EMISSION TRENDS

Reporting issues

11. The NC3 of Annex I Parties contain a wealth of information on policies and measures and policy processes launched by Parties in the design and implementation of these policies. In their NC3, Parties significantly improved the presentation of information and reporting of policies and measures compared to the previous national communications. This was most likely due to improvements in the UNFCCC guidelines and also because of the increased capacity of Parties for climate change analysis and reporting. The quality of reporting improved in the energy and transport sectors, which are the most important sectors in terms of emissions and mitigation policies for the countries being reviewed, except

[3] Including information on policies and measures at regional and local level at this stage could potentially lead to double counting (see FCCC/SBI/2001/INF.4).

for New Zealand, where agriculture is the most important sector. The quality also improved in other sectors which had received considerably less attention in previous communications. For example, the increasing role of fluorinated gases in industrial processes resulted in more attention being given to the policies targeting these gases and the quality of reporting.

12. Still, in many cases information was not very clear and in terms of presentation did not strictly follow the requirements and categorization required by the UNFCCC guidelines. There was often no clear correlation between policies and measures and the effect on historical and future emission trends. The status of implementation was not always clear and Parties did not always use the levels of implementation agreed in the UNFCCC guidelines, such as planned, adopted and implemented, in a consistent manner. Finally, if a policy was not included in the summary table required by the UNFCCC guidelines, it was difficult to understand the status of implementation from the text in the NC3. In many reports, some important elements of information were missing; for example, only a few Parties reported on the cost of measures (CHE, HRV), although many Parties reported overall funding of certain policies and measures (FIN, LVA, NLD, SWE). Some Parties did not report policies and measures by sector, but rather by gas and then by sector (JPN, LVA, NZL). Most of the Parties used the terms given in the guidelines to categorize the type of policy instrument (fiscal, regulation, etc.), although there were a few deviations (technical, investment decisions, etc.).

13. Parties also differed significantly in their approach as to which policies and measures to include in the summary table, which should contain all the principal policies, according to the UNFCCC guidelines. Some Parties reported 10-15 policies and measures in sufficient detail for the reader to have a good overview of the key policies and measures. Others reported more than 100 policies and measures including also projects on international cooperation, which did not contribute to the clarity of reporting. There was also inconsistency in terms of the detail provided in the NC3 of different Parties and within many NC3 across different sectors. Also, Parties rarely reported information on policies that may lead to greater levels of emissions and policies and measures no longer in place.

Overview of policies reported

14. Parties reported policies and measures in all sectors required by the UNFCCC guidelines. These policies covered all important sources of emissions much more comprehensively than in the previous communications. The policies and measures reported in the NC3 broadly showed continuity with those reported in the previous communications, as Parties continued to report on strengthening of the existing policies launched with objectives other than climate change and having climate change benefits. However, there was also a clear shift towards implementing new policies and measures that have climate change as their primary objectives, and placing more emphasis on these policies in the evolving climate response strategies of Parties. Examples of such policies and measures include emissions trading, carbon taxes and green certificate trading. The most important objectives of policies and measures reported are summarized in the box below.

Major objectives of climate change policies reported by Annex I Parties

Energy
- Promote economically efficient energy supply and energy use
- Enhance energy security and diversification of energy sources
- Protect the environment
- Promote energy sector reform to increase economic efficiency by introducing more private sector participation, more competition in supply and distribution, and increasing consumer choice over energy suppliers
- Promote efficient use of resources, including energy resources, through "green tax" reform
- Climate change mitigation through emissions trading

Transport
- Air quality management
- Congestion management
- Energy security

Industrial processes
- Reduce gases emitted as by-products in industrial processes
- Improve efficiency of industrial processes

Agriculture
- Improve environmental performance of agriculture, e.g. preventing pollution of underground waters
- Promote sustainability through, for example, improved food quality, rural development, and land-use planning

Land-use change and forestry
- Protection and sustainable management of forests
- Conservation of biodiversity, wildlife, soil and water
- Enhance forest sink capacity

Waste
- Reduce environmental impacts of waste management such as prevention of pollution of air, soil and underground waters
- Waste minimization and recycling.

15. In terms of gases and sectors targeted, CO_2 emissions from the energy and transport sectors were by far the most important. Still, in the past many Parties achieved significant emission reductions of non-CO_2 gases, e.g. emissions from waste and industrial processes, because of the cost-effectiveness of measures targeting these gases. This stems from the large proportion of the cost being associated with objectives other than climate change, e.g. reducing pollution of air and underground waters and enhancing productivity in aluminium and adipic acid production. This may also be the case for projected emissions, where many Parties expect energy-related CO_2 emissions to stabilize at their base year levels, or increase slightly, while non-CO_2 emissions in most cases are expected to decline below base year levels.

16. Some of the sectors, however, are yet to receive the attention needed. Transport, for example, is for most Parties among the largest emission sources and/or fastest growing sectors. However, few policies and measures were reported there, around 14 per cent of the key measures in the database, and so far very few of them seem to deliver noticeable reduction gains. In the industrial processes sector, process-related CO_2 emissions from the iron and steel and cement industries were important sources of emissions, but no policies and measures were implemented as mitigation options were not easily available. Agriculture is also an important sector for some Parties, but it was difficult to find significant measures in terms of emission reduction apart from fertilizer and manure management and the European Community (EC) Common Agricultural Policy (CAP).

Key policies and measures reported by Parties in all sectors

	AUT	BEL	CAN	CHE	CZE	ESP	EST	EUR	FIN	FRA	GBR	HRV	JPN	LVA	NLD	NOR	NZL	POL	SVK	SWE	USA
Combined heat and power	X	X								X	X	X		X	X	X			X		X
Renewable energy sources	X	X	X	X		X		X	X	X	X	X	X	X	X	X			X	X	X
Fuel switch (mainly to natural gas)					X	X	X			X	X	X	X								
Energy efficiency improvements	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X
Vehicle and fuel taxes	X	X		X			X		X	X	X				X	X				X	
Integrated transport policy frameworks	X			X				X	X						X					X	
Pollution prevention in industry	X	X		X	X		X			X	X	X	X	X	X	X			X		X
Landfill site gas recovery	X		X		X	X	X	X		X	X			X	X	X	X			X	X
Fertilizer and manure management	X	X			X	X	X	X		X	X	X	X	X			X	X	X		X
Common Agricultural Policy	X	X						X			X			X						X	X
Afforestation and reforestation		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	

17. The central governments continued to play a major role in setting the overall climate response strategy. However, a clear tendency towards wider involvement of regional and local governments, and municipalities in climate change consultations and implementation featured prominently in many NC3. This reflected the expectation that the regional and local governments, and municipalities were likely to play an increasingly prominent role in the future in addressing both mitigation and adaptation issues. Such tendencies were either related to the existing distribution of powers (AUT, BEL, CAN, CZE, FIN, JPN, NOR, NZL, SVK, SWE, USA) or linked to the ongoing process of devolution (FRA, GBR).

18. Typically, the implementation of some specific aspects of climate policy has been delegated to the local authorities, such as climate change aspects of territorial planning and management of buildings, energy conservation, transportation and waste. In some cases, however, regional governments were entrusted with the preparation and implementation of comprehensive policy plans and action programmes, including in the context of the action plan Agenda 21 (AUT, BEL).

19. Many Parties reported involvement of their cities in the Cities for Climate Protection campaign of the International Council for Local Environmental Initiatives. This initiative aimed at providing technical assistance and training for the cities to achieve GHG mitigation. The United States reported that 7,000 Gg CO_2 eq. had already been saved annually as a result of this initiative.

20. All the Parties with economies in transition (EIT Parties) acknowledged the role of the process of harmonization of their legislation with the EC legislation in the framework of the EC accession partnership, in the shaping of their climate policies. This extended to translation of several EC directives into national law in the following areas: energy (liberalization of electricity and gas markets, fuel excise taxes), waste, air and water pollution and agriculture (EC Common Agricultural Policy). It also extended to initiating implementation of this national law and launching environmental monitoring systems. To support this work, several EC programmes that provided the accession countries with both financial and methodological support (PHARE, SAPARD, ISPA) were noted by the EIT Parties.

Emission trends in the period 1990–2000

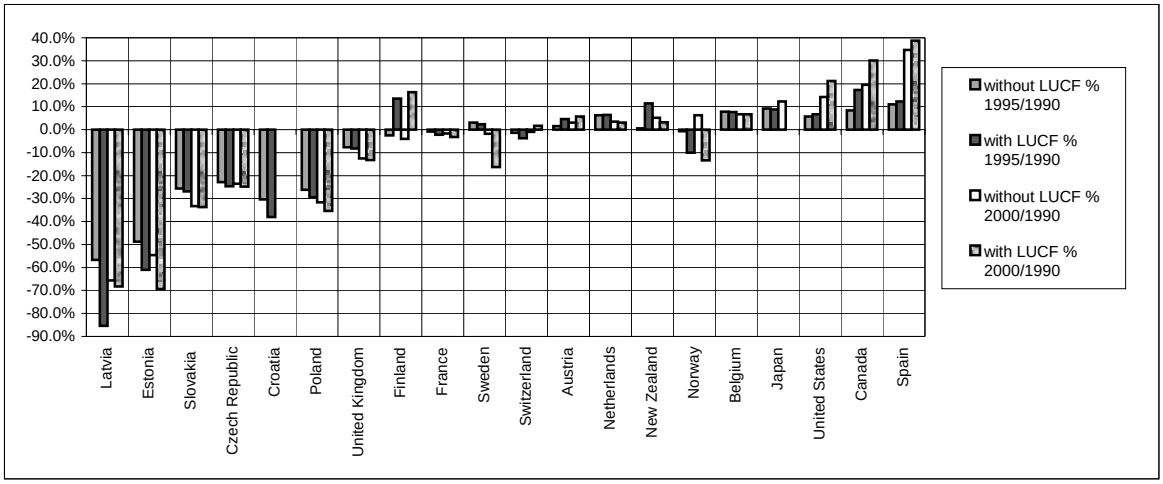
21. As the preliminary data from the GHG inventories for 2002 containing data on emission estimates until 2000 suggest, emissions of most Annex II Parties covered in this report were above the 1990 levels in 2000, without LUCF, see table 1 and figure 1.[4]

Table 1. Aggregated GHG emissions of Annex I Parties with and without LUCF (Gg CO_2 equivalent), in 1990, 1995 and 2000

	without LUCF	with LUCF	without LUCF	with LUCF	without LUCF	with LUCF
	1990	1990	1995	1995	2000	2000
Austria	77,388	68,173	78,606	71,352	79,754	72,121
Belgium	142,741	141,139	153,848	151,969	152,356	150,533
Canada	607,183	545,684	657,772	640,126	726,250	709,761
Croatia	31,944	25,459	22,259	15,754	NA	NA
Czech Republic	192,019	189,891	148,272	142,987	146,792	142,776
Estonia	43,494	37,174	22,287	14,505	19,746	11,381
Finland	77,093	53,295	75,168	60,481	73,958	62,005
France	559,342	503,110	554,691	491,896	550,033	486,787
Japan	1,246,724	1,162,821	1,320,666	1,276,539	1,357,842	NA
Latvia	31,054	20,229	13,435	2,951	11,164	6,921
Netherlands	210,347	208,920	223,608	222,376	216,916	215,503
New Zealand	73,161	51,316	73,609	57,206	76,956	52,949
Norway	51,965	42,215	51,636	37,996	55,263	36,563
Poland	565,264	530,518	417,353	374,473	386,187	343,093
Slovakia	72,937	70,510	54,284	51,601	48,667	46,722
Spain	286,428	257,176	318,135	288,882	385,987	356,735
Sweden	70,573	50,274	72,771	51,451	69,356	42,051
Switzerland	53,233	50,045	52,506	48,196	52,748	50,927
United Kingdom	742,492	751,283	685,474	690,162	649,106	652,460
United States	6,130,724	5,032,977	6,481,809	5,371,792	7,001,225	6,098,730

[4] The EC decreased its total GHG emissions by 3.5 per cent, without LUCF. Its numbers are not included in the table or in the chart, as not all countries in the EC submitted their national communications by the end of June 2002.

Figure 1. Changes in aggregated GHG emissions of Annex I Parties with and without LUCF in 1995 and 2000 compared with 1990 (percentage)



Several Annex II Parties contributed significantly to attaining the aim of the Convention

The EC, Finland, France, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland contributed significantly to attaining the aim of the Convention to return individually or jointly the GHG emissions in 2000 to their 1990 levels. The success in achieving the stabilization aim of the Convention was attributed by Parties to a mix of factors, such as: proactive climate change policy, including policy to improve energy efficiency; fuel switch to natural gas; nuclear power and some economic slowdown in the early or mid 1990s.

More specifically, in the EC the increase in emissions of many member States was offset mainly by the emission drop in Germany[5] and the United Kingdom. In the United Kingdom the decrease in emissions was largely attributed to the effect of market liberalization and the resulting fuel switch from coal to natural gas. In France, the stabilization of emissions was mainly achieved by reducing emissions of N_2O from the chemical industry and increasing the share of nuclear in electricity generation. In Finland, the decrease in emissions stemmed mainly from a shift from coal and peat to natural gas, increased share of renewables, especially linked to good hydropower availability in the Nordic electricity market, and upgrading of existing nuclear power plant.

22. Some policy-relevant national circumstances, e.g. higher-than-expected economic growth and lower-than-expected oil prices, contributed to the higher-than-expected baseline emissions and lowered the actual emission reductions from many policies in some of the Annex II Parties experiencing emission growth. In addition, in many Parties climate policies implemented in the beginning of the 1990s were not sufficient to deliver the reductions needed to stabilize emissions, or relied heavily on voluntary approaches with no consequences in case of non-compliance with the targets set. However, the end of the last decade saw some slowdown in the rate of emission growth in several Annex II countries (BEL, JPN, NLD) and in 2000 emissions in some Annex II Parties only slightly exceeded their 1990 emission levels (AUT, NLD, NZL). This observation could be at least in part explained by the effects of climate policies, although some slowdown in economic growth at the end of the decade and milder winters could also have contributed to this.

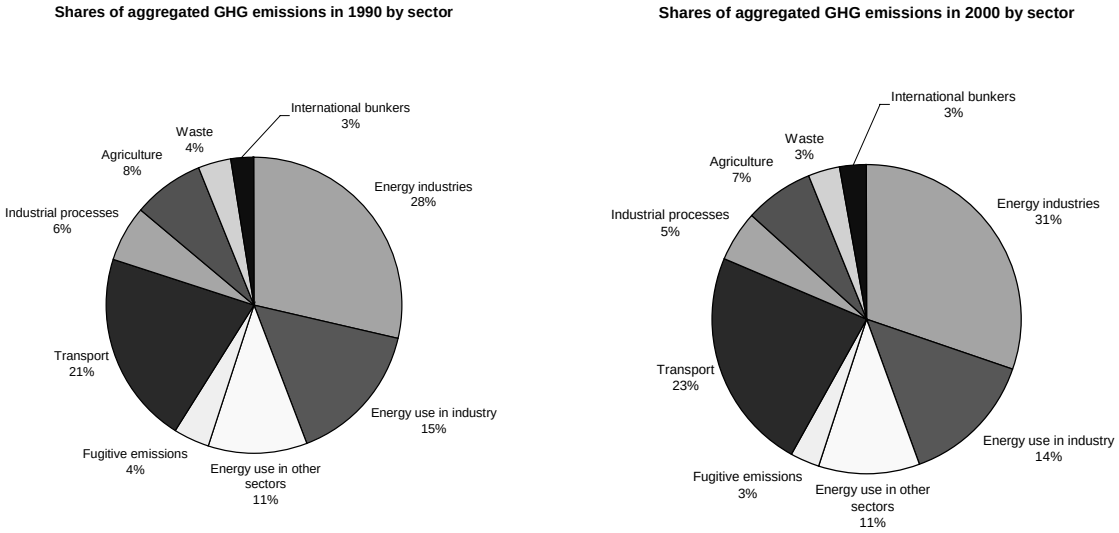
[5] Although Germany is not covered by this report as it did not submit its NC3 by 30 June, a reference to its contribution to attaining the aim of the UNFCCC is made here in the context of the EC attaining this aim.

Several Annex I Parties with economies in transition have made successful steps to decouple their emissions from economic growth

The 2000 inventory data suggest that emissions of Annex I Parties with economies in transition were well below their 1990 levels in 2000. Decreases ranged from 66 per cent in Latvia to 23 per cent in the Czech Republic. The important observation, however, is that in most of these countries, Poland for example, the economy recovered after 1995 growing by an average of 6.6 per cent annually between 1995 and 1997 and of 4.3 per cent annually between 1998 and 1999, while emissions continued to decline. This suggests a significant decoupling of economic growth from emissions growth due to a profound structural reform of the economy.

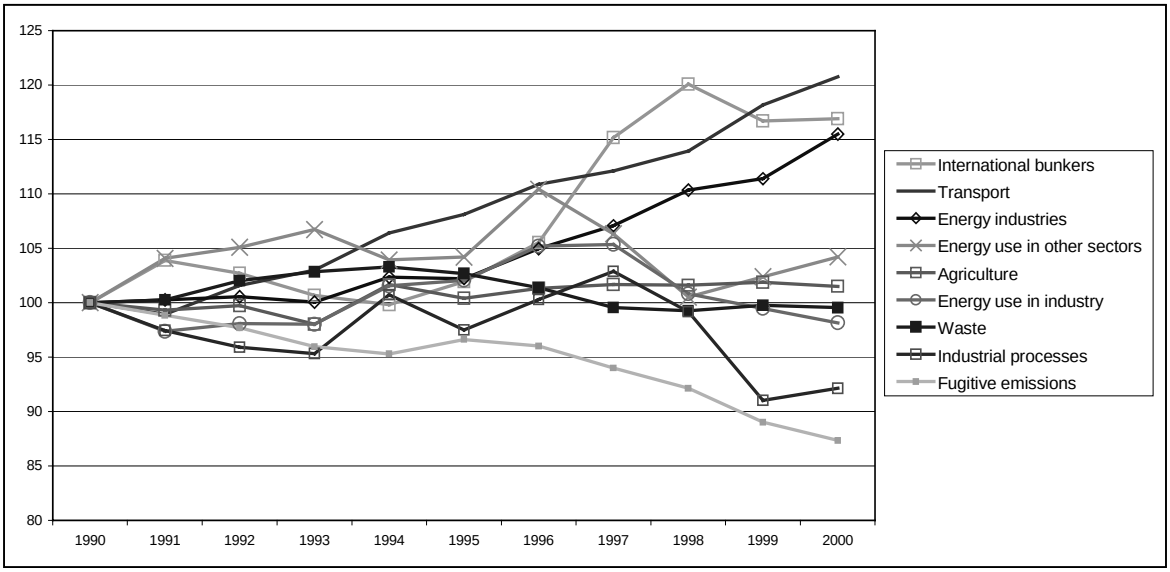
23. In terms of emissions by sector, the emission profile of the Parties remained broadly unchanged (see figure 2). Energy industries with a share of 33 per cent and transport with a share of 23 per cent of the overall emissions in 2000 remained by far the most important sectors. These were followed by energy use in industry, 14 per cent, energy use in other sectors (residential, commercial, institutional and others), 11 per cent, agriculture, 7 per cent, industrial processes, 5 per cent, and waste and fugitive emissions with equal shares of 3 per cent. Significant differences remained, however, between the shares of emissions by sectors between different Parties.

Figure 2. Shares of aggregated GHG emissions in 1990 and 2000 by sector



24. Among all sectors, emissions from transport and international bunkers grew the most, by around 20 and 17 per cent respectively, followed by emissions from energy industries, 15 per cent (figure 3). The other sectors such as energy use in other sectors, energy use in industry, agriculture and waste grew at a moderate pace or remained broadly stable. Emissions from industrial processes and fugitive emissions exhibited a clear downward trend.

Figure 3. GHG emission trend by sector, percentage change from 1990 to 2000



25. Future emission trends by sector broadly followed the historical trends. Transport and bunker fuel continued to be the fastest-growing sectors, followed by energy industries. Emissions from waste and from industrial processes, except for hydrofluorocarbons (HFC) used as a substitute for ozone-depleting substances, and fugitive emissions, were expected to continue to decline. Emissions from other sectors did not suggest any consistent trend among the Parties.

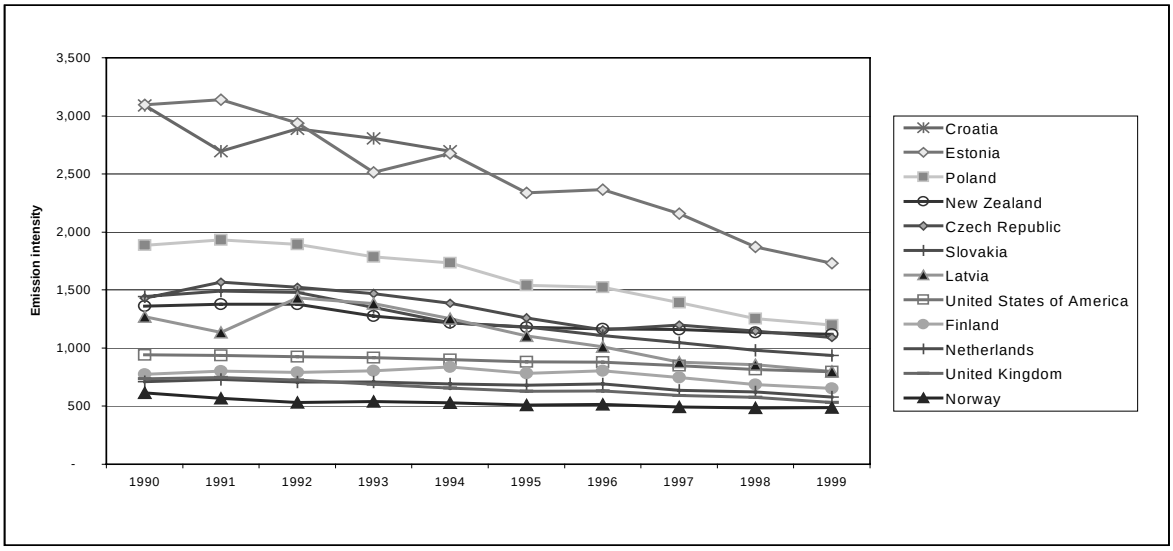
26. With a few exceptions, Annex II Parties expected their total emissions to grow at a slower rate or even to stabilize in some cases after some initial post-2000 growth with the existing and adopted policies (exceptions include CAN, NOR, USA). However, for many Parties these policies may not be sufficient to achieve the Kyoto Protocol targets (BEL, CHE, FRA, JPN, NLD, NZL). Projection data for EIT Parties suggest that, after the significant emission drop between 1990 and 2000, either emission growth is expected to rebound, or emissions were already following an upward trend at the end of the 1990s. For most of these countries it will not be difficult to achieve the Kyoto targets with the existing policies.

Some indicators of policy performance

27. Many Parties used different sets of highly aggregated indicators to assess policy performance and the impact of the key drivers on emission trends at national and sectoral level. These indicators were also used for setting the national and sectoral goals for policies. In particular, Parties used such indicators to assess improvements in the emission intensity of economies expressed as a ratio between GHG amount and gross domestic product (GDP) (figures 4 and 5), and the carbon intensity of economies expressed as a ratio between the amount of CO_2 and GDP (figures 6 and 7). They also linked the carbon intensity of the economy with the energy intensity of the economy, the latter being expressed as a ratio between the total primary energy supply (TPES) and GDP, (figures 8 and 9).[6] Finally, a combination of two indicators, such as the emission intensity of the economy and emissions per capita was also used, (figure 10 and 11). In most of these indicators, GDP was among the major factors considered, which to some extent reflected national circumstances. In addition to these aggregated indicators, Parties used many disaggregated sector-specific indicators, by which the effect of the mix of policies affecting the same output, e.g. vehicle miles travelled, could be monitored and assessed in detail.

[6] Emission estimates to calculate the indicators were taken from the UNFCCC inventory database, and data on GDP at constant prices expressed in purchasing power, and population were taken from the International Energy Agency (IEA) database. As these data, except for emission data, were available until 1999 only, all the indicators cover the 1990–1999 period.

Figure 4. Emission intensity of economies, Parties showing a decreasing trend in this indicator between 1990 and 1999, (kg GHG per thousand US dollars GDP)



28. The data on the emission intensity of the economy suggest that, in all Parties except Spain, this intensity declined. In terms of this indicator, Parties could be split into three groups. The EIT Parties belong to the first group, with a drop in emission intensity of between 44 and 20 per cent between 1990 and 1999. However, two of the Annex II Parties, the United Kingdom and Norway, also fell into this group. The majority of the Parties fell within the second group, with an emission intensity decline of between 10 and 20 per cent, which suggests an improvement of more than 1 per cent annually (AUT, BEL, DNK, FIN, FRA, NLD, NZL, SWE, USA). Some Parties in these two groups experienced significant economic growth but still ranked high in terms of emission intensity improvement (NLD, NOR, NZL, POL, USA). The rest of the Parties fell into the third group, with an emission intensity decline of less than 10 per cent between 1990 and 1999 (CAN, CHE, JPN) or even an increase (ESP). However, some of the Parties in this group had already achieved high energy efficiency gains in their economies and associated low emission intensity in the early 1990s and further improvements were difficult to achieve (CHE, JPN).

Figure 5. Emission intensity of economies, Parties showing a broadly steady or slightly decreasing trend in this indicator between 1990 and 1999 (kg GHG per thousand US dollars GDP)

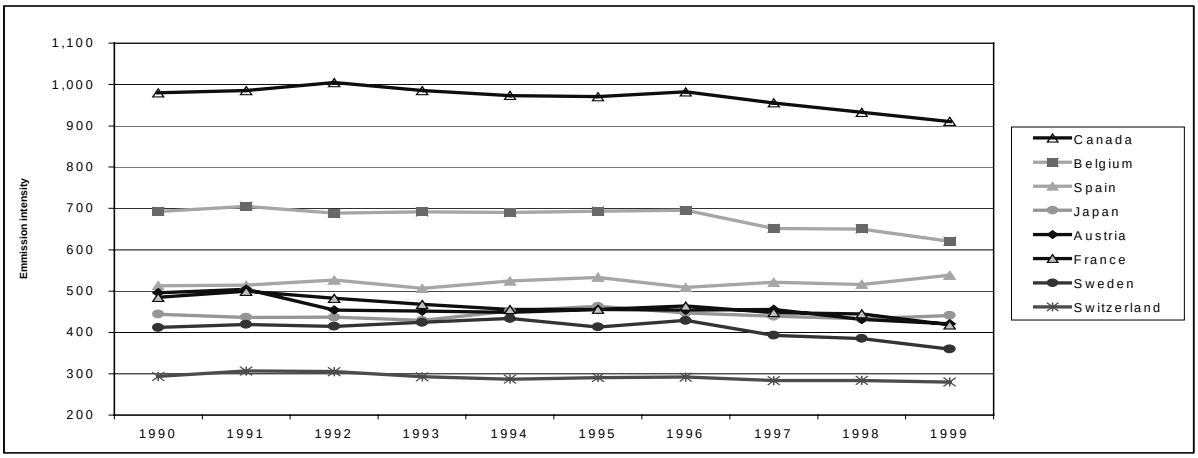
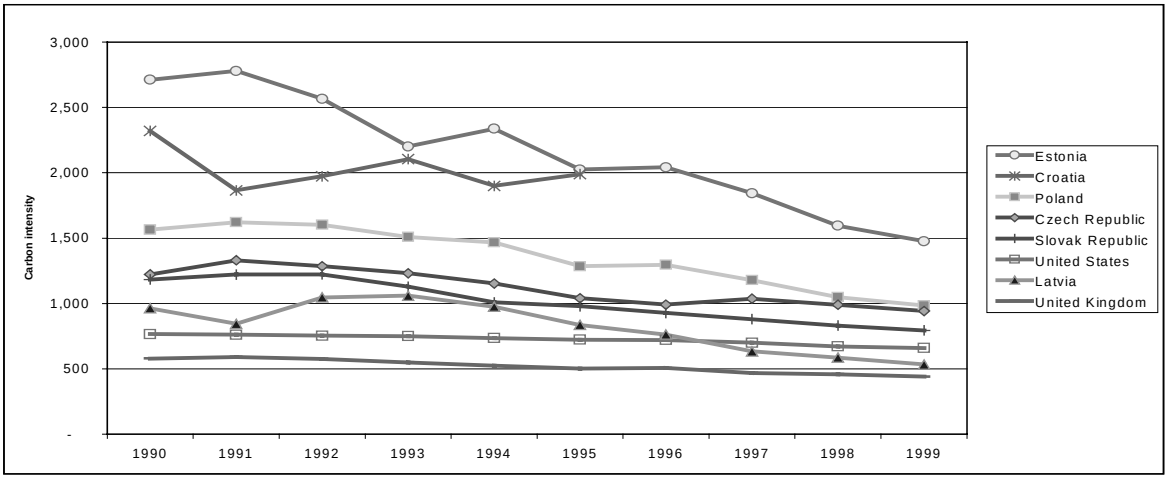


Figure 6. Carbon intensity of economies, Parties showing a decreasing trend in this indicator between 1990 and 1999 (kg CO_2 per thousand US dollars GDP)



29. If only the carbon intensity of the economy is considered, given that CO_2 is by far the most important gas for the Parties covered in this report except for New Zealand, the distribution of the countries within the three large groups remained the same as above with few exceptions. Norway, for example, moved to the group of countries with carbon intensity reductions of between 10 and 20 per cent and New Zealand moved to the group with carbon intensity reductions of less than 10 per cent. This suggests that carbon intensity improvements broadly defined the overall emission intensity improvements of Parties.

Figure 7. Carbon intensity of economies, Parties showing a broadly steady or slightly decreasing trend in this indicator between 1990 and 1999, (kg CO_2 per thousand US dollarsGDP)

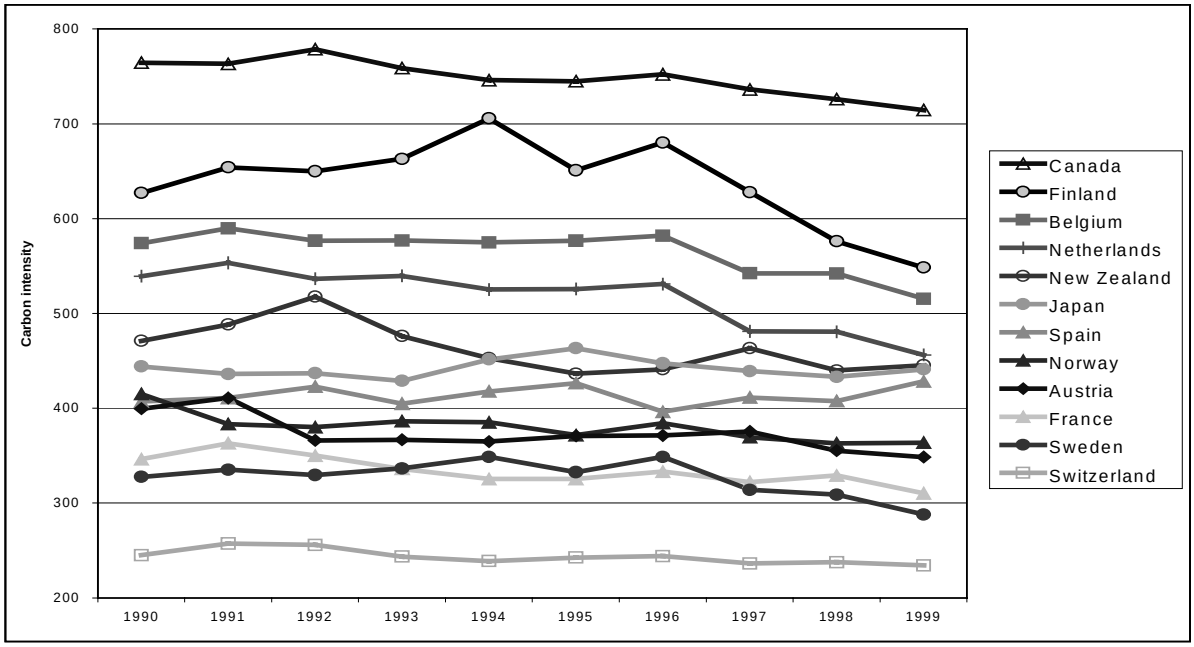
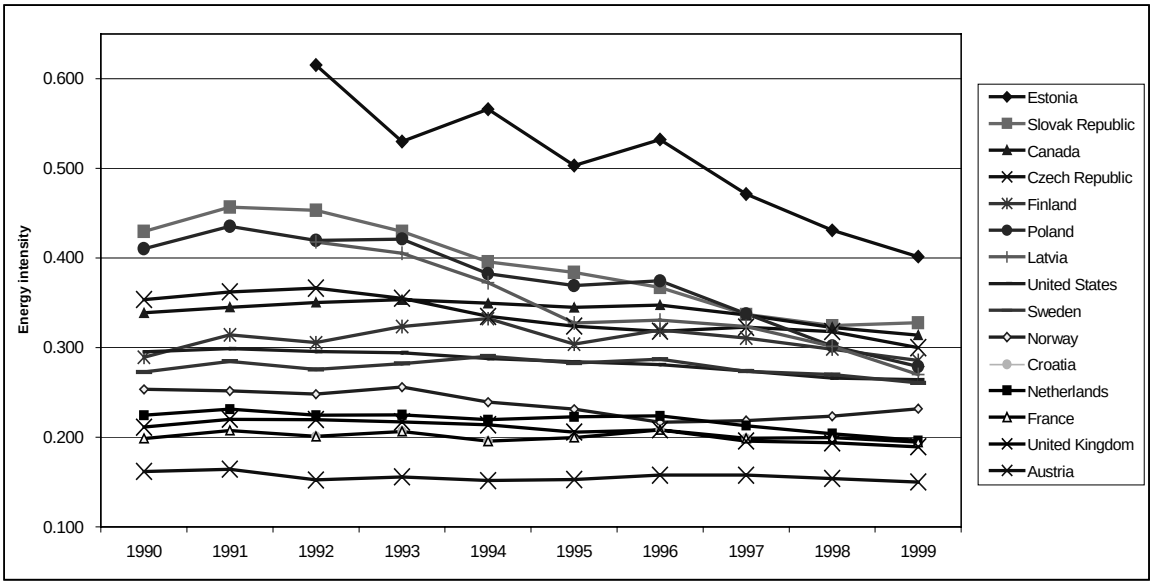
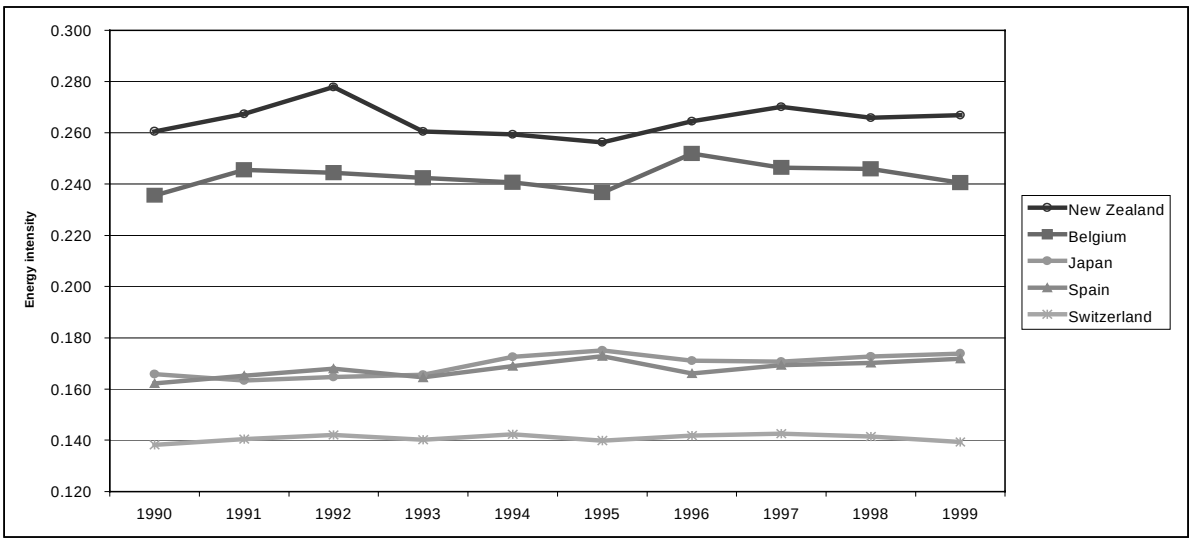


Figure 8. Energy intensity of economies, Parties showing a decreasing trend in this indicator between 1990 and 1999 (PJ TPES per thousand US dollars GDP)



30. Another important indicator is the energy intensity or energy efficiency of the economy. An analysis of energy efficiency improvements between 1990 and 1999 suggests its close correlation with the emission and carbon intensity. A few EIT countries obtained significant efficiency gains and improved the energy efficiency of their economies by between 15 and 32 per cent thanks to structural changes (CZE, POL, SVK).[7] Some Annex II Parties improved their efficiency by between 10 and 12 per cent (GBR, NLD, USA). The rest improved energy efficiency by between 1 and 8 per cent (AUT, CAN, FIN, FRA, NOR, SWE) or saw it decrease (BEL, CHE, ESP, JPN, NZL).

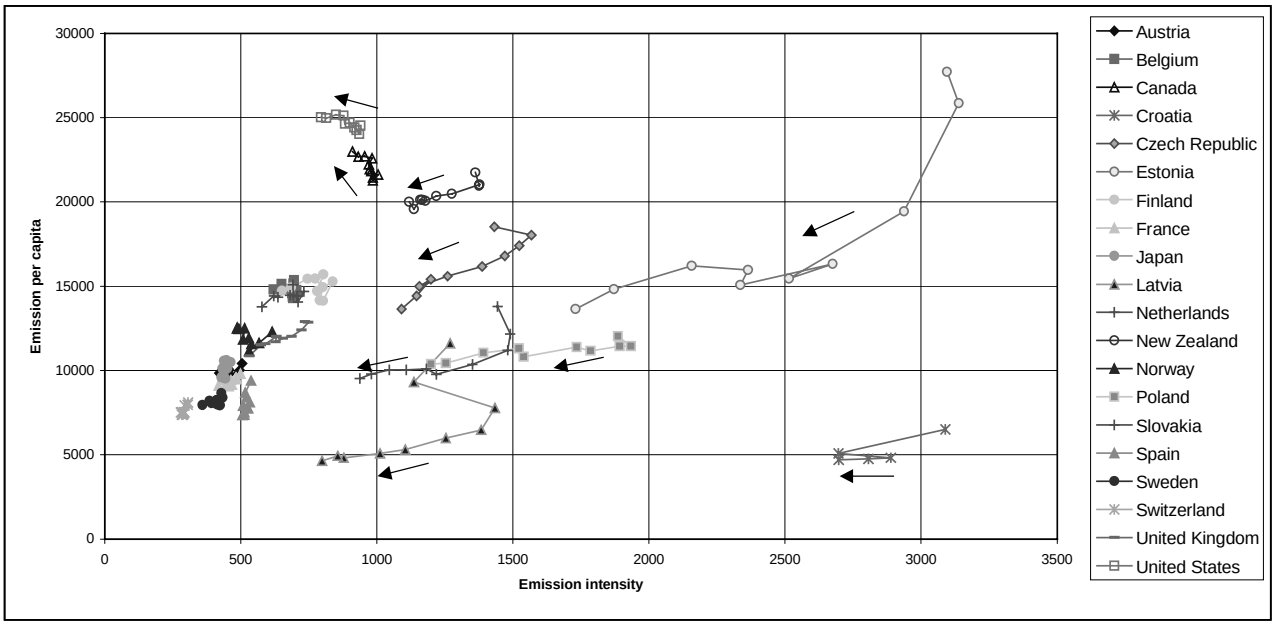
Figure 9. Energy intensity of economies, Parties showing an increase in this indicator over time, or a decrease at the end of the1990s after an initial increase (PJ TPES per thousand US dollars GDP)



[7] These structural changes included an increase in services on account of industry, a shift toward less carbon-intensive fuels such as natural gas, and an increased share of appliances with higher energy efficiency, e.g. refrigerators.

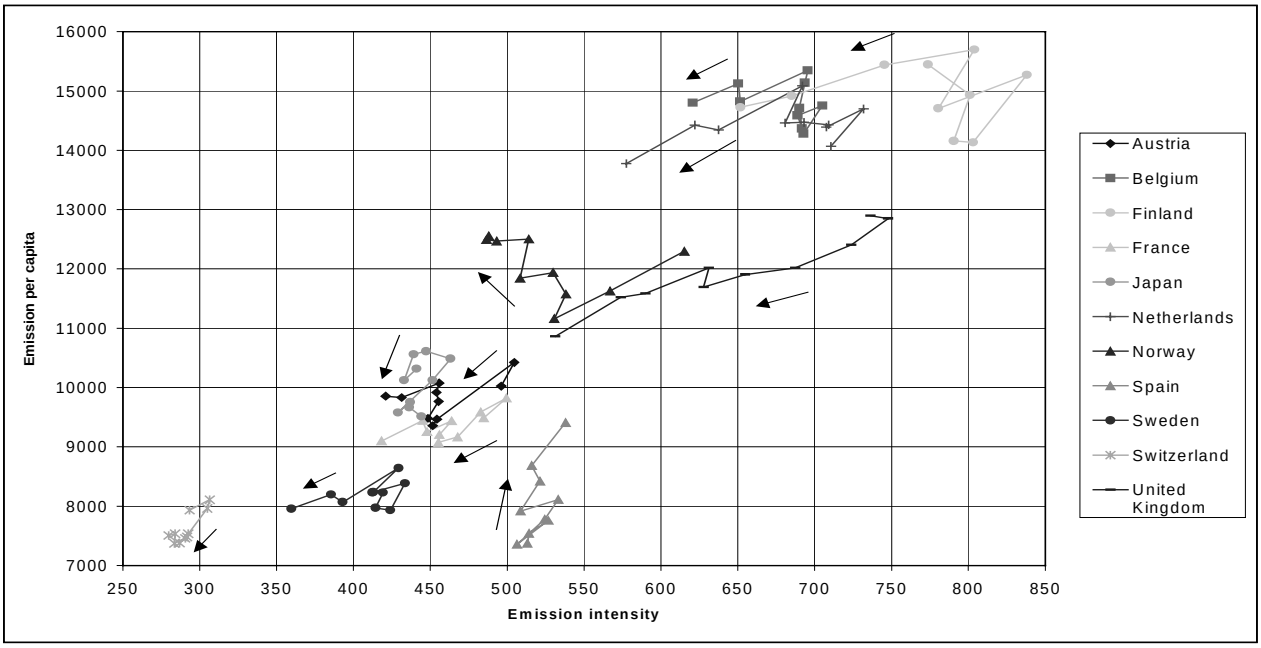
31. Sweden reported a combination of two related indicators, the emission intensity of the economy and emissions per capita. Following this approach, the trend analysis of these two indicators between 1990 and 1999 suggests that most of the Annex II Parties that reduced the emission intensity of their economies, also reduced their per capita emissions (AUT, CHE, FIN, FRA, GBR, NLD, NZL, SWE). Among the rest of the Parties, Norway and the United States increased their per capita emissions by 2 per cent only, while the emission intensity of their economies dropped by 21 and 15 per cent respectively. Other Parties increased even more their per capita emissions, by between 4 and 8 per cent, and meanwhile slightly decreased the emission intensity of the economy (BEL, CAN, JPN). Spain increased both its per capita emissions and the emission intensity of its economy.

Figure 10. Relationship between emissions per capita and emission intensity of the economy between 1990 and 1999



32. While EIT Parties, broadly distributed on the right-hand side of figure 10, showed a remarkable decrease in both indicators (with a reduction of up to 44 per cent in emission intensity and a decrease of up to 60 per cent in GHG per capita (LVA)), European Annex II Parties and Japan showed relatively little variation over time (on the lower left side of figure 10; this part is also shown enlarged in figure 11). The remaining Annex II Parties (CAN, NZL, USA) showed the highest per capita emissions (upper left side of the figure) of all Parties, with only small changes over this period combined with a relatively low emission intensity of the economy.

Figure 11. Relationship between emissions per capita and emission intensity of the economy between 1990 and 1999 for the countries clustered on the left in figure 10



III. CROSS-CUTTING ISSUES ON POLICIES AND MEASURES

Institutional framework for climate change policy

33. As part of their climate change policy framework, many Parties reported strengthening of the existing institutional arrangement for climate change policy design and implementation. In particular, more emphasis was placed on coordination and strengthening the interlinkages between all relevant national institutions, together with involvement of new institutions, to ensure an integrated approach to policy (GBR, SWE). More emphasis was placed on the work of the ministries of energy and economic affairs and, when relevant, transport, agriculture and forestry. This reflected the prominence of particular sectors such as energy, and particular instruments such as economic instruments, in the national climate change strategies. The ministry responsible for the environment continued to coordinate or at least to have key responsibilities for climate change policy in many Parties (AUT, CZE, EST, FIN, GBR, LVA, NLD, POL, SVK, SWE).[8]

34. A few Parties reported on new institutions being set up to address climate change, which provided a strong foundation for a comprehensive and targeted set of policies and measures. New Zealand reported on the Climate Change Ministerial Group set up in 2000, directly accountable to the Prime Minister. France reported on reinforcement of the inter-ministerial task force on climate change by placing it directly under the office of the Prime Minister. Japan reported on reinforcement of the global warming prevention headquarters set up in 1997 under the Cabinet of Ministers.

[8] Examples of different institutional arrangements included the Ministry of Trade and Industry in Finland being responsible for coordinating the preparation of the climate change strategy, the Parliament of Norway being responsible for overall climate policy, and the United States inter-agency coordinating committee chaired by the Executive Office of the President being in charge of the climate policy.

Evolution of climate change policies and measures between the second and third national communications

35. All Parties included in this report, except for the United States, underlined the importance of the Kyoto Protocol in shaping their domestic climate policy responses. They noted the steps taken to prepare for the ratification of the Protocol, including the necessary legislation. They reiterated their Kyoto targets as a first step towards long-term and continued emission reductions, and stressed the importance of the domestic effort to deliver significant contributions towards meeting these targets. Parties stressed to a varying extent the need to use the Kyoto Protocol's flexible mechanisms and sinks to achieve these targets.

36. Some EIT countries noted that attaining the Kyoto targets is realistic in their specific economic and environmental context. Still, they acknowledged that the estimates of their future emission levels are uncertain and that these levels could be higher than projected due to possible faster economic growth. They further underlined the role of energy efficiency, energy market reform and renewables in reaching the Kyoto targets.

37. The United States reported a new domestic target to reduce its emission intensity by 18 per cent over the next decade through a combination of voluntary, incentive-based and existing mandatory measures. This was reported to represent a 4.5 per cent reduction from the emission level projected in 2012 under "business as usual".

38. Climate change has risen in importance in the national policy agenda in almost all Parties, and some of them acknowledged this (BEL, NLD). Others stressed the strong linkages between climate change, energy and mobility on the one hand and the sustainable development objectives on the other hand (BEL, CAN, EST, EUR, FRA, GBR, NZL, POL, SVK, SWE). In the context of sustainable development, most of these countries addressed in an integrated manner all three aspects of the sustainable development paradigm: economic, social and environmental. The EC highlighted sustainable development as being amongst its fundamental objectives and noted the linkages to climate change. Many Parties have become instrumental in integrating climate change into policy objectives of the different sectors, especially the energy sector (EST, EUR, FIN, FRA, NZL, POL, SWE). This is also valid for other sectors, such as agriculture and waste (NZL, SWE), and transport (FIN).

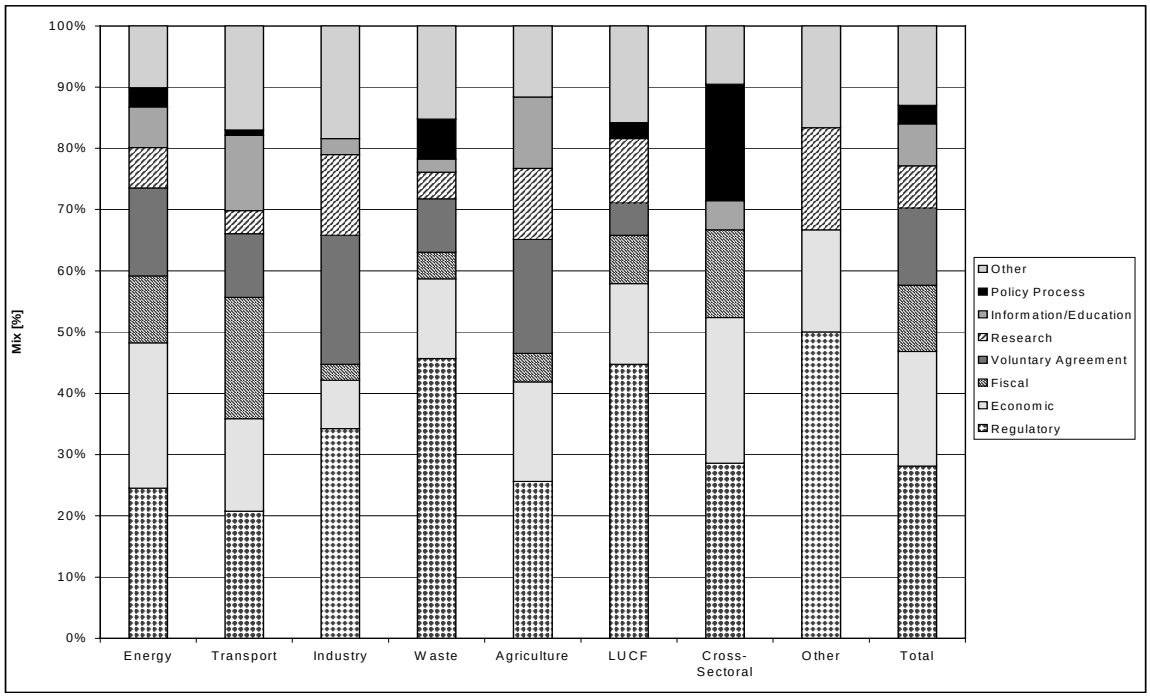
39. Parties used combinations of policy instruments for climate change mitigation. There was a clear, common trend towards widening the scope and increasing the coverage of the policy instruments within each sector. Some important cross-sectoral instruments, such as carbon taxes and emissions trading, were given an increasingly prominent role. On the balance of policy instruments, when the information from the key policies and measures from the database is considered, economic and fiscal instruments together with regulations appeared to be by far the most important policy instruments used, in terms of both their number and the emission reduction expected (figure 12).

40. The mix of instruments used varied from sector to sector. Voluntary agreements, for example, still prevailed in the energy use by industry and industrial process sectors, whilst regulations together with a target-oriented approach were typical for the waste sector. More detail on the choice of policy instruments by sector and underlying reasons for such choice is given in the analysis by sector below.

41. By sector, the post-Kyoto period (after 1997) saw the most significant changes in climate policies in the energy sector. These changes extended to: strengthening the role of some existing instruments and approaches, such as energy/CO_2 taxes; introducing new and innovative instruments, such as domestic emissions trading and green certificate trading; and placing more emphasis on climate change related aspects in pursuing regulatory reform in the energy sector, such as promoting renewables

and combined heat and power (CHP) generation. Parties continued to explore the efficiency of different policies and approaches to mitigate emissions from transport, which remained one of the most difficult sectors for climate policies. Integrated transport policy frameworks that are well suited to national circumstances emerged as a promising climate policy approach in transport, e.g. in Finland.

Figure 12. Percentage composition of portfolio of policy instruments reported by Annex I Parties by sector



42. There was an increasing amount of fluorinated gases in the emissions from industry, resulting in an increase in policies and measures targeting these gases. In the waste sector, there was a significant shift from the end-of-pipe technologies and related policies (capture and treatment of landfill gas) to more comprehensive waste policies centring on waste minimization and recycling, and to incinerating and landfilling of only the remaining waste. Also, more attention was given to policies and measures in agriculture and LUCF, which stemmed from the increased awareness of the role sinks can play in meeting the Kyoto targets.

A new, integrated approach to climate policy formulation and implementation

43. A clear tendency toward using a new integrated approach to climate policy formulation and implementation could be observed in the NC3 of the Parties that have ratified the Kyoto Protocol or intend to do so. To a lesser extent, this tendency could also be observed in the NC3 of the other Parties. This tendency was characterized by an emphasis on a portfolio and phased approach, and also by greater involvement of local and regional governments and important groups of stakeholders in the design and implementation of climate change policy. In this integrated approach, Parties placed greater emphasis on mitigation but also included elements of adaptation, especially in sectors where the success in mitigation may depend on enhancing the adaptive capacity of different systems, e.g. LUCF.

44. Examples of such integrated approaches could be found in the 2001 draft Climate Strategy 2001 of Austria, the 2001 draft National Climate Plan of Belgium, the 2000 Canada's Implementation Strategy on Climate Change and its First National Climate Change Action Plan, the 2001 European Sixth Environmental Action Programme and the 2000 European Climate Change Programme, the 1999 National Climate Policy Implementation Plan of the Netherlands, the 2000 National Programme to

Combat Climate Change of France, the 2002 Guideline for Measures to Prevent Global Warming in Japan, (currently updated) and the 1998 Climate Change Reduction Policy Plan of Latvia.

45. Significant emphasis was placed on the portfolio approach, meaning that a wide range of instruments which complement each other were used to obtain maximum mitigation gains, for example in promoting renewable energy or energy efficiency. The portfolio approach was used at national level, for example when Parties considered supplementarity of emissions trading and carbon taxes, or at a level of specific policy, for example using a mix of preferential tariffs, grants and tax exemption to promote renewables. However, Parties continued to choose different portfolios and combinations of policy instruments even in cases when they have some similarity in the national circumstances.

46. Many Parties estimated that, even with the most recent measures launched in the late 1990s, they may not achieve the Kyoto targets. This is why some of them outlined a phased approach to their climate policy, meaning that they clearly identified initial and secondary, or reserve policy packages to be put in place in the interim period a few years before the first commitment period under the Kyoto Protocol, if they are not on track to meet the Kyoto targets (BEL, CHE, FRA, JPN, NLD, NZL). This is especially true for energy/carbon taxes for the Parties that have them in place or consider them as a part of their climate change policy package.

47. The Netherlands, for example, described a basic package of measures, to be supplemented by a "reserve" package only if it is not on track to meet its Kyoto targets. Switzerland focused on voluntary measures from 2000 to 2004 and envisaged introducing a CO_2 tax and other mandatory measures, if necessary, thereafter. The United Kingdom and Japan also identified an initial set of policies and measures to be introduced immediately and a secondary set of such measures to be introduced later.

48. Greater involvement of local and regional government, as noted above, and consultation and collaboration with targeted groups and major stakeholders seem to have an increasingly important role in climate change policy making (AUT, BEL, CAN, CHE, EUR, FIN, NLD, NZL). The climate change policy packages reported by many of the Parties emerged after several stages of intensive policy consultation with different branches and levels of governments, and key stakeholders. Such consultations allowed the definition of principal measures in the national context and explored how these principal measures could be complemented by other measures at sectoral level, and at regional and local government level. It also contributed to defining the most effective mix of policies, given Parties' national circumstances. Parties acknowledged that such cooperation and consultations have been among the critical elements to secure consensus and ensure success in climate policy implementation.

Role of new technologies

49. Most of the Parties attached great importance to new technologies in dealing with climate change. Key technologies noted by most Parties included renewables, end-use technologies with higher energy efficiency and fuel cells. The 2001 United States' National Energy Policy, for example, recommended the use of existing and developing technologies to reduce GHG emissions, including improved energy efficiency for vehicles, buildings, appliances and industry, development of hydrogen fuels and expanded use of cleaner fuels, including initiatives for coal and gas and new nuclear technology.

50. Most of the EC countries considered innovations in technology as an important element of efforts to reduce emissions in the medium and long term and envisaged the expansion of programmes aimed at increasing the market penetration of the next generation of fuel efficient technologies. They also made reference to the emission reduction gains which could be delivered by some new technologies which are close to the margins of commercial viability, such as microturbines, fuel cells, solar cells, solar heating, advanced biomass-based technologies and propulsive systems and fuel cells in transport.

Latvia noted the importance of the EC Organization of Promotion of Energy Technologies (OPET) programme to promote new technologies, in particular renewables and energy efficient technologies.

51. In addition to energy, several Parties reported policies aimed at stimulating research on mitigation in agriculture (FRA, JPN, NZL,USA). These policies are important as they have the potential to provide the new technologies that will form the basis of future mitigation in a sector where so far only few policy and technology options have been identified and implemented.

52. In most of the cases, the new technologies were referred to in the context of the Parties' research and development effort, or in the consideration of policies and measures, with no reference to their effect on GHG mitigation in the near and mid-term. This is most likely due to the uncertainty as to when these technologies will become commercially available and what will be the rate of their market penetration. One of the exceptions in this context was Japan, which foresaw a reduction of 26,000 Gg CO_2 in 2010 from the new technologies, in addition to the existing and additional measures.

Criteria used for climate change policy design and implementation

53. Parties used different sets of criteria and applied different weights to individual criteria in the ex-ante choice of climate change policies and in the ex-post evaluation of their effects. Environmental effectiveness together with cost-effectiveness appeared as the most prominent of these criteria. Other criteria included distributional impacts, social inclusiveness, competitiveness of industry and commercial opportunities, impacts on employment, commercial opportunities, human health and welfare, acceptability to various stakeholders, and effects in changing attitudes and awareness.

54. There was limited information in the NC3, however, on how these criteria were considered in policy making. Information on the cost of implementation of specific policies was largely missing or referred to other sources outside the NC3 and information on the reductions delivered or planned by different measures was rarely provided. In most cases, only highly aggregated information on the total effect expected or the effect expected by sector was reported. Even when information on cost was provided, it was difficult to judge what type of cost it represented: social, economic, marginal, shadow or other. It seems that in most cases when information on cost was provided, a cost-effectiveness analysis was conducted to estimate it, i.e. the cost associated with the implementation of policy was assessed with regard to a policy goal set, e.g. $/ton GHG emissions saved.

55. Only a few Parties provided a comprehensive description of how different criteria were taken into account in the evolving climate change strategies (EUR, GBR, NLD). The Netherlands, for example, reported the methodology used for cost estimates and how cost-effectiveness was considered in ranking the measures within this strategy. It also reported on the possibility of saving 19,000 Gg CO_2 (11 per cent of base year emissions) at negative cost, as the value of energy saved would outweigh the cost of measures. The EC presented in detail how cost-effectiveness could be used as an underlying criterion for climate policy design without compromising the environmental effectiveness of such policy.

56. The environmental effectiveness of climate policies could include not only climate change mitigation, but also other environmental benefits, e.g. local air and water quality improvement and transboundary air pollution reduction. These additional environmental benefits could be considered together with some social and economic benefits, e.g. employment and welfare, land-use change practices, and traffic congestion mitigation as ancillary benefits that arise as a consequence of climate change policies. Switzerland, for example, noted that its "Energy 2000" programme, a core programme in implementing climate change policy, created new investment opportunities of Sw F 4.4 billion and new employment amounting to 40,000 person-years.

57. However, Parties rarely elaborated on how such ancillary benefits had underpinned their policy choices. This stems from the fact that, so far, most of the climate change policies and measures reported by the Parties have been implemented with primary objectives different from climate change. Climate change mitigation, with few exceptions, was a side effect of these policies, or co-benefit of them.[9] New policies having climate change as their primary objective, e.g. emissions trading, which will possibly bring ancillary benefits, were launched only recently. An example of co-benefits for climate change is the strengthening of measures to encourage fuel switching from coal to gas reported by some Parties, with one of the policy drivers for fuel switching being reducing air pollution.

Monitoring and evaluation of policies and measures, and projections of emission levels

58. Many Parties, especially the EC countries, stressed the role of monitoring and evaluation of climate change mitigation as an integral element of their climate change strategies. Monitoring provided a means of tracking annual emission levels and assessing the progress towards meeting the policy objectives and targets, e.g. national emission targets and targets for renewables and CHP. In particular, the EC made reference to the *1999 Monitoring mechanism of Community CO_2 and other GHG emissions*. This monitoring was largely based on the result of the annual GHG inventory at national level and at the level of different sectors.

59. Many Parties noted methodological difficulties in ex-post evaluation of the implementation of policies and measures and, in particular, the difficulties in establishing a counterfactual baseline scenario, obtaining high quality data and separating clearly the effect of different measures or portfolios of measures. They also noted inevitable uncertainties associated with estimates of mitigation effects and cost. This explains, in part, why monitoring of effects was done in a more systematic manner in the case of some policies, e.g. policies aimed at end-use energy efficiency, compared to the others and why monitoring of the performance of individual policies or sets of policies targeting a single output was rarely reported.

60. Still, some Parties used different ex-post evaluation approaches to evaluate the effects of policies, including structural analysis of historical emission levels to distinguish between the impact of activity levels, changes in structure, weather and energy efficiency on energy and emission levels (CAN, CHE, GBR, NLD, NOR). Norway, for example, used a dynamic equilibrium economic model to study the effect of the carbon tax. Switzerland provided details of independent evaluations of its Energy 2000 programme, a core element of its climate change policy. It is likely that the role of monitoring will become more prominent in the future, given that most countries have a target value for emission reductions to be delivered by the key sectors and key measures (e.g. GBR, JPN).

61. Methods used by Parties in the NC3 for preparing projections of future emission levels, and for assessing the ex-ante effect of policies and measures, and their impact on future emission trends remained broadly the same as in the previous communications. To assess the total effect of policies and measures in the future, Parties used in most cases complex macroeconomic equilibrium or partial equilibrium models, or models combining the features of macroeconomic models with engineering bottom-up models (optimization and simulation). Yet, these models more comprehensively reflected the underlying drivers of the emission trends and links between the economy, energy and emissions, because of the longer time series of historical values available for NC3 analysis than for the NC2.

62. Parties rarely described in detail the models used for projections of non-energy sources and usually employed expert judgement together with spreadsheet models for this purpose. One such exception was Austria, which reported on the carbon balance model it used to produce full carbon accounting by reflecting the dynamics of the carbon cycle in Austria. Another example was

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[9] IPCC and the economic literature make a clear distinction between ancillary benefits and co-benefits.

New Zealand, which developed a similar tool for monitoring the terrestrial carbon cycle based on a carbon monitoring system for indigenous forests and scrublands and a monitoring programme for carbon storage in soils. The forest scrubland monitoring programme is based on remote sensing combined with ground truthing, and will provide a five-yearly check on afforestation, reforestation and deforestation activities. Spain also developed a similar type of model.

IV. ENERGY

A. GHG profile

Total emissions

63. The energy sector comprises the two subsectors, fuel combustion and fugitive fuel: The emission profile and policies in the fugitive fuel subsector are reported below in a separate section of this chapter. In 2000, fuel combustion accounted for 9,675,630 Gg CO_2 eq., or 81 per cent of total emissions (excluding LUCF).[10] Emissions from fuel combustion have increased by 11 per cent since 1990, compared to a 9 per cent increase for total emissions.

Carbon dioxide

64. Excluding transport, which is reported upon separately, CO_2 emissions from fuel combustion rose by 8 per cent between 1990 and 2000, accounting for 71 per cent of total CO_2 emissions at the end of this period. This was equivalent to 56 per cent of total emissions.

65. In one group of Parties, emissions rose by between 11 per cent and 22 per cent (CAN, ESP, NOR, NZL, USA,). Strong economic growth and, to some extent, population growth were the main drivers in these countries, with an additional contribution from oil and gas production for export (CAN and NOR). Emissions of CO_2 from EIT Parties plummeted by between 20 per cent (POL) and 73 per cent (LVA) as a result of economic recession and restructuring. The United Kingdom also showed a substantial decrease of 9 per cent in CO_2 emissions from fuel combustion. This was primarily due to a switch from coal to natural gas and an increase in nuclear plant utilization rates, following liberalization of the electricity market and in response to requirements to reduce emissions of acid rain precursor gases.

66. The trend in CO_2 emissions from fuel combustion (excluding transport) from 1990 to 2000 by Party is given in table 2. Five groups of Parties can be distinguished: (a) with a consistent fall in emissions (CZE, EST, GBR, LVA, POL, SVK[11]); (b) with emissions fluctuating within a certain range (AUT, BEL, CHE, FRA, NZL); (c) with emissions rising until 1996/1997, then falling (FIN, NLD, SWE); (d) with emissions rising until 1996/1997, then stabilizing (JPN, NOR); and (e) with a consistent rise in emissions (CAN, ESP, MCO, USA).

67. In summary, only four Parties had clearly rising energy-related CO_2 emissions at the end of the decade, a very different message from that given by a simple comparison of 1990 and 2000 data. Emissions appeared to be broadly stable in eight Parties, and falling in eight Parties, including four non-EIT Parties. Several Parties noted that milder winters at the end of the decade reduced energy demand and thus contributed to the stable or falling emission trend. Nonetheless, climate change related policies in energy seem to be partly responsible for reducing emissions in some Parties (FIN, FRA, GBR, NLD, SWE).[12]

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[10] All references to total emissions in this section of the report exclude LUCF emissions and sinks, unless noted otherwise.

[11] In fact, SVK emissions have fallen to a plateau.

[12] The FRA emission drop was mainly due to the phasing-in of new nuclear plants to meet the increase in electricity demand, and GBR emission drop came mainly from energy market liberalization as explained above.

Methane and nitrous oxide

68. In 2000, CH_4 emissions from fuel combustion amounted to 3.4 per cent of total CH_4 emissions, and 0.4 per cent of all GHG emissions. In the same year the energy sector, excluding transport, contributed only 5 per cent of N_2O emissions, or 0.3 per cent of total GHG emissions. These emissions rose by 3.5 per cent between 1990 and 2000.

B. Implementation issues for all energy sub-sectors

Policy objectives and policy trends

69. Parties reported that key policy objectives in energy are: safeguarding the environment, promoting economically efficient energy supply and energy use, and energy security. Climate-related policies mostly targeted CO_2 emissions, but tended to reduce other energy-related gases in proportion to their share in the primary energy supply. The competitiveness of the economy had a strong influence on the choice of policies in this sector.

70. Climate change has risen in importance as a policy objective in almost all Parties. This is most clearly demonstrated in Parties' reporting of new or strengthened measures that are mandatory or that provide direct financial incentives for actions that reduce emissions. Most Parties reported three or more such new measures (AUT, BEL, CAN, CHE, CZE, EST, FIN, FRA, GBR, JPN, LIE, NLD, NOR, POL, SVK, SWE).[13] Similarly to other sectors, only those measures that Parties reported as being implemented, or adopted and clearly on track to be implemented in the near future, were included in the analysis of the energy sector.[14]

Policy instruments

71. Almost all Parties reported new mandatory policies, including taxes on energy and CO_2, negotiated agreements linked to environmental permitting, emission trading schemes, energy efficiency standards and portfolio standards, and generation quotas for renewables or combined heat and power.[15] Almost all Parties also reported new policies that give a direct financial incentive to some actors to take measures that reduce emissions. These included investment grants and preferential loan rates for renewables and energy efficiency projects, preferential electricity tariffs for renewables or CHP, and tax relief including accelerated depreciation of capital and exemption from tax on electricity tariffs.[16]

72. All but two Parties (ESP, MCO) reported new or revised voluntary policies and measures of various kinds, including labelling of consumer appliances, information, training and best practice schemes, and voluntary reporting of measures to reduce emissions from power generation with "early crediting" in the absence of government-mandated emission reductions (e.g. CAN).

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[13] Parties reporting fewer such measures were LVA (2), HRV (1), USA (1) and MCO (0).

[14] Because of ambiguities in the style of reporting by some Parties, policies that might have qualified could have been overlooked. In particular, Spain's national communication was presented in Spanish only and only the executive summary was available in English in time for this analysis.

[15] Four Parties did not report any policies of this type (CZE, ESP, MCO, POL).

[16] Five Parties did not report any policies and measures in this category (ESP, EST, HRV, MCO, USA).

Table 2. CO_2 emissions from fuel combustion excluding transport 1990 - 2000, Gg

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Trend 90-00
Estonia	34,801	32,223	24,330	18,647	19,642	17,991	19,010	18,787	16,598	15,221	15,464	down
Latvia	16,953	14,640	11,707	10,104	9,528	8,269	7,752	6,287	5,925	5,298	4,626	down
Poland	434,760	329,846	330,452	326,139	332,550	312,657	335,400	324,214	298,731	287,581	274,075	down
Slovakia	50,654	45,257	41,784	39,016	35,684	36,685	37,194	37,212	35,139	34,066	33,183	down
Croatia	16,497	11,828	10,928	11,521	10,506	11,048	0	0	0	0	0	down and up
Czech Republic	152,805	141,938	127,486	122,347	115,371	115,735	119,620	122,534	113,707	105,485	113,310	down and up
United Kingdom	440,026	448,930	433,942	419,138	412,574	407,163	421,124	397,583	401,461	391,351	398,566	down and stable
Austria	36,754	39,800	35,064	34,974	34,676	37,212	39,163	39,158	37,576	37,246	36,382	stable
Belgium	89,600	92,803	90,520	88,736	90,416	92,743	95,325	89,992	93,245	89,290	90,126	stable
France	244,790	267,233	255,200	236,225	229,447	234,071	247,526	239,250	257,788	243,246	238,511	stable
New Zealand	13,601	14,009	15,402	14,277	13,686	12,973	13,820	15,582	13,826	15,064	15,064	stable
Switzerland	25,529	27,209	26,885	25,702	24,701	25,975	26,699	25,460	26,478	25,817	24,451	stable
Finland	41,418	41,461	39,675	41,072	46,965	44,757	50,226	48,283	45,105	44,047	42,553	up and down
Netherlands	128,058	136,310	133,600	135,430	135,950	138,170	144,393	133,037	137,643	134,042	135,023	up and down
Sweden	32,703	33,400	31,403	32,044	35,799	34,397	38,061	33,148	33,830	31,836	31,283	up and down
Norway	15,453	14,891	15,335	15,675	17,258	16,566	18,638	18,785	18,485	18,068	17,862	up and stable
Japan	841,693	849,171	852,238	838,045	881,792	887,088	891,272	886,765	864,250	901,743	910,049	up
United States	3,322,288	3,311,237	3,379,531	3,465,723	3,513,864	3,524,496	3,667,717	3,732,301	3,721,639	3,742,415	3,856,435	up
Canada	275,782	270,856	281,047	275,109	280,867	288,408	295,895	300,701	306,234	315,996	335,922	up
Spain	147,199	152,603	158,900	150,303	156,878	167,574	150,550	167,715	167,931	188,158	196,181	up
Monaco	57	67	68	73	74	72	78	78	75	80	0	up
Liechtenstein	143	0	0	0	0	0	0	0	0	145	0	NA

73. Many Parties reported on policies that give an indirect financial incentive to reduce emissions, including support for feasibility studies and project preparation, and research, development and demonstration of improved technologies. The United States placed particular emphasis on research and development. Some other Parties also stressed the importance of making new technologies available (CAN, EUR, JPN).

Estimated impacts and cost-effectiveness of policies and measures

74. Parties reported a variety of methodologies to monitor and evaluate the effectiveness of existing policies. Switzerland emphasized the role of independent experts in evaluating in detail the impacts of individual elements of the Energy 2000 programme. The programme was estimated to have reduced emissions by 10,000 to 14,000 Gg CO_2 for an investment cost of S Fr 4.7 billion.[17] These estimates did not distinguish between the total investment and the additional investment required to achieve the energy savings targeted by each measure. Therefore, they do not provide a basis for estimating the cost per tonne of CO_2 avoided.

75. Some Parties reported estimates of the effects to date of some of their current policies, but the reports covered methods for estimating the impacts of only a limited number of these measures (e.g. NLD, USA). Norway reported difficulties in establishing hypothetical "no-measures" baselines, gathering data and selecting analytical tools. Norway's list of quantified emission reductions to 2000, and projections to 2010, is therefore only partial and, in particular, it excludes measures relating to energy efficiency, renewables, transport and agriculture. Canada noted that, although it had comprehensively reviewed the impact of all government and some private sector initiatives,[18] as an input to the NC2, there had been no equivalent assessment for the NC3. Few Parties addressed additionality and baselines, making estimates of cost-effectiveness uncertain and comparisons of cost-effectiveness between Parties difficult.[19]

Projections of future impacts of policies and measures

76. Most Parties drew upon existing models of the energy economy (e.g. the NEMS model in the United States) in making projections of future emissions. The impact of policies and measures, such as energy and CO_2 taxes, were estimated by reflecting the energy price increase in the model. Most Parties considered a range of scenarios that allowed for varying assumptions about GDP growth, demographics and geopolitical factors.

77. Some Parties reported the use of cost-optimizing models that included a database of performance and cost data for individual energy technologies, such as MARKAL (CZE, LVA, NLD, SWE). Measures to reduce the cost of technologies, e.g. investment grants, are easy to reflect in such models to produce estimates of their impacts. Some Parties emphasized the uncertainty inherent in projections and, as for assessing the past impact of policies, the difficulties in determining baselines (e.g. AUT, NOR).

78. Some Parties reported projections for a "without measures" baseline scenario, and a scenario with existing measures, therefore giving an estimate of the aggregate impact of policies (e.g. CAN, CZE, NLD, SVK). The Czech Republic noted that the "without measures" scenario excluded measures that came into force after 1995. In addition, the Netherlands and Slovakia also provided a scenario with

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[17] Cumulative, from 1991 to 2000.

[18] Specifically, all Voluntary Challenge and Registry initiatives established under the National Action Program on Climate Change.

[19] The Netherlands noted that estimated emission reductions by industrial participants in negotiated agreements took account of comprehensive studies of the expected autonomous improvement in energy efficiency in the absence of policy. This allowed the true, additional effect of policy to be estimated.

additional measures. In some Parties, projections already incorporated existing policies and no baseline scenario was provided, so the effect of those policies was not identified (e.g. EST, GBR, USA).

79. A few Parties reported aggregate projections for the effects of policies on individual energy subsectors, or on energy and transport separately (BEL, CAN, CHE). A very few Parties (e.g. AUT) projected emission reductions for each key implemented, adopted and planned policy.

80. Most of the Parties projected that existing, adopted and planned measures will be sufficient to stabilize or reduce their energy emissions (excluding transport, where this is specified) (AUT, BEL, CHE, CZE, EST, FRA, GBR, HRV, JPN, LVA, POL, SVK, SWE). Six Parties projected a substantial rise in energy emissions even with existing, adopted and planned measures (CAN, FIN, NLD, NOR, NZL, USA). Two of these Parties proposed using the Kyoto flexibility mechanisms to help close this gap (NLD, NOR). Two others indicated possible, additional measures to close the gap (FIN, NZL). Three Parties did not provide quantitative information on the impacts of policies and measures on projections (ESP, LIE, MCO).

C. Key cross-cutting energy policies

81. Parties reported on three main types of policies and measures affecting the energy sector as a whole. These were taxes on energy and CO_2, domestic emission trading schemes, and regulatory reform in the energy sector.

Taxes

82. Many long-standing energy taxes reported by Parties were first introduced to raise revenue and/or to reduce demand and hence reduce vulnerability to foreign energy suppliers, particularly of oil.[20] At the beginning of the 1990s, several Parties introduced also CO_2 taxes defined by the carbon content of fuels (e.g. FIN, NOR, SWE). Overall, there has been an expansion in the coverage of energy/CO_2 taxes and an increase in the number of Parties applying or seriously considering them. Norway has extended the coverage of its CO_2 taxes, although it reduced the level of the CO_2 tax on offshore oil and gas production, in response to difficult trading conditions caused by low oil prices in 1998–1999. Sweden raised its CO_2 tax rate in 2001. The United Kingdom introduced in 2001 the climate change levy (CCL), a tax applied to energy used in the business and public sectors in 2001. In 2000, Estonia introduced a CO_2 pollution charge on emissions from all fossil fuel-fired power plants with a capacity greater than 50 MW.

83. Sometimes it was not clear whether a new or updated energy/CO_2 tax had been introduced specifically to reduce GHG emissions, or to meet more traditional policy objectives. Austria acknowledged that, while its energy-related taxes are primarily revenue-raising, they have the positive effect of potentially reducing GHG emissions.

84. In some Parties, energy/CO_2 taxes have been introduced as part of a broader policy of moving towards "green" taxation, i.e. shifting the tax base from labour towards physical resources such as energy and minerals. Sweden stressed that adjustments to the general system of taxation (beyond just energy/CO_2 taxes) can influence the behaviour of the public in ways that are positive for the environment. France emphazised ecological tax reform as its ultimate aim, and stressed that this

[20] Any tax on energy products raises the price for consumers, reduces energy demand when it is sensitive to price, and so reduces GHG emissions. This relationship is long-established: those Parties with the highest per capita energy use have the lowest energy taxes, and vice versa.

approach could help the EC as a whole meet its Kyoto targets. However, it noted that its proposed eco-tax system was suspended in 2000, after world oil and gas prices rose rapidly.[21]

85. A few Parties emphazised the benefits of "revenue recycling", i.e. allocating some or all of the revenue from an energy/CO_2 tax to specific uses. The United Kingdom recycles some CCL revenues to the businesses affected, by reducing the labour charges they pay towards public welfare schemes. A large part of the revenue from the levy was used to promote climate-friendly technologies and best practices. In effect, this is a shift towards green taxation. Some Parties reported their intention to use the revenues from any fines and penalties (e.g. incurred by electricity utilities that fail to meet quotas for supplying energy sourced from renewables) for similar purposes (AUT, FIN).

86. Regarding the cost-effectiveness of CO_2 taxes, Norway noted that its tax rates could not be equal in all sectors of the economy, as this could reduce the competitiveness of some sectors, particularly energy-intensive industry. This reduces the cost-effectiveness of the tax. Norway also reported on studies that suggest GHG emission reductions of between 1.5 and 4 per cent, in the sectors where the tax applies (excluding offshore oil and gas). Another study of Norway's offshore CO_2 tax identified technological improvements that would have been cost-effective even with no tax, but that might not have been identified and implemented if the tax did not exist.

87. Sweden reported that (again for competitiveness reasons) industry pays reduced rates of CO_2 tax, and sometimes zero rates, inevitably reducing the cost-effectiveness of the overall tax. The United Kingdom emphasized that the cost-effectiveness of the CCL is enhanced by allowing companies increased flexibility. Companies can join negotiated agreements and qualify for reduced rates under the CCL, and then choose to buy permits from the emissions trading scheme as an alternative to making reductions themselves. However, the CCL is a general energy tax, applied on the energy content (e.g., £ 0.0043 per kilowatt-hour of electricity), rather than the fuel's carbon content.

88. In addition to the taxes that have been implemented or strengthened since the NC2, some Parties are considering introducing energy/CO_2 taxes as part of their package of measures under the Kyoto Protocol (e.g. CHE, NZL). Switzerland reported its intention to reintroduce a proposal for an energy savings tax, after its rejection in a referendum in 2000. Table 3 summarizes the status of climate-related energy and CO_2 taxes implemented, adopted or under consideration in Parties.

Regulatory reform of the energy sector

89. Most Parties are enacting regulatory reform in the energy sector (all 15 EC countries, all EIT Parties reporting, JPN, NZL, NOR, USA). The main objective is to increase economic efficiency by introducing more private sector participation, more competition in supply and distribution and increased consumer choice over energy suppliers. Governments are generally retaining authority over gas and electricity transmission networks, to ensure reasonable terms of access to the networks and reasonable charges for using them.

90. One important element of regulatory reform is the reduction of subsidies for the production or consumption of energy, particularly fossil fuels. Phasing-out of subsidies is a main objective of reforms in EIT Parties (CZE, HRV, POL, SVK). Prices are now much closer to the real costs of production, stimulating much greater energy conservation measures than before.

91. Very few other Parties reported on fossil fuel or electricity subsidies. The EC has proposed that its member States phase out all fossil fuel subsidies by 2010. France subsidizes electricity for residents in its overseas territories, where the cost of production is higher than in mainland France. While

[21] FRA notes that the higher energy prices are restraining energy demand and that this was the original intention of the proposed tax reform. GBR cancelled its fuel duty escalator, intended to restrain demand for transport fuels, around the same time.

acknowledging that the electricity price subsidy makes solar water heaters uncompetitive, it noted that it has successfully stimulated the market through countervailing subsidies on the purchase price of solar water heaters.

Table 3. GHG-related taxes in the energy sector, excluding transport

Party	Implemented[1] updated[2], planned and optional[3]	Energy, CO_2, GHGs	Energy sectors targeted	Rate: (local currency/ tonne CO_2))	Industry exemptions?	Comments
Austria	Updated, 2000	Energy	All	na	No	Mainly revenue-raising
Belgium	Planned	Energy	na	na	Planned	
Estonia	Implemented	CO_2	All	EK 7.5	No	
Finland	Updated, 1998	Energy/CO_2	All	17.2 euros	Yes	
France	Planned	Energy/CO_2	All	na	na	Suspended until further notice
Netherlands	Implemented, 1998	Energy	All	na	na	
New Zealand	Planned	CO_2	na	na	na	Tax scheme or emissions trading under consideration
Norway	Updated, 1999	CO_2	na	up to NK 315	Yes	Planned switch from tax to emissions trading by 2008
Sweden	Updated, 2001	CO_2	All	SK 530	Yes	
Switzerland	Optional, from 2004	CO_2	All	na	Yes, mandatory alternative	
United Kingdom	Implemented	Energy	Industry, commercial, institutional	na	Yes, mandatory alternative	

[1] New tax schemes implemented since the NC2 and not updated since then.

[2] Tax schemes existing at the time of the NC2 and significantly strengthened since then.

[3] To be introduced if other measures are not on track to meet targets for emission reductions.

92. Some Parties project that energy market reforms will favour natural gas over coal, for new power plants. The EC estimated that in its member countries this will avoid annual emissions of 63,000 Gg CO_2 equivalent from 2010 onwards. The United States reported that natural gas has been the fuel of choice in recent years for new power generation plants, and expected this trend to continue as market liberalization advances. No Parties quantified the sensitivity of the fuel-switching effect to future coal and natural gas prices.

93. Some EIT Parties reported on new, broad, framework legislation for energy, air pollution, environmental strategy and environmental impact assessment (CZE, EST, HRV, SVK). Much of this legislation established new arrangements for energy markets and created new institutions with powers to take measures that might affect emissions of GHGs. These legislative programmes were part of the general overhaul of government structures in the EITs.

Domestic emissions trading schemes

94. Since the NC2, Parties have become more familiar with the concept of emissions trading schemes (see box on *Domestic emissions trading schemes*). Discussions between Parties on the emissions trading "flexibility mechanism" under the Kyoto Protocol may have played a role in this.

95. One of the first domestic emissions trading schemes (ETS) has been implemented by the United Kingdom. This ETS covers all six GHGs defined under the Kyoto Protocol.[22] Initially, large

[22] Two Parties that did not report are known to have implemented emissions trading schemes (AUS, DNK).

emitters volunteered to join the ETS and were allocated emission permits. The Government then held an auction in which it bought back, and permanently retired, permits from participating companies. This created an initial incentive to join the scheme. By the end of 2006, total annual emissions from these companies will be about 4,000 Gg CO_2 equivalent less than their baseline emissions. From September 2002, around 6000 additional sites will be eligible to enter the ETS, to help them meet targets arising from negotiated agreements. Permits will be convertible at the rate of 1 permit equal to 0.23 MWh of energy. Similarly excess emissions reductions can, following verification of energy consumption (and production, for targets based on energy consumption per unit of product), be converted into permits that can be banked or traded within the United Kingdom's ETS.

96. The United Kingdom plans to include power generation companies in the ETS and to allow participants in other schemes, such as the Renewable Energy Obligation, to convert targets under those schemes into tradable permits. These linked schemes all involve voluntary or mandatory emission caps.

97. Other Parties have advanced plans for emissions trading schemes. The EC has produced a framework to try to ensure compatibility among national schemes in EC member States. Canada was running a pilot programme that certifies private, voluntary trades of emission reductions. Certified reductions would be eligible for recognition within any future, mandatory scheme for emission reductions. Other Parties are also considering emissions trading (AUT, NLD, NZL, SWE). Norway reported plans to shift from its current system of CO_2 taxes to a broad-based emissions trading scheme, by 2008. This should cover 80 per cent of all GHG emissions, including many sources not covered by the current tax.

Domestic emissions trading schemes

The emissions trading schemes reported on by Parties all share the important feature that an absolute cap on emissions is imposed on some group of polluters. By doing this, governments create the market within which participants can trade. Individual polluters are allocated an initial share of the overall cap, e.g., in the form of permits to emit a certain tonnage of CO_2 each year. A polluter that emits less than its allocation allows, can sell its spare permits to another polluter that is emitting more than its allocated amount. All Parties implementing or considering emission schemes invoke penalties, e.g. fines, for emissions that are not covered by permits (otherwise there would be no incentive for one participant to buy permits from another). Parties reported emissions trading schemes as "economic" measures, although the overall cap, and penalties for non-compliance, are mandatory regulations, while the buying and selling of emissions permits is a market measure.

Technology development

98. Most Parties use research and development, and technology demonstration programmes to develop new technologies and reduce their costs to competitive levels (e.g. the EC common funded programmes under successive framework programmes). Many Parties also use measures to increase the application of technologies to increase the scale of production, and so drive down costs through economies of scale and the "technology learning" effect (e.g. renewables procurement policies in Canada). Most technology-related measures cited by Parties are sector-specific, and are considered in each subsection below, where appropriate. Key technologies cited by most Parties include renewables of various kinds, and fuel cells. Several Parties emphazised advanced fossil fuel power generation, including capture and storage of CO_2, and a few Parties noted the need for advanced nuclear power technologies.

D. Energy industries

GHG profile

99. In 2000, emissions of CO_2 from the energy industries accounted for around 31 per cent of all GHG emissions. These emissions rose until 2000, to 3,681,720 Gg, a 14 per cent increase compared to 1990. However, some large variations occurred in individual Parties. Significant rises, ranging from 5 per cent to 43 per cent occurred in one group of Parties (CAN, CHE, ESP, FIN, JPN, MCO, NLD, NOR, NZL, SWE and USA). Meanwhile, emissions fell by between 4 per cent and 16 per cent in another group of Parties (AUT, BEL, FRA and GBR). In EIT Parties, emissions fell by between 25 per cent and 76 per cent (CZE, EST, LVA, POL, SVK).

Implementation issues

100. The energy industries sector is a priority area for policies and measures for almost all Parties. Many of the policies affecting energy industries were connected to broader energy sector reforms, such as regulatory reform, restructuring of energy companies and privatization. Parties stressed that the main objective of these reforms was to increase economic efficiency and consumer choice, but emphasized the potential for reforms to introduce or strengthen policies specifically designed to reduce GHGs.

101. Since the NC2, most Parties have introduced or updated direct financial incentives for renewables and CHP (AUT, BEL, CAN, CHE, CZE, EST, FIN, FRA, JPN, LIE, LVA, NLD, NOR, POL, SVK, SWE). Mandatory measures have been introduced or strengthened in some Parties (AUT, BEL, EST, FRA, GBR, HRV, NLD, SVK). Two Parties reported only indirect financial incentives (e.g. funding for feasibility studies, project preparation, pilot projects and research and development) for renewables and CHP (NZL, USA).

102. Some Parties (especially EIT Parties) have strengthened measures (such as investment grants and soft loans) to encourage fuel switching from coal to gas. One of the policy drivers for fuel switching measures was reduction of local and regional (acid rain-related) air pollution.

103. New technologies appeared critical to maximizing emission reductions through renewables, cleaner fossil power technologies and nuclear power. Some Parties noted that reducing the cost of renewable technologies is a key objective of measures that increase their scale of application.

Framework and description of policies

Renewables

104. Many Parties are using regulatory reform of the energy sector as an opportunity to design incentives for preferential treatment of renewable energy sources and CHP (EC member countries and EIT Parties). Some Parties have established, or strengthened, quotas for the amount of electricity from renewable sources that electricity suppliers must supply (AUS, BEL, FRA, GBR, SWE) or have adopted measures to establish quotas in the near future (BEL). Some Parties (e.g. BEL) refer to this quota as a "renewables portfolio standard", i.e. renewables must be accorded a certain percentage share in the "portfolio" of sources of power generation.

105. Suppliers that do not meet their renewable electricity quotas are subject to financial penalties in some Parties (e.g. AUT, GBR). Revenue from penalties is sometimes earmarked exclusively for measures that encourage renewables, or other environmentally friendly energy options ("revenue recycling"). Green certificates are a new type of measure arising from the general interest in quotas (see box below).

106. Many Parties reported grants towards investment in renewable power generation projects. Other increasingly reported forms of direct financial incentive were accelerated depreciation on capital invested and preferential interest rates on loans for project financing. Preferential tax treatment was used in many different ways to promote renewables. For example, Canada encouraged manufacturing, processing and mining companies to invest in renewable energy supply (and energy efficiency measures) by allowing investments to be written off against tax on *all* sources of income.

Green certificates

Parties emphasized that quota schemes (or renewables portfolio standards) require robust certification that a particular source of electricity is indeed renewable or, in the case of CHP, meets certain quality standards. This certification of green power has led to the concept of "green certificates". In some Parties, green certificates can be traded to give electricity suppliers more flexibility in meeting their quotas (BEL, CAN).

Green certificate trading in the EC is supported by the EC Directive on the Promotion of Electricity from Renewable Sources, which addresses technical issues related to accurate and reliable certification of green electricity. As EC member States begin to implement the EC Directive nationally, these provisions should encourage trading of green certificates between countries.

107. Preferential "green" tariffs for electricity from renewable energies have existed in some Parties for over a decade. Many Parties continue to report the use of green tariffs, which guarantee a higher price for a unit of renewable electricity than the prevailing market price (e.g. BEL, CHE).

108. Procurement schemes, in which public sector agencies (primarily) undertake to procure their electricity from renewable sources, were cited by some Parties (AUT, CAN). There was little information on their effectiveness, even for those schemes cited in the NC1 and NC2 (e.g. CAN).

109. Many Parties were placing increased emphasis on biomass within their renewables portfolios. Wood, in particular, was being promoted through grants and tax relief measures to encourage wood crops for electricity and heat generation, in several Parties (e.g. FRA, LVA, USA).

110. Many Parties emphazised the need for substantial increases in renewable power generation, in order to restrain future growth in GHG emissions. Renewables have been promoted by most Parties for decades, but have so far failed to capture a significant share of electricity supply. The adoption of mandatory quotas by some Parties is perhaps a direct response to the little impact of other measures. In some Parties, e.g. the United Kingdom, quotas should lift the share of renewables to as much as 10 per cent of electricity supply by 2010. This is equivalent to a reduction of GHGs from the energy sector of typically a few percentage points. In New Zealand the target for increasing renewable energy supply was set at 25-55 PJ, by 2012, and measures to achieve this target were planned for 2002. In general, however, policies and measures for renewables were not sufficient to meet the stated targets, and in particular the EC umbrella target of 12 per cent renewable electricity supply by 2010 did not seem to be matched by Parties' current and proposed measures.

CHP and district heating

111. For many Parties, measures to increase the use of CHP in electricity supply were closely linked to measures to encourage renewables: a similar array of incentives, such as generation quotas, preferential tariffs and tax treatment, capital investment subsidies and accelerated depreciation of capital investment, were seen to be useful (e.g. AUT, FRA, HRV, NLD). For example, as of 1997, France has exempted CHP plants from its tax on natural gas and heavy fuel oil (for low-sulphur fuel only), supplementing reduced rates of business tax and accelerated depreciation on investment in CHP. In some

Parties, CHP projects generated green certificates that were equivalent to certificates generated by renewables projects (e.g. BEL). Other Parties address CHP, especially CHP for district heating (DH) systems, under energy efficiency measures. Many EIT Parties still have extensive DH networks and are taking measures to improve their efficiency and to reduce the environmental impacts from their heating units. Slovakia cited its programme of subsidies and other financial assistance to improve the efficiency of DH systems as being an effective measure to reduce CO_2 emissions.

112. A few Parties reported some problems for CHP arising from electricity market reform, suggesting a need for careful consideration of the incentives for CHP in the design of electricity markets (FRA, GBR, NLD). The United Kingdom, for example, reported that demand for CHP fell substantially when the original post-privatization electricity trading "pool" was replaced with a new market model - the New Electricity Trading Arrangements. Sweden noted that changes to its energy tax structure that were intended to reduce demand for electricity, had a negative impact on CHP.

Oil and gas production

113. Several Parties are large producers of oil and gas. Related emissions are not only CO_2 emissions from energy use in oil and gas production, but also fugitive emissions of CH_4 and non-methane volatile organic compounds (NMVOC).[23] Some Parties projected decreasing oil and gas production and, therefore, decreasing emissions, to 2010 (GBR, NLD). The United States projected a slight decrease in oil production and a small rise in gas production.

114. Two reporting Parties are major oil and gas exporters, i.e. their exports greatly exceed their domestic consumption (CAN, NOR). Canada reported that the production of oil and gas for export was responsible for 25 per cent of its overall increase in emissions between 1990 and 1999. The oil and gas sector in Norway accounted for more than 50 per cent of its total increase in emissions over the same period. Both of these Parties projected increasing oil and gas production to meet growing export demand, through 2010.

115. In its baseline projection, Norway projected increasing emissions from the sector up to 2010. The key Norwegian policy restraining emissions is a tax on CO_2 emissions from offshore production. However, when the Kyoto Protocol enters into force, the oil and gas sector will be included in a comprehensive emissions trading scheme before the first commitment period that will reduce emissions from all sources by 5,700 Gg CO_2 eq., to 58,000 Gg CO_2 eq.

Fuel switching in power generation

116. In Parties with substantial coal-based power generation, a long-standing, policy-driven shift away from coal continued, in order to reduce local health impacts and to reduce emissions of acid rain precursor gases. This trend remained strongest in the EITs, e.g. Croatia, where the national electricity company is constructing new, high-efficiency CHP units, fuelled by natural gas. The Czech State Environmental Fund provided subsidies for switching from coal to gas, that helped to reduce the number of furnaces in the range of 0.2-5 MW that continue to burn brown coal by 75-80 per cent, between 1990 and 1999.

117. At the time of the NC2, some Parties noted that factors such as low capital costs for new gas plants, low prices for natural gas, and environmental pressures might encourage a switch from coal to gas power generation within liberalized electricity markets. In their NC3, some Parties continue to provide projections of the impact of coal-to-gas fuel switching. For example, the EC projected that full liberalization of electricity and gas markets in member States will lead to a reduction of 63,000 Gg

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[23] Specific measures to address fugitive emissions are discussed below.

CO_2 eq. per year, from 2010 onwards, as a result of construction of natural gas power plants instead of coal plants. However, Parties' projections do not provide sensitivity analyses of factors currently affecting coal and natural gas markets, such as increased gas price volatility, increased difficulty in obtaining long-term, fixed-price, gas supply contracts and the fall in the price of world traded coal.

Cleaner fossil fuel technologies

118. Several Parties emphasized the possible contribution of advanced fossil fuel combustion technologies. The United States has large research and development budgets on more efficient coal and gas fired power generation. One particularly promising technology option — capturing CO_2 emissions from coal or gas fired plants and sequestering them in geological structures — has, in the view of several Parties (CAN, EUR, JPN, NLD, NOR, USA), recently become a serious mid-term option. All the technologies for CO_2 capture from power plants and geological sequestration are commercially available today, with the exception of power plant scale capture of CO_2 from flue gases.

119. Only the Netherlands included CO_2 capture and geological sequestration among its set of "reserve" policies and measures. Based on current cost estimates, it might use this option if the "basic package" of policies is not on track to meet its Kyoto targets. The EC identified CO_2 capture and sequestration as a measure for possible further action under the second phase of the EC Climate Plan. Since 1996, Norway has been injecting 1,000 Gg CO_2 per annum into a saline reservoir under the North Sea. Seismic monitoring suggests that the CO_2 is permanently trapped below the impermeable cap layer overlying the reservoir. The United States reported on a large research and development budget aimed at reducing the cost of capture and storage and, in the medium to long term, developing versions of the technology that would produce hydrogen for use in power generation or transport. Canada reported on several studies and pilot projects in this field.

Nuclear

120. In many Parties, nuclear power provides a significant proportion of the supply of electricity (BEL, CAN, CHE, CZE, FIN, FRA, GBR, HRV, SWE, USA). Any decisions either to extend the lifetimes of nuclear plants, or for early retirement of plants, will have a major impact on emissions, unless carbon-free alternatives are available. Several Parties have expanded, or plan to expand, nuclear power generation (CHE, CZE, HRV, JPN). The Czech Republic reported that the Temelin plant was brought on line over 2001-2002, but that up to 2020 no new plants were planned. Japan noted that its programme for new plants has fallen behind the schedule set out at the time of the NC2. Extending the lifetime of existing nuclear plants can be a cost-effective means of reducing GHG emissions. The United States reported on a major research and development programme on lifetime extension.

121. Some Parties drew attention to the impact of likely closures of nuclear plants. The United Kingdom noted that a recent announcement of possible nuclear plant closures would increase the emissions projections set out in their NC3 by 1,000 Gg carbon per year, in 2010. Canada noted that its CO_2 emissions projection for 2010 has increased by 4,000 Gg since the NC2, following an assumption that a nuclear plant in Ontario will not now be restored. Sweden emphasized a mix of long-term and short-term measures to compensate for the closure of the two nuclear reactors at the Barseback plant. Further accelerated nuclear plant closures in Sweden may occur only if adverse impacts on electricity price and availability, the environment and GHG emissions can be avoided.

E. Energy use in industry

GHG profile

122. CO_2 emissions from energy use in industry fell by 1.2 per cent between 1990 and 2000, to 1,714,270 Gg. This represents 14 per cent of all GHG emissions in 2000 (excluding LUCF). There were rises of between 3 per cent and 32 per cent in many Parties (AUT, CAN, CHE, ESP, FIN, JPN, NLD, NOR, NZL, POL and SWE) and falls of between 2 per cent and 8 per cent in a few Annex II Parties (BEL, FRA, GBR, USA). There were significant falls of between 39 per cent and 82 per cent in three EIT Parties (CZE, EST, LVA) while Poland already showed an increase of 4.1 per cent.

Implementation issues

123. For most Parties, the competitiveness of industries in the world market continued to be a major concern, which influenced the nature and stringency of policies and measures. In many Parties the measures applied to energy-intensive industries were different from those applying to less energy-intensive industries.

124. Voluntary and negotiated agreements were considered as key measures in this sector by many Parties. Direct financial incentives were also widespread. In many EC countries, the EC Directive on Integrated Pollution Prevention and Control (IPPC), influenced domestic policies. Taxes and emissions trading schemes were also important in some Parties, although energy-intensive industries were often exempted to protect their competitiveness. Almost all Parties placed importance on programmes of education, training, dissemination of best practices and energy auditing and advice. Often these were tailored to help companies meet targets arising from agreements (e.g., CAN, GBR, NLD, NZL).

125. Cost-effectiveness was difficult to assess, for new or existing measures, largely because of the problem of identifying expenditures by industry that were truly *additional* to what would have occurred in the absence of the measure. Similarly, when assessing improvements in energy efficiency, it was essential to estimate what the natural trend rate of improvement would be in the absence of measures. The Netherlands, for example, reported a high rate of energy saving (above baseline) flowing from negotiated agreements, but did not report on the cost incurred by industry. In EIT Parties, economic and policy reforms led to the creation of new institutions for encouraging energy savings and environmental improvements in industry. Common measures in these Parties included information on best practices, training, subsidies, preferential tax treatment investment grants and soft loans.

Framework and policies reported

Voluntary and negotiated agreements

126. The number of Parties using voluntary or negotiated agreements between government and industry increased, and as of 2002 included several Parties (CAN, CHE, GBR, NLD, NOR, NZL, USA). Agreements were often allied with benchmarking efforts, dissemination of information on best practices and improved technologies, and government support for energy audits.

127. In some Parties, agreements were negotiated within a framework that exerts pressure on industries and individual companies to join the agreements, and achieve their stated targets. These negotiated agreements appear to be the most effective. The Netherlands, for example, negotiated an extensive set of long-term agreements (LTAs) with industrial sectors, covering the period 1989-2000 in their first phase. These delivered substantial additional energy savings of 2.2 per cent per annum, compared with an expected autonomous efficiency improvement rate of 1.3 per cent per annum. Measures that individual companies agree to take, as part of their involvement in the sectoral LTA,

become integrated into the environmental permitting process of each company. Companies that choose not to join the LTA in their sector, are obliged by the authorities to undertake every energy-saving measure with an internal rate of return on investment of at least 15 per cent, after tax. The Netherlands recently allocated additional funds to support the role of local authorities in the environmental permitting process. For competitiveness reasons, energy-intensive sectors are not required to develop LTAs. Instead, from 1999, they have committed themselves to being among the world's most energy-efficient businesses in their sector.

128. Japan has taken a similar approach to the Netherlands, with regulators focusing their attention on those sectors of industry that have not established *voluntary action plans*, or are failing to meet their targets. It has recently strengthened its remedial action against companies that fail to meet their agreed targets. The United Kingdom has linked a new scheme for negotiated agreements to the EC IPPC Directive. Energy-intensive companies joining agreements benefit from an 80 per cent reduction in CCL, on the condition that they achieve their agreed targets.

129. New Zealand reported that its voluntary agreement scheme from 1995-2000 was successful, achieving a reduction of 1,500 Gg CO_2 in 1999. It planned to develop a successor scheme that might include more mandatory elements, e.g. linkages to carbon charges. Switzerland implemented a framework for voluntary agreements in 1999, which were judged to have been effective to date and were backed up by the prospect of exemptions from a proposed CO_2 tax.

Energy and CO_2 taxes

130. There was an increase in the application of energy and CO_2 taxes affecting the industry sector. Parties applying energy and CO_2 taxes took steps to avoid tax rates that would make their industries uncompetitive on world markets.

131. For energy-intensive industries, the United Kingdom applied the CCL at only 20 per cent of the standard rate, if these industries concluded negotiated agreements. Sweden reduced its CO_2 tax on fuel to 35 per cent of the standard rate, for all manufacturing industry, agriculture, forestry and aquaculture. When the tax exceeded 0.8 per cent of gross sales, the tax rate dropped to less than 10 per cent of the standard rate, so the marginal incentive to reduce energy dropped, as energy use increased. For some energy-intensive industries (cement, lime, rock and glass production) the tax was capped at 1.2 per cent of gross sales, at which point the marginal incentive to reduce energy drops to zero.

Grants, subsidies and other direct financial incentives

132. Tax relief on investments that improve energy efficiency in industry were introduced in some Parties (e.g., BEL, NLD). Some Parties reporting investment grants, subsidies and other incentives did not distinguish between the sectors involved. This made it difficult to form a clear picture of the importance of these measures in the industry (e.g. the United Kingdom reported a new scheme for accelerated depreciation of investments in energy efficiency by "businesses").

Environmental permitting of energy efficiency and IPPC

133. In the EC, the 1996 IPPC Directive required national governments to regulate energy consumption in all industrial sites falling within the scope of the directive. The directive applied to new and upgraded sites from 1999, and will apply to all sites from 2007. The EC, with the help of national experts and others, produced guidance documents on best available technology (BAT), which, for example, indicate that CHP is the most efficient way of supplying process heat and power in many cases. National permitting authorities have discretion to apply the BAT guidance according to local conditions,

and industrial sites that take part in domestic CO_2 emissions trading schemes are exempt from energy efficiency permitting.

134. The EC reported that, as of 2001, experience with the application of IPPC to energy efficiency was limited. Two major challenges would be to avoid low cost-effective solutions, and to balance energy reductions with measures to reduce "traditional" pollutants that might increase energy requirements.

Materials substitution

135. Some Parties have been exploring the possibilities for large reductions in whole life-cycle emissions through substitution of traditional materials with less energy-intensive materials. For example, engineered wood can replace steel, and ash from coal power plants can replace a substantial percentage of dry Portland cement. France, for example, has a new programme to develop the use of wood in construction which should avoid an estimated 26,000 Gg of CO_2 emissions, by 2010. Japan also promotes wood as an alternative to steel and concrete. However, traditional regulatory approaches that focus on individual processes or industrial sites, including the IPPC, may create barriers to the multi-sectoral, innovative actions that are required for materials substitution.

F. Energy use in the residential, commercial and institutional sector and "others" sector

GHG profile

136. Emissions of CO_2 from energy use in the residential, commercial and institutional sectors and in agriculture, forestry, excluding LUCF, and fishing accounted for 11 per cent of total GHG emissions in 2000 (excluding LUCF), or 1,289,240 Gg. This was an increase of 5 per cent from the 1990 level of emissions. There were rises of between 3 per cent and 9 per cent in some Parties (BEL, FRA, GBR and JPN), and more significant rises between 10 per cent and 33 per cent in some others (CAN, ESP and USA). Emissions fell by between 2 per cent and 28 per cent in some Parties (AUT, CHE, FIN, NLD, NOR, NZL, POL, SWE). In the EITs, the falls were between 51 per cent and 86 per cent (CZE, EST, LVA).

137. Emissions of CO_2 from "other" fuel combustion sources (i.e. those not included under energy industries, industry, transport or residential, commercial, institutional, etc.) rose by 8 per cent, to 68,020 Gg in 2000, or 0.6 per cent of total GHG emissions (excluding LUCF).

Implementation issues

138. Most Parties used a variety of measures in the residential, commercial and institutional sectors. In many cases, these built upon long-standing programmes to improve energy efficiency, which were initiated with energy security or economic efficiency in mind, rather than climate change. Parties increasingly reported that new and revised measures in this sector were undertaken primarily within a GHG policy framework.

139. This sector differs from the industry sector because of the very large number of actors, i.e. consumers and small businesses. Parties therefore report mainly on broad instruments including taxes, energy efficiency standards and labels, and information campaigns. Some measures, particularly investment grants, are targeted at narrower subsectors of the commercial or residential sectors.

140. Several Parties introduced or increased energy or CO_2 taxes affecting the sector, with the primary objective of reducing CO_2 emissions (e.g. FIN, GBR, SWE). Two Parties reported postponing plans for climate-related energy taxes destined to encourage energy saving, because of a sudden increase in world energy prices feeding through to consumers and creating public opposition (CHE, FRA).

141. Many Parties reported the introduction or upgrading of mandatory minimum standards for energy efficiency, in buildings and/or for consumer appliances[24] (AUT, BEL, CAN, EST, EUR, FRA, GBR, JPN, LIE, NZL, NOR, SWE, USA). Many Parties introduced or increased direct financial incentives such as investment grants, low-cost loans or preferential tax treatment, particularly to improve the energy efficiency of buildings (CZE, FIN, NLD, SVK).

142. Almost all Parties reported on a wide range of measures to influence consumer behaviour, such as educational campaigns, energy audits and energy efficiency labelling.

Framework and policies reported

Buildings

143. The energy efficiency of buildings was a priority area for many Parties, which emphasized the large potential for energy savings not just through improvements in existing buildings, but also over the longer term, as the stock of buildings is gradually replaced. Building energy efficiency was subject to a wide range of measures.

144. Minimum national standards for energy efficiency of new buildings were updated by a number of Parties (e.g. AUT, FRA, GBR, JPN, NZL). Generally, building standards were enacted as requirements that have to be met in order to gain approval for any new construction, for example a minimum level of thermal resistance for walls, or a minimum level of thermal efficiency for water heaters. In France, for example, the required energy efficiency of housing was raised by 15 per cent in 2000, compared with the previous 1988 standard and the efficiency standard for commercial buildings was raised by 40 per cent. France also committed itself to reviewing these standards every five years. It further sought to restrain fast-growing demand for air-conditioning by requiring that new houses should meet a specified "comfort level" in hot weather, without air-conditioning.

145. Some Parties also use energy *ratings* for buildings, to supplement other measures. The United States reported its rating scheme, the "Energy Star" label, as the main measure for increasing energy efficiency in new and existing homes. Homes with the Energy Star label have energy savings on average 35 per cent greater than are set out in the national "model energy code" (which is not enforced in all States).

146. For existing buildings, new, mandatory standards were often considered not appropriate. Parties reported on a mix of measures to persuade owners or occupiers to make energy efficiency improvements. Foremost were subsidies in the form of direct grants, or relief from income tax, and reduced rates of purchase tax on equipment and services that improve efficiency. Many Parties also provided free energy audits, gave information and advice to owners, and provided information and training for building contractors and architects.

147. Austria noted that apparently similar measures can vary greatly in their cost-effectiveness. Some of its regions gave subsidies for renovations that bring a building up to a minimum level of heating efficiency, e.g. 80 kWh per square metre per year. Others set requirements for the thermal resistance of walls, windows, etc., that can qualify for subsidies. New, high-performance components received higher subsidies. This encouraged new technologies but might reduce the cost-effective of the subsidies, at least in the short term.

[24] Recent EU-level minimum standards for appliances affect all EU member States.

Consumer appliances

148. Most Parties tightened labelling standards and increasingly moved towards mandatory standards, e. g. the United States. In Japan, the "Top Runner" set of appliance standards was expected to save around 30,000 Gg CO_2 per year, e.g. by cutting the energy requirements of home video recorders by 59 per cent, of refrigerators by 30 per cent and of computers by 83 per cent. The Netherlands reported on a measure to supplement the EC-wide appliance standards: householders were entitled to a partial rebate on the purchase price of the most efficient appliances. The rebates also applied to improved wall and window insulation and household renewable energy systems.

149. Several Parties reported new voluntary agreements with manufacturers to increase the energy efficiency of appliances. The EC introduced several initiatives, including an energy "code of conduct" in the area of digital television equipment and agreements with electronic equipment manufacturers to reduce "standby losses" when appliances are in "sleep mode".

150. Many Parties continued or expanded programmes to influence consumer behaviour and choices through education and awareness-raising. Japan has initiated an innovative programme to help guide its citizens towards sustainable (i.e. lower energy-consuming) lifestyles, through their own efforts. Public education efforts were expected to persuade consumers to re-use shopping bags, reduce thermostat settings, pack refrigerators more efficiently, and take a host of other measures.

Institutional sector

151. To address energy consumption in the institutional (primarily public) sector Parties often choose to strengthen the measures that apply to the economy as a whole with policies to procure energy from low-GHG emitting sources, especially renewables, and to reduce energy consumption in public procurement. The EC reported on a draft directive and voluntary agreements on reducing energy consumption in goods and services procured by the public sector. Canada set a target of reducing GHG emissions from government operations to 31 per cent below 1990 levels, by 2010.

152. Austria emphasized its successful experience in inviting external, commercial enterprises to take over financing of energy efficiency improvements in public sector buildings, in return for a share of the financial savings. The use of such “third party financing” companies, known as energy service companies, was particularly effective for investments with a payback period of 5-10 years.

G. Fugitive emissions

153. In 2000, fugitive fuel emissions accounted for 3 per cent of all GHG emissions (excluding LUCF) or 363,360 Gg of CO_2 eq. This was a fall of 13 per cent from the 1990 level of emissions. In 2000, CH_4 accounted for 95 per cent of total fugitive fuel emissions and CO_2 the rest.

154. More than 90 per cent of emissions of CH_4 in the energy sector were fugitive fuel emissions, e.g. from oil and gas production and leakage of natural gas from pipelines. This was a major issue in EIT Parties, where the oil and gas infrastructure has in the past had relatively high rates of fugitive emissions.[25] Coal mining was also a substantial source of CH_4 emissions. Only a few Parties provided information on efforts to reduce fugitive emissions in the energy sector. The United States reported on voluntary programmes under which companies made cost-effective reductions in fugitive emissions but,

[25] Two EIT Parties that did not report their emissions in 2000 (RUS, UKR) together accounted for over 50 per cent of total CH_4 fugitive fuel emissions in 1990.

in addition, the Government helped to develop and demonstrate improved technologies and encouraged industry to adopt improved technologies and practices.[26]

155. In Norway, fugitive emissions of NMVOCs from the oil production industry amounted to 1,100 Gg CO_2 eq. in 1999. This was several times greater than fugitive CH_4 emissions from all energy sources. Norway made an attempt, with limited success, to establish a voluntary programme to reduce these fugitive NMVOC emissions and decided to apply case-by-case requirements for best available technologies, under the Pollution Control Act. Canada projected strongly rising emissions from oil and gas production through to 2010. It operates a tax incentive for investments in equipment to generate power from CH_4 that would otherwise be flared. Other measures were voluntary, such as a multi-stakeholder working group to review flaring practices in Alberta.

156. EIT Parties generally included measures to reduce fugitive emissions from oil and gas operations within broad packages of measures to improve operations and efficiency in their energy industries. Poland reported on a new programme to reduce methane emissions from coal mines.

H. Policies and measures having a negative impact on emission trends

Reduced prices in liberalized gas and electricity markets

157. One of the main objectives of regulatory reform of energy markets is to increase efficiency in the production and supply of energy, and so reduce prices to consumers. Inevitably, lower prices will increase demand, and hence emissions of GHGs. Austria increased its electricity tax by 100 per cent in 2000, to "compensate for demand-driving electricity price-cutting", following market liberalization in 1999. Switzerland noted that incentives for energy efficiency may be reduced as liberalization of its electricity market progresses. Most Parties were yet to study more this effect, include it in projections, and introduce countervailing measures. In addition, when regulatory reform reduced the cost of producing fossil fuels, or of producing heat and power from fossil fuels, alternatives that were already more costly, particularly renewables, found it even more difficult to gain market share. Sweden noted this effect following the creation of the Nordic common electricity market (Nordpool).

Incoherent treatment of GHG emissions in integrated, regional electricity markets

158. Finland noted that it was obliged to abandon a pure CO_2 tax on the fuel inputs to electricity production and shift instead to an energy tax on electricity consumption. Finland's border charges on imported electricity, intended to reflect the CO_2 content of the source fuels in neighbouring Parties, were disallowed under EC trade rules. The energy tax was less cost-effective at reducing CO_2 emissions and could introduce distortions that must be corrected with countervailing policies, further reducing the cost-effectiveness of the original measure.

I. Conclusions

159. Some individual, effective measures to reduce emissions stand out, despite the difficulties in determining the true additionality of measures, or comparing measures between and within Parties. A number of mandatory measures, both market based and regulatory that seem particularly effective or promising are summarized below.

- *Energy and CO_2 taxes* have substantially reduced emissions in several Parties, notably Norway, Sweden and Finland. However, Sweden noted unintended side effects of its tax and stressed the need to address these. The new *emissions trading system* in the United Kingdom is very likely to

[26] Such programmes in natural gas networks and coal mining reduced emissions in 2000 by 15,000 Gg and 7,000 Gg CO_2 equivalent, respectively, and should reduce emissions in 2010 by an estimated 22,000 Gg and 10,000 Gg, respectively.

achieve substantial quantified emission reductions from the initial industrial participants (assuming that the scheme is enforced by the Government).

- *Quotas, or portfolio standards*, for the share of renewables or CHP in power generation should significantly increase their rate of penetration and help to drive down their costs. Again, future enforcement of the quotas that have been set appears critical. For some Parties, this approach was a clear step forward from the setting of soft targets for renewables and CHP.

- *Negotiated agreements* to reduce energy use in industry have contributed to emission reduction in some Parties (e.g. NLD). Several Parties have moved from voluntary agreements to these tougher forms of agreement.

- *Mandatory regulations for energy efficiency in buildings* have proven to be an effective policy in the residential sector. Many Parties acknowledged a large potential for saving energy and reducing emissions in this way. Parties also generally found *minimum energy efficiency standards* to be an effective way of reducing emissions from the use of appliances in homes and offices.

- In the institutional sector, many Parties have *made additional commitments* to increase energy efficiency in public buildings. Several Parties stressed that such commitments were more effective when private energy service companies helped institutions to meet their targets.

- A number of *innovative* policies and measures have been identified by Parties and are discussed above. These included green certificates (energy industries sector), materials substitution and integration of energy efficiency objectives in industrial site licensing (industry sector), and promoting sustainable lifestyles (residential sector).

- *Close integration of policies and measures* was emphasized by several Parties (e.g. integration of emissions trading, an energy tax, negotiated agreements and the EC IPPC in the United Kingdom). This could prove to be an effective means of finding the right mix of policies and allowing businesses flexibility in responding to increasingly stringent targets.

160. In the energy sector (excluding transport), the mix of policies and measures that most Parties put into operation has generally been somewhat fragmented and not rigorous enough to achieve the aim of stabilizing CO_2 emissions in 2000 at their 1990 levels. On the other hand, at the *end* of the 1990s, only a few Parties were on a clear rising emission trend. For many Parties with apparently stable emissions at the end of the 1990s, it is too early to say whether policies have played a significant role in restraining emissions, not least because emissions may have steadied only temporarily because of factors such as a milder climate. However, it is likely that increasingly tough climate change related policies in Finland, the Netherlands and Sweden were partly responsible for the downward trend in their emissions at the end of the 1990s.

161. Most Parties are now, after a long period of "wait and see", putting in place policies and measures that should reduce emissions substantially from baseline levels. Other Parties plan to do so, or are holding measures such as CO_2 taxes and emissions trading schemes in reserve, to be introduced if necessary. In particular, almost all Parties have implemented or adopted (or updated) a mix of mandatory measures (whether market-based or regulatory) and direct financial incentives for actions that reduce emissions.

162. For the most part, these new measures have not begun to have their full impact on reducing emissions. Even so, many Parties acknowledged that these policies and measures will not be sufficient in themselves to guarantee stable or falling emissions. Some Parties (CAN, NLD, NOR, USA) projected that, by 2010, their range of policies and measures will not bring the emissions down to achieve Kyoto

targets or stabilize emissions at 1990 levels. Two Parties of this group have plans to strengthen already existing, comprehensive, tax or emissions trading schemes, that are projected to play a major role in halting the rise in emissions and perhaps reducing them towards their target level (NLD, NOR). Canada recently introduced policies that, by 2010, should have halted the rise in emissions and the United States projected steadily increasing emissions through the period to 2010.

V. TRANSPORT

A. GHG profile

163. In 2000, transport was a major source of GHG emissions in all Annex II Parties, with a share of total emissions (excluding LUCF) ranging from 16 per cent (BEL) to 31 per cent (CHE). EIT Parties showed a significantly lower share of transport GHG emissions, ranging from 5 per cent (EST) to 9 per cent (SVK), with the single exception of Latvia (21 per cent).[27]

164. Between 1990 and 2000, the transport sector emissions of most Annex II Parties increased steadily, with GDP growth as the main underlying driver. The economic recovery of EIT Parties was most often associated with an increase in transport activity due to the growth of vehicle fleets on the one hand and the reduction and even removal of subsidies for public transport on the other. While a few Parties showed a rather stable level of transport-related GHG emissions (FIN +/-0 per cent, SWE +4 per cent), other Parties showed remarkable increases (CZE +57 per cent, ESP +49 per cent). The highest increase rates in the sector were linked to aviation and road transport.

165. Projections of future transport emissions show further steady increases over time. For example, the United States projected a rise of 46 per cent in transport sector CO_2 emissions until 2020 compared to 2000, although the transport sector carbon intensity is expected to decline by 19 per cent. The EC projected a more moderate increase of 25 per cent of transport sector CO_2 emissions until 2010, compared to 1990.

166. Among the different GHGs, CO_2 accounted for the vast majority (e.g. 97 per cent in EC) of all transport related GHG emissions in 2000. Transport is a major source of CO_2 emissions in all Annex II Parties, ranging from 20 per cent (BEL) to 40 per cent (NZL). In EIT Parties, this share ranges from 6 per cent (EST) to 10 per cent (SVK), again with a very high share in Latvia, 31 per cent. In most Parties, the transport sector accounts for less than 10 per cent of the total N_2O emissions. However, in countries with relatively high transport activity (CAN, USA) and in countries with a high share of hydropower (AUT, CHE, NOR), the transport sector contributes significantly to total N_2O emissions, ranging from 12 per cent (NOR) to 22 per cent (AUT). Transport contributed a very small share of CH_4 emissions, ranging from 0.1 per cent (EST) to 4 per cent (SWE).

167. In addition to emissions of the main GHGs, the transport sector[28] became a major source of tropospheric ozone precursors (NO_X, NMVOC and CO) in many Parties, as the related emissions from stationary sources have declined significantly in the past decade.[29] Also, international aviation and

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[27] Annex II Parties had a relatively high level of transport-related GHG emissions per capita, which contributed significantly to the high level of overall per capita emissions. Within the transport sector, there was a strong differentiation between larger countries (USA: 7 Mg CO_2 eq. per capita, CAN: 6 Mg CO_2 eq. per capita) on the one hand and the EC countries on the other hand (EUR: 2.3 Mg CO_2 eq. per capita). EIT Parties showed an even lower per capita value (e.g. LVA: 1 Mg CO_2 eq. per capita).

[28] Following the IPCC Guidelines for National Greenhouse Gas Inventories, transport is only an energy subsector. None the less, the UNFCCC guidelines require policies and measures in transport to be reported in a separate chapter. These policies and measures address the main sources of GHG emissions from transport according to the IPCC Guidelines. There are, however, other sources of GHG emissions when the entire life cycle in transport is considered. For example, the construction and maintenance of transport infrastructure as well as production of vehicles leads to additional emissions. Moreover, pre-chain emissions (processing of fuels in refineries, listed under energy supply industries) and HFC emissions from mobile air conditioners (listed under industry) are also transport emission sources. Thus, policies reported in the transport sector can have a much larger reduction potential than presented by the estimated effects in the transport sector.

[29] For example in Switzerland, in 1999 the transport sector accounted for 58 per cent of NO_x, 19 per cent of NMVOC and 62 per cent of CO emissions.

maritime transport are GHG emission sources which are reported separately and are not included in the national totals, following the IPCC methodology. These international bunker fuel emissions show an add-on share of 4 per cent of total GHG emissions, ranging from 2.5 per cent (AUT) to 31 per cent (NLD), and are growing fast in most Parties.

B. Implementation issues

Reporting issues

168. All Parties reported policies and measures in the transport sector and most of them used a broad portfolio of policies and policy instruments. For most of the Parties, transport was seen as one of the priority[30] sectors for policy intervention (AUT, BEL, CAN, CHE, CZE, EUR, FIN, FRA, GBR, JPN, LIE, NLD, NZL, POL, SVK, USA).

169. Of the key policies and measures listed in the database, about two thirds were already implemented, and one sixth were adopted; the remainder were in the planning stage. Eighty per cent of key policies and measures were implemented at the national level, while the remaining measures were equally implemented at the regional and local levels.

Policy objectives and policy trends

170. Climate change policies in the transport sector can be broadly divided into technical policies aimed at improving both the energy efficiency of the vehicle fleet and the carbon intensity of the fuel mix, and non-technical policies addressing transport activity and structure through transport demand management, push-and-pull incentives for modal shifts towards less polluting transport modes, traffic flow improvements and spatial planning. The reported transport policies were mainly linked to air quality management, congestion management and energy security (dependency on oil imports).

171. While most reported transport policies and measures are in principle replicable by other Parties, few of the described measures were effective and innovative. Exceptions are integrated national transport policy plans (reported by AUT, CHE, EUR,[31] FIN, NLD, SWE, with NZL in the developing phase), that combine a set of complementary measures which are implemented synergetically and with thoroughness.

172. While it is recognized that packages of economic, fiscal, regulatory and information measures which form part of local and national integrated approaches to reduce transport emissions demonstrate the greatest potential for climate change mitigation, Parties reported only limited success in this context. A positive example could be the case of Finland, as the only Party which managed to stabilize its transport emissions from 1990 to 2000, by implementing successfully an integrated national transport strategy (see box).

Policy instruments

173. Analysis of the key policies and measures in the database suggests that economic and fiscal instruments were by far the most important ones, accounting for around one third of the instruments used, followed by regulatory instruments, information and education, and voluntary agreements. Research activities were rarely reported. Hence, compared to the policies reported in the previous NC, a shift from regulatory approaches towards economic and fiscal approaches can be observed.

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[30] Priority was identified in those cases where one or more of the following attributes were used: key, critical, urgent, strategic, main, particular, special emphasis, important role.

[31] The EC White Paper on a Common Transport Policy.

Finland's integrated transport strategy: zero growth of transport emissions

Since 1990, climate policy has been an integral part of Finland's transport policy. It explicitly aims at restraining the growth of transport. Finland's 1994 "Action Programme for Reducing the Adverse Effects of Transport on the Environment" already contained the objective for the transport sector to stabilize GHG emissions at 1990 levels, which was indeed achieved in 2000. Finland's new environmental management programme "Environmental Guidelines for the Transport Sector" extended this aim until 2010.

This aim of decoupling transport volumes from economic growth is also mirrored in Finland's long-term strategic programme called "Towards a Sustainable and Intelligent Transport Sector", which aims at 'reaching a transportation system in which the demand for road transport (passenger car traffic and road freight traffic) should peak by the year 2020 and gradually decrease thereafter.

Finland has built this success story on a diverse, well-tuned mix of renowned transport policies including strong taxation of vehicles and fuels as its core, complemented by promotion and development of public transport, walking and cycling. This policy mix provided the necessary push- and pull-effect to keep the market share of public transport at a relatively high level (around 20 per cent).

In freight transport, the logistical efficiency of transport chains has been an important objective. The catalogue of future transport policies includes vehicle tax reform, regulations for the development of new agglomerations, voluntary agreements with transport operators, campaigns and better information, education and motivation aiming at changing transport behaviour.

Estimates of effect

174. Several Parties reported the estimated effects of individual policies in the transport sector (AUT, CHE, CZE, ESP, EST, EUR, FRA, GBR, NLD, NOR, SWE). Some Parties reported the estimated effects of transport policies as a whole (CZE, FIN, USA). However, except for the voluntary agreements with car manufacturers (EUR) and the fuel duty escalator[32] (GBR), all other transport-related policies were reported to have had only a limited effect in moderating the emissions growth from transport.

175. The fact that only one half of the policies and measures were quantified reflected, among other factors, the complexity of performing ex-post and ex-ante assessment of transport measures. To some extent, it also reflected difficulties in identifying acceptable packages of measures to address the broad range of technological and behavioural determinants underlying the growth of passenger and freight transport demand. Costs and ancillary benefits of policies in the transport sector were quantified to an even lesser extent. The description of assessment methodologies in the NC3 lacked detail, especially with regard to the definition of baseline scenarios, possibilities of double-counting, consistency of assumptions and elasticity values.[33]

C. Framework and description of policies

176. In analysing emission trends from transport, Parties reported one or more underlying drivers of emission growth, and in many cases established links between policies and measures, and some of these drivers. The steady growth in transport activity in many Parties was reported as the most important of these drivers (e.g. CAN, EUR, USA). More than 70 per cent of the growth in transport energy use in Canada stemmed from the activity effect. The United States and the EC also noted the growth of the vehicle fleet, increase of trip lengths and reduction of vehicle occupation/load factor, as the main drivers contributing to the road transport activity growth.

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[32] This measure was no longer in place as of 1999 due to a significant rise in oil prices.

[33] Quantification exercises in France, the Netherlands and the United Kingdom call for a refinement of assessment methods for the transport sector and more scientific effort to develop internationally agreed 'best practices' in this field.

177. Other important drivers were the structure of the transport sector in terms of the share of its subsectors and transportation modes, the intensity of different transportation modes, defined by the energy consumption per vehicle-km and fuel mix.[34] Losses in market share for public transport and non-motorized transport modes also led to this highest emission growth of all transport subsectors. In particular, in goods transport, road transport and aviation gained high market shares at the expense of rail and ship transport. More than 25 per cent of the growth in transport energy use in Canada was due to this modal shift.

178. Parties included in this analysis reported policies and measures aimed at improving vehicle efficiency, reducing fossil fuel carbon intensity, moderating growth of transport activities, shifting urban transport towards less polluting transport modes, improving traffic flow and spatial planning, which are summarized below.

179. Policies and measures to improve vehicle efficiency were reported by 10 Parties, and included vehicle tax adaptation (AUT), European road tax modulation (BEL), vehicle fuel efficiency programme (CAN), voluntary agreements with car manufacturers (EUR), energy efficiency improvement for railways, ships and aircraft and efficiency (top runner) standards (JPN), CO_2 differentiation in vehicle tax and car labelling (NLD), improvement of vehicle and aircraft fleet (ESP), energy efficiency in the transport sector (CHE), comprehensive transport planning (GBR), fuel duty escalator (GBR), vehicle systems research and development, clean automotive technology (USA).

180. Among the measures reported, most of the European Annex II Parties stressed the voluntary agreements of the EU with European and Asian automobile manufacturer organizations, which set targets for passenger cars (average CO_2 emission figure of 140 g per km for all new cars sold in the EU, as measured according to the EC test procedure) and light commercial vehicles for the first commitment period. However, the effectiveness of these agreements has yet to be proved and monitored over time as these targets are non-binding. Further measures to improve vehicle efficiency are likely be required.

181. Policies and measures to reduce the fossil fuel carbon intensity of the fuel mix were reported by eight Parties, and, included improvement of fuel quality[35] and promotion of 'biodiesel' (AUT), an allowance for liquefied petroleum gases (LPG), alternative and future transportation fuels (CAN), excise tax exemption for ethanol and methanol (CAN), national biomass ethanol programme (CAN), alternative motor fuel support (CZE), fuel quality standards (EST), recovery of fiscal dues on diesel fuel and gasoline (FRA), internalization of carbon costs (FRA), purchase and investment tax exemption for alternative fuels (NOR), CO_2 tax exemption for natural gas (NOR), biomass motor fuel pilot projects (SWE), renewable energy for rail (SWE) and a biofuels programme (USA). While spark-ignition engines fuelled with compressed natural gas (CNG) or LPG show little potential for CO_2 emission reduction when compared to standard diesel engines, the switch from mineral oil diesel to biodiesel significantly reduces the vehicles' impacts on GHG emission levels.

182. Policies and measures directed at the growth of transport activity were reported by five Parties, and included road tolls (AUT), a mileage-based toll for lorries (AUT), a teleworking (JPN), tax measures to limit passenger traffic (NLD), a CO_2 tax, petrol and diesel taxes (NOR), a fuel duty escalator (GBR), and commuter options programmes (USA). Among these policies, vehicle and fuel taxes seem to play an important role (see box).

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[34] IEA uses the four underlying drivers: activity, structure, energy intensity and fuel mix, as elements of the so-called ASIF concept. This concept provides a very useful framework for the analysis of GHG emission levels and policy options. Canada explicitly referred to the ASIF concept in its NC3. However, only a few Parties addressed all the drivers in their NC3.

[35] The use of low-sulphur gasoline and lean-burn engines offers a significant CO_2-reduction potential when compared to conventional gasoline engines.

Vehicle and fuel taxes: widely imposed but of unproven effect

Fuel and other transport-related taxes have been widely used by Parties. They constitute more than 90 per cent of all environmentally related tax revenues in OECD countries.

Fuel taxes are most often differentiated between gasoline and diesel fuel and are further differentiated by sulphur content in some countries (FIN, NOR, SWE). Some Parties report a CO_2 tax on top of these fuel taxes (FIN, NLD, SWE).

Vehicle purchase taxes are sometimes differentiated by vehicle efficiency (measured by CO_2 emissions per kilometre driven in a given test cycle).

As short-term travel patterns are seen to be fairly unresponsive to changes in the fixed or even variable cost of travel, the effects of fiscal transport measures are reported to be moderate. However, within an integrated transport policy framework, vehicle and fuel taxes can have a much greater effect on fuel efficiency in transport, given their role in providing price signals to car buyers and manufacturers.

183. Policies and measures to shift urban transport towards less polluting modes reported by 11 Parties comprised investments in public transport (AUT, BEL), promotion of walking and cycling (AUT, BEL, LVA), promotion of public transport in urban areas (BEL, ESP, JPN, LVA, SVK), tax exemptions for public transport commuter tickets and car pooling expenditures (BEL, SWE), moving on sustainable transportation (CAN), urban transport planning (FRA), greater investments in tramway infrastructure (SWE), a commuter options programme (USA), a ground freight transport initiative (USA), and an emission reduction initiative[36] (USA). While the combination of push (e.g. road pricing) and pull (e.g. promotion of ship and rail transport) measures can help to maintain the market share of public transport and non-motorized transport in urban areas, investment in public transport alone without the necessary disincentives for private car use, e.g. parking fees, does not seem to slow down growth of urban transport activity.

184. Policies and measures to shift long-distance transport towards less polluting modes were reported by 10 Parties, including investments in rail (AUT, BEL), promotion of ship and rail in freight transport (BEL, CHE, JPN), moving on sustainable transportation (CAN), intermodal freight transport (FRA), high-speed trains (ESP, FRA), inter-city infrastructure (FRA), construction of transport systems with minimal environmental impact (JPN), environmentally differentiated charges for shipping and air travel (SWE), road-pricing for heavy goods vehicles (AUT, CHE), sustainable distribution (GBR), a ground freight transport initiative and an emission reduction initiative (USA). Measures to promote a modal shift in long-distance transport could not only help to attain climate change goals, but also to prevent some of the transportation modes, e.g. road freight transport, from growing beyond the limits of today's infrastructure.

185. Policies and measures and policy packages aimed at improving traffic flow were reported by eight Parties, and included traffic management and speed limitation (AUT), intelligent transportation systems (CAN, JPN), speed limits and speed limit enforcements (FRA, NLD), road pricing (NLD), improved driving behaviour (CAN, NLD, SWE), improved aviation control systems (ESP) and commuter options programmes (USA). While some of the these measures (e.g. speed limits, road pricing and driver training) were estimated to have a clearly positive mitigation effect, other elements (e.g. traffic signal timing, traffic information systems and motorway improvements) might have increased emissions as they could induce new transport activity.

[36] The United States' emission reduction initiative launched by the Department of Transport includes transit programmes, congestion mitigation and air quality improvements, transportation enhancements, pilot programmes and corporate average fuel economy (CAFE) standards. The last-mentioned standards were adopted primarily to save energy in the use of automobiles and light trucks. Compliance is based on the average performance of a manufacturer's fleet, and additional credit toward compliance is available to alternatively fuelled vehicles.

186. Policies and measures relating to spatial planning reported by a few Parties included improvement of spatial planning (AUT), urban sprawl control (FRA), comprehensive municipal planning (SWE), smart growth and brownfields policies (USA). Parties acknowledged the role of spatial planning measures as an important element of mid- and long-term strategies, given the long response time until their effect becomes visible.

D. Conclusions

187. Transport is one of the largest and fastest growing sectors, but Parties included in this report implemented only a small number of measures, with a limited effect on emissions compared to other sectors. Of the four drivers underlying emission growth in transport, the policy response pattern of Parties showed a clear preference for only two of them, intensity and fuel mix. Both drivers were mainly targeted through technical measures. The remaining two, activity and structure, which need mainly non-technical response approaches, were rarely addressed, although analysis of the emission trends in transport suggests that these two drivers contributed the most to emission growth in this sector. Improvement of public transport, walking and cycling were widely accepted but in most cases did not seem to be sufficiently implemented to avoid the decline in their shares.

188. The policy mix used by Parties in transport varied between them. However, there was a general trend towards a shift from regulatory towards more flexible economic and fiscal instruments in most of the Parties. Consumers, however, mostly responded to this shift by showing a willingness to pay higher fuel prices and vehicle taxes than to reduce substantially their transport activities.

189. Although the main driver of the steady GHG emission growth in the transport sector was identified as the growing demand for passenger and freight transport, very few Parties reported systematic policy approaches in this field. Integrated transport policy frameworks that are well fitted to national circumstances, as reported by Finland, are one of these systematic approaches, which seem to be very promising in terms of emission mitigation. In particular, the case of Finland suggests that, by using an integrated policy framework, it is possible to stabilize GHG emissions at 1990 levels. However, even considering all the transport policies implemented so far by Parties, there has been very little "bending of the curve" in nearly all Parties.

190. The transport sector appears to be among the most difficult sectors for climate policy interventions. Given the long lead time for land-use changes, the turnover of capital stock in the transport sector and the development of advanced fuel technologies and infrastructures, further effort may be needed, including enhanced involvement of the private sector in climate policy design and implementation, to improve the mid-term emission trends.

191. An analysis of the approaches to estimate the effects of policies and measures in transport and uncertainties associated with the few cases where such estimates were provided, suggests that Parties face certain methodological difficulties and data problems in this sector, which stem mainly from the complexity of policy interaction within the sector. Further refinement of assessment methods could help to solve some of these problems and difficulties.

VI. INDUSTRIAL PROCESSES

A. Emission profile

192. This sector comprises all emissions of greenhouse gases from industrial production, except energy-related emissions, and all emissions of fluorinated greenhouse gases. The most relevant categories are: (a) process-related CO_2 emissions from cement and lime production, the iron and steel industry, the aluminium industry and other metal production, the pulp and paper industry, and the food and drink industry; (b) N_2O emissions from ammonia, nitric acid and adipic acid production;

(c) hydrofluorocarbon (HFC), perfluorocarbon (PFC) and sulphur hexafluoride (SF_6) emissions during their production and use.

193. Emissions from industrial processes amounted to 3–8 per cent of the total national GHG emissions of Annex I Parties. The lowest contribution in 2000 was 1 per cent (LVA), the highest 20 per cent (NOR). The most important processes were usually cement production, the iron and steel industry, the production of nitric and adipic acids and fluorinated gases. The large difference in the share of emissions from industrial processes in total greenhouse gas emissions of different Parties reflects mainly differences in the industrial structure of Parties and the role of fossil fuels in electricity generation.

194. Between 1990 and 2000, both increasing and decreasing GHG emission trends for industrial processes were reported. Most Annex II Parties reported increasing emissions (e.g. USA 6 per cent) mainly because of increasing emissions of fluorinated gases, while the EIT Parties often reported declining emission trends (e.g. SVK –13 per cent) mainly driven by a decline in cement and steel production.

195. For future emission projections, no general trend could be observed. Both steep decreases, e.g. of 88 per cent (LVA), and increases, e.g. of 18 per cent (JPN) were projected for the emissions in 2010 compared to the base year. In general, emissions related to production processes are likely to decrease, while emissions from the use of HFCs and PFCs are likely to increase in the future. While in 2000 industrial processes represented only a small portion of the total GHG emissions compared to other sectors (about 5.5 per cent of total GHG emissions), this sector could gain in importance in those countries where emissions of fluorinated gases continue to rise.

B. Implementation issues

Reporting issues

196. Most Parties (AUT, BEL, CHE, EUR, FIN, FRA, GBR, HVR, JPN, LIE, NLD, NOR, NZL, POL, SWE, USA) outlined detailed activities in the field of industrial process emissions and fluorinated gases, while other Parties mentioned only general activities without specific reference to their effects on emissions (CZE, EST, LVA, SVK). Monaco did not report policies and measures in this sector.

Policy objectives and policy trends

197. In the industrial sector, the implementation of measures is driven by economic rather than environmental considerations. The reduction of PFC emissions in the aluminium industry, for example, has been a part of the optimization of the production process, since PFCs are only produced and emitted when the production process is not in an optimal phase.

198. Linkages to policy objectives other than those related to climate change are apparent for those uses where ozone-depleting substances are replaced. Here, the emissions of ozone-depleting substances under the Montreal Protocol are often reduced by introducing HFCs. Most ozone-depleting substances are also greenhouse gases. They not only act directly as greenhouse gases (causing warming) but also destroy the greenhouse gas ozone (causing cooling). Their total impact on the climate is therefore difficult to quantify.

199. Additional considerations, such as health and safety, are also important for policies and measures related to industrial processes. Especially in the phase-out of ozone-depleting substances, for example, the flammability may increase substantially when hydrocarbons instead of HFCs are used in foams and as cooling agents. In other processes, occupational health risks are of concern, e.g. if SO_2 is used as an alternative to SF_6 in magnesium foundries.

Policy instruments

200. The type of policy instrument used in this sector is influenced by the fact that emissions are mainly driven by the actions of private enterprises. Consequently, Parties usually opt for industry consultation processes as a policy approach before deciding upon specific policies in this sector. Adopting adequate policies and measures in this sector is heavily dependent on detailed technical expertise which is available from the industries themselves and on how efficient the consultation processes are. Because of the complex emission structure, difficulty of monitoring and competitive pressures, taxes and other economic instruments are rarely implemented (e.g. CHE). Consequently, voluntary agreements were the most frequently used policy instrument, and legislation and regulations were also used to some extent.

201. Research and development was mentioned by only a few Parties, possibly because the development of alternatives is seen less as a public task than as a task for private, profit-oriented activities. Education and training was implemented by some Parties, focusing more on workers and companies than on end-consumers because of the limited choice of the consumers and the importance of good practice in manufacturing industries and services.

Estimates of effects

202. The emission reductions expected from the implementation of certain measures were reported by some Parties (AUT, EUR, FRA, NLD, NOR, NZL). Other Parties, however, did not assess the environmental effectiveness of individual measures relating to industrial processes. Among the measures reported in this sector, reductions in production processes, e.g. in the PFC emissions of the primary aluminium industry, were most easily quantified. Measures to reduce leakage of refrigerants and air-conditioning agents were very difficult to quantify because the underlying data, such as the leakage rates, are uncertain and therefore the effects of related measures are equally uncertain.

203. The methodologies applied for assessing the total effects of measures and for projecting future emissions from industrial processes mainly relied on the extrapolation of past activity trends and spreadsheet models. The assessments were based on both bottom-up and top-down approaches. Few Parties (BEL, CZE, HRV, NLD, NOR, SWE) gave detailed information on the related background data applied and the underlying assumptions.

204. Information on the costs of measures was given by only a few Parties. The Netherlands considered emission reductions in the industrial processes sector as highly cost-effective compared to other measures. Croatia noted the cost of applying catalytic convertors for N_2O emission reductions in nitric acid production as being 1 \$/t CO_2 eq. France reported the results of a study on potential actions to reduce emissions of fluorinated gases, including the estimation of costs for selected applications.

205. In comparison to second national communications, the fluorinated substances subsector received more attention. The complex emission structures are better understood and comprehensive strategies are being developed.

C. Framework and description of policies

206. Due to the diversity of the activities and emissions in the industrial processes sector, the description of the policies and measures reported by Parties is made on a gas-by-gas basis.

Policies targeting CO_2 and N_2O

207. Process-related CO_2 emissions are important in the cement industry, the iron and steel industry and the aluminium industry. In these processes, CO_2 is produced as a by-product and no cost-effective

measures exist for extracting CO_2 from the waste gas. A few policies and measures are available and were reported by the Parties targeting these emissions. Some policies and measures targeting energy-related CO_2 emissions were reported in the energy section of the national communications following the IPCC approach, and not in the industrial processes section. The production of blended cement by mixing clinker with slag was reported by a few Parties (JPN, SVK). This measure reduces energy-related as well as process-related emissions, because the quantity of clinker produced, i.e. the most GHG emitting process step, is reduced.

208. Process-related N_2O emissions are only relevant for those countries where ammonia, nitric acid and adipic acid are produced (AUT, BEL, CAN, CHE, CZE, ESP, EUR, FIN, FRA, GBR, HRV, JPN, NLD, NOR, POL, SVK, SWE, USA). In other Parties (EST, LIE, LVA, MCO, NZL), no production facilities exist. The common and cost-effective measure for reducing N_2O emissions is the application of abatement technologies. Several countries with nitric acid and adipic acid production did not report any measures. In these cases it is unclear whether abatement technologies have already been implemented or whether emissions have not yet been reduced. The N_2O emission reductions were implemented through voluntary agreements (FIN, JPN, NOR, USA), legislation (BEL, FRA) and taxation (FRA).

209. Reducing N_2O emissions had a significant effect on total greenhouse gas emissions in some Parties. France, for example, noted that the stabilization of total greenhouse gas emissions from 1990 to 1999 was "mainly due to the fall in greenhouse gas emissions other than CO_2 and, in particular, to the determined action taken to reduce emissions of nitrous oxide from the chemical industry." For the United Kingdom, the reduction of N_2O emissions amounted to 3 per cent of its total GHG emissions in 1990.

Policies targeting fluorinated greenhouse gases

210. The emissions of fluorinated gases originate during production and consumption of the gases. In several cases, HFCs have been introduced as a replacement for ozone-depleting chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).

211. A range of measures targeted fluorinated GHG emissions as a group. The EC IPPC directive was mentioned both by European Annex I and by EIT Parties (AUT, BEL, CZE, EUR). A regulation on chemicals and hazardous substances aimed at reducing and phasing out HFCs, PFCs and SF_6 in specific applications has already been adopted (CHE, LIE) or prepared for further applications (AUT), also on wastes containing HFCs and PFCs and their categorization as special waste (CHE) and on improved containment of fluorinated gases (EUR). Voluntary agreements were reported on HFC, PFC and SF_6 emission reductions (EUR), on industrial emission limits for fluorinated gases (JPN), on environmental management systems (LVA) and on an improved exchange of information between government and enterprises (EST).

212. Economic instruments included a tax on fluorinated gases (FRA) and an emissions trading scheme of certain industrial emissions (NOR). Research and development was conducted on alternative fluids, technologies and substances (EUR, FIN, FRA, JPN). Soft measures were reported, e.g. to promote the use of substitutes for fluorinated gases (JPN). Other policies and measures included a programme on environmentally friendly alternatives for ozone-depleting substances (USA) and public procurement and support measures for delivery and construction services (AUT).

HFCs

213. Wide-ranging policies and measures aimed at reducing HFC emissions were reported by several Parties. The Netherlands launched a range of measures, including economic instruments and regulations, to reduce HFCs and PFCs as (H)CFC alternatives. The use of HFCs was regulated in Canada. Leakage

control (FIN) and a tax on HFC imports (NOR) were proposed. The United Kingdom developed an HFC emission reduction strategy.

214. Specific HFCs are produced as by-products during the production of other fluorinated chemicals and can be emitted into the atmosphere. For example HFC-23 is produced and emitted in the production of HCFC-22. In some countries, a regulation requires abatement technologies to be installed or optimized to reduce HFC emissions (GBR, NLD). The United States reported a reduction partnership with industry. The United Kingdom reported a reduction from this measure equivalent to 1.3 per cent of its total GHG emissions in 1990.

215. HFC emissions from refrigeration, both household and commercial, are of concern to many Parties (AUT, BEL, CHE, FRA, GBR, JPN, NZL, POL, SWE). National preferences and the application of technologies in this subsector vary widely among Parties. For example, Sweden reported that 80 per cent of refrigeration appliances contained the hydrocarbon isobutane in 1999 and that a changeover to isobutane in new appliances would be complete by 2005. In contrast, HFCs currently play an important role as refrigerants in Italy, Spain and the United Kingdom.

216. Several policies and measures concerning emissions from refrigeration were implemented. Regulation applied to compulsory inspections, leakage avoidance and sealing of refrigeration units (AUT, BEL, FRA, SWE) and the recovery of refrigerants (FRA, JPN). Voluntary agreements on reducing HFC emissions from refrigeration were reported by a few Parties (AUT, CHE, GBR). Training and qualification of companies and workers in refrigeration was reported by two Parties (FRA, NZL).

217. HFCs are also used in stationary and mobile air-conditioning systems. Policies and measures included voluntary agreements (GBR), reduction and phase-out plans (AUT), plans for a decree prohibiting venting into the atmosphere (FRA), plans for the standardization of piping systems (FRA) and training and qualification of companies working on air-conditioning equipment (FRA).

218. HFCs are further used as blowing agents for foams. Hydrocarbons are available as alternative blowing agents not affecting the climate but with an increased risk of flammability. Several Parties started activities in the field of foams and insulation material, including the adoption of a polyurethane foam-blowing system with cyclopentane as blowing agent (POL), the development of foaming agent substitutes (JPN) and the reduction and phase-out of HFCs in insulation material and construction foams (AUT). France considered limiting the use of HFCs to certain applications and developing recycling facilities. Two Parties reported voluntary agreements (CHE, GBR).

219. HFCs in aerosols are of concern to several Parties (AUT, CHE, FRA, GBR, LIE). Some Parties (CHE, LIE) banned HFCs in aerosols by legislation. Voluntary agreements are here under way, including limiting the use of HFC-134a in non-medical aerosols to critical applications where inflammability is the limiting factor.

PFCs

220. PFC emissions from primary aluminium production can be reduced by process adjustments and optimizations. Several Parties (FRA, NLD, NOR, NZL, USA) reported such measures. Often, this was implemented through voluntary agreements with the respective aluminium industry associations. The process optimization has environmental and economic benefits. France noted the application of inert anodes in primary aluminium production as a long-term goal. This would reduce PFC and CO_2 emissions related to the oxidation of carbonaceous anodes presently applied. As an indirect measure, the aim of increasing aluminium recycling was reported (CAN, GBR).

221. PFCs in fire extinguishers are banned by regulation by some Parties (CHE, LIE). The reduction or intended reduction of PFC and SF_6 emissions in semiconductor manufacturing was reported by several

Parties (AUT, CHE, FRA, JPN, NLD, NOR, USA). These measures were often implemented or were planned through a voluntary agreement. Austria reported plans to include semiconductor manufacturing in its legislation to reduce or phase out the application of SF_6.

SF_6

222. Several Parties (FRA, GBR, NOR, USA) specifically planned to reduce SF_6 emissions from magnesium foundries, where SF_6 is used as a protecting gas for liquid magnesium during the casting process. SO_2 can be used as an alternative but introduces occupational health risks. Several Parties also addressed SF_6 emissions from use in high voltage equipment (CHE, FRA, GBR, NLD, NOR, USA), in sound-proof windows (AUT, CHE) and in car tyres (AUT).

D. Conclusions

223. Common, well-developed and frequently implemented measures in the industrial processes sector were reported for the large-scale process emissions, such as N_2O abatement technologies in adipic acid production, the reduction of PFC emissions in primary aluminium production by process adjustments and the application of waste gas treatment in HCFC production. These measures resulted in relatively large emission reductions at relatively low cost. The use of hydrocarbons as cooling and blowing agents and improved service and maintenance of air-conditioning and cooling systems were also well developed.

224. The emission levels and, therefore, the importance of measures related to industrial processes varied substantially between the Parties. Relevant here are differences in the industry structure and the extent to which ozone-depleting substances have been replaced by fluorinated gases. Also, national preferences in the application of certain chemicals may be important, e.g. the use of hydrocarbons vs. HFCs in household refrigeration.

225. The above-mentioned measures relating to large-scale process emissions reduced emissions from the industrial processes. Emissions also declined in cases where industrial activity declined. For some countries these reductions were, however, offset by the increase in emissions due to the use of HFCs.

226. For process-related CO_2 emissions, unless the production volume is reduced, e.g. by reducing the clinker content of cement, no feasible measures are available at present or will be in the near future. Alternatives or reduction technologies for some uses of fluorinated gases are not yet readily available and need further research and development. These include HFCs in mobile air-conditioning, SF_6 in the magnesium foundries, and HFCs in some specific medical aerosols. Until environmentally safe alternatives are readily available, the Parties are likely to focus on lesser use of the application, leakage reduction, recovery, recycling and destruction technologies.

227. Two different strategies relating to fluorinated gases can be observed. Some Parties are currently developing comprehensive reduction and phase-out legislation on fluorinated substances (e.g. AUT, CHE), while others promote industry partnerships aimed at reducing *emissions* without restricting the *use* of substances (e.g. JPN, USA).

228. The emission reductions of specific measures were reported by only some Parties; monitoring efforts were rarely mentioned. The measures relating to large-scale process emissions such as N_2O from adipic acid production are most easily quantified, have immediate effect and can be monitored through the greenhouse gas inventory.

VII. AGRICULTURE

A. GHG profile

Total emissions

229. On average, agricultural emissions from Annex I Parties accounted for approximately 7 per cent of the total aggregate emissions in 2000 (excluding LUCF) compared to 8 per cent in 1990. New Zealand had by far the highest value – 55 per cent of 2000 emissions arising from agriculture. Other Parties above average were Latvia (16 per cent), France (16 per cent) and Spain (11 per cent). Parties well below average included Japan (1.5 per cent) and Estonia (4.5 per cent). The wide distribution of shares of agricultural emissions is due to a combination of the absolute magnitude of Parties' emissions and the weight of agriculture within individual economies. The United States, for example, emits 55 per cent of total Annex I agricultural emissions but these comprised only 7 per cent of the United States' total 2000 emissions. New Zealand emits 5 per cent of total agricultural emissions of Annex I Parties, but this represents 55 per cent of its total 2000 emissions.

230. In 1990, total emissions of agriculture of Annex I Parties amounted to 877,000 Gg CO_2 eq. In 2000, total emissions had risen by 1 per cent compared to 1990 to reach 885,370 Gg CO_2 eq. The United States contributed an increase of more than 36,000 Gg CO_2 eq. (8 per cent increase from 1990), followed by Canada (3 per cent increase from 1990) and Spain (17 per cent increase from 1990). Other Parties reported decreases of more than 10 per cent of their 1990 emissions (AUT, CZE, EST, FIN, JPN, LVA, POL, SVK).

231. Most Parties expected reductions in total emissions from agriculture in the order of 5 to 10 per cent (e.g. AUT, FRA, FIN, HRV, POL) until 2010, with roughly equal contributions from both CH_4 and N_2O reductions. Several Parties expected recent increases in emissions to continue (CAN, CZE, NOR, NZL, USA). Canada, for example, expected emissions to increase by 22 per cent and New Zealand expected a 38 per cent increase in N_2O emissions from soil due to increasing fertilizer use.

232. Anthropogenic emissions from agriculture comprise emissions of CH_4 and N_2O. The changes in emissions of these individual gases and the drivers behind these changes are described below. Emissions of CO_2 from energy use in agriculture were reported under fuel combustion and emissions or sequestration by agricultural soils are covered under the LUCF sector.

Methane

233. Emissions of CH_4 from the agricultural sector accounted for 3 per cent of total GHG emissions of Annex I Parties (excluding LUCF) and fell by 4 per cent from 17,630 Gg in 1990 to 16,970 Gg in 2000. Canada and Spain both reported large increases, of 11 per cent and 20 per cent respectively. However, these increases were more than offset by reductions in the majority of the remaining Parties, notably EIT Parties (CZE, EST, LVA, POL) where the reduction rates ranged from 44 per cent to 72 per cent. Another group of Parties (AUT, CHE, FIN, JPN, NLD) showed reduction rates of between 10 and 20 per cent, while all remaining Parties (BEL, FRA, GBR, NZL, SWE), except for the United States (increase of 3 per cent) and Norway (increase of 0.4 per cent), showed reduction rates from 3 to 7 per cent.

234. The main driver behind increases in emissions was the demand for animal products, which has been rising in line with disposable income. Livestock farming generally produces larger emissions of GHGs than arable farming (SWE). The main driver of reductions in CH_4 emissions, where such reduction occurred, was the overall drop in number of livestock as farming practices intensified and yield per animal increased, the collapse of EIT markets and the abandonment of agricultural lands (particularly

paddy fields in JPN). Some of these reductions may be offset by increased CH_4 emissions arising from manure management in intensive rearing conditions, where anaerobic conditions become more common.

Nitrous oxide

235. Emissions of N_2O from the agricultural sector accounted for 4.4 per cent of total GHG emissions of Annex I Parties (excluding LUCF) and increased in 2000 by 6 per cent compared to the 1990 level. Some Annex I Parties (CAN, ESP, NLD, POL, USA) reported increases in excess of 10 per cent of the 1990 levels, with absolute increases ranging from 12.5 Gg in Poland to 103 Gg in the United States. New Zealand reported a slight increase of 6 per cent. These increases were not completely offset by large percentage falls in other Annex I Parties, notably EIT Parties (EST, CZE, LVA, SVK), ranging from 37 per cent (CZE) to 63 per cent (LVA). Within the group of Annex II Parties, Finland (-21 per cent) and the United Kingdom (-12 per cent) showed clear reductions of N_2O emissions.

236. The main driver behind the increase in emissions was agricultural intensification, resulting in greater use of nitrogen fertilizers and higher N_2O emissions from soils. Decreases in emissions, where they occurred, were driven by reductions in fertilizer use and pasture management. However, several Annex I Parties cited high levels of uncertainty in the quantification of N_2O emissions, e.g. Sweden, and particularly New Zealand, which reported research suggesting that emissions of N_2O could be substantially higher than estimates based on IPCC methodologies.

B. Implementation issues

Reporting issues

237. Almost all Parties reported policies and measures in the agricultural sector, exceptions being Liechtenstein and Monaco. The majority of Parties cited other objectives in addition to climate change behind the implementation of agricultural policies (e.g. EUR, SWE). However, despite the lack of climate change specific policies, most Parties reported decreases in agricultural emissions in 1999 compared to 1990 and expected further decreases by 2010, reflecting the fact that their portfolios of wider agricultural policies were having a positive impact upon emission reductions.

238. The majority of agricultural policies impact upon both CH_4 and N_2O emissions, but some of these policies impact upon one gas only or upon CO_2 sequestration. Out of a total of around 40 policies and measures included in the database for agriculture, half have been implemented, around a third adopted and the remaining are planned. The low fraction of planned policies and measures reflects the fact that few Annex I Parties have identified and planned additional measures for the agriculture sector, should existing measures prove inadequate.

Policy objectives and policy trends

239. Policies and measures in agriculture are strongly linked to a wide range of policy objectives. For example: market reform (e.g. the Common Agricultural Policy in the EC and accession States); rural development (e.g. Agenda 2000 in the CAP); environmental pollution (e.g. the EC nitrates directive; the EC IPPC directive; good agricultural practice; organic farming standards; and environmental protection); afforestation and its associated benefits (e.g. use of set-aside land in EC States; permanent cover programmes; sustainable agriculture; shelterbelts and others).

240. Policies and measures in agriculture may impact upon one or several GHGs. The impact of these policies may be summarized as follows:

- All GHGs: these are the most common policies in agriculture and tend to be driven by economic and environmental issues. They may be described as policies promoting improved environmental performance.

- Carbon sequestration and CO_2 emissions: policies and measures addressing carbon sequestration were limited to afforestation / reforestation of agricultural land, which should be reported under the LUCF sector. Sequestration in soils was correctly reported under the LUCF sector. Emissions of CO_2 arise from energy consumption reported elsewhere but some Parties reported issues related to the growth of biomass and energy crops in the agricultural sector (e.g. oilseed crops in Austria).

- N_2O emissions: policies and measures to address these emissions are widely implemented and all focus on the use of nitrogen fertilizers and manure management. They include the EC nitrates directive and associated national measures; taxation of nitrogen production from farms (FRA, planned); a range of water quality legislation and regulations; and manure and grazing management.

- CH_4 emissions: these policies and measures specifically target the number of livestock and fodder management.

241. Whilst none of the policies and measures reported were particularly innovative, some research activities could result in innovative policies in future. One exception is the proposed tax on nitrogen production on farms in France. Most policies and measures are broadly replicable, and for example, policies focusing on improved environmental performance have already been widely implemented.

Policy instruments

242. An analysis of the instruments used to implement the policies and measures in the database indicates that the five most popular policies in agriculture were all implemented using a wide range of policy instruments. The CAP strongly influences activity levels and profitability in the agricultural sector and hence has a strong influence on GHG emissions in EC countries. The CAP was implemented throughout by a variety of regulatory, fiscal and economic means. In the absence of estimates of the effectiveness of individual policies and measures, it is not possible to conclude whether individual instruments are particularly effective.

Estimates of effects

243. The majority of Parties did report on the expected impacts of portfolios of agricultural policies in their projections for 2010. Only a few Parties provided quantitative assessments of the environmental effectiveness of individual policies in agriculture (CZE, ESP, EUR). Methodologies to estimate the effectiveness of individual policies and measures and overall trends impacted by portfolios of policies were not described in detail. In most cases these were based on projections of economic activity by macroeconomic models or predicted activity levels such as fertilizer applications and livestock numbers within the sector (e.g. NZL).

244. Spain provided consistent estimates of the impacts of several policies in agriculture on CO_2, CH_4 and N_2O emissions which in 2005, were expected to reduce aggregate emissions from this sector by around 3,780 Gg CO_2 eq., or 7 per cent of aggregate emissions from the sector in 1999. The EC reported the expected impact of the CAP on CH_4 and N_2O emissions to be a total reduction of 40,000 and 56,000 Gg CO_2 eq in 2000 and 2010 respectively, or 10 per cent and 14 per cent of 1999 emissions from the sector. Structural changes within the agricultural sector in Finland were reported to have reduced GHG emissions from 9,200 Gg CO_2 eq. in 1990 to 7,300 Gg CO_2 eq. in 1999 (26 per cent of 1999 emissions).

245. All Parties except Canada, the Czech Republic, New Zealand, Norway and the United States expect emissions of N_2O and CH_4 from their agriculture to decline by 2010 as a result of their portfolios of policies and other external drivers such as market reform, intensification and improved environmental performance. Most of these also expect emissions of CO_2 from agriculture to decline.

C. Framework and description of policies

246. Policies and measures in the agricultural sector can be described within a framework that distinguishes between: (a) policies and measures with wider policy objectives that also impact upon GHG emissions; (b) policies and measures that focus more specifically on individual activities within the sector that may or may not have GHG emissions as their primary objective; and (c) research-based policies and measures designed to provide new solutions to technical problems.

Policies and measures with wider policy objectives

247. The most commonly reported policies in agriculture fall into this first category. These policies are designed to reduce the environmental impacts of agricultural practices and promote sustainability. They include: extension of ecological farming (AUT); organic agriculture action plan (BEL); rural development plan (BEL); agricultural environmental stewardship initiative (CAN); Common Agricultural Policy (EUR); organic farming act (EST); agro-environmental standard (ESP); and ecological practices on farms (CHE). These policies have the potential to impact upon emissions of both N_2O and CH_4, depending upon the particular emphasis and the existing conditions.

248. New Zealand removed subsidies from agricultural products and this had a marked effect on the whole agricultural sector, resulting in significant changes in land use and GHG emissions. Sweden commenced the removal of agricultural subsidies in 1990, but joined the EU and came under the provisions of the CAP in 1995.

Policies and measures targeting specific activities

249. More focused policies and measures with direct impacts on the major sources of GHGs from agriculture were also widely implemented, including:

- Policies and measures addressing nitrate pollution and emissions of N_2O from applications of nitrate fertilizer and animal manure to agricultural soils: manure action plan (BEL); the EC nitrates directive (EUR); agriculture environment support (FIN); reduction of N_2O emissions from soil and taxation of nitrogen production (FRA); animal waste management systems (NZL); code of practice for the use of fertilizer (NZL); nutrient management tools (USA). At the same time, some of these policies impacted CH_4 emissions by encouraging better management of animal manure and thereby reducing the occurrence and duration of anaerobic conditions when methane is emitted.

- Policies and measures addressing CH_4 emissions from enteric fermentation in livestock focus on reduction of livestock numbers through reducing national herds and intensifying farming practices combined with increased yields per head: reduction in pig breeding (BEL); reduction in livestock numbers (SVK); and very specific research programmes to investigate means of reducing methane (and N_2O) emissions from farming practices (FRA, NZL).

- Policies and measures promoting sequestration of CO_2 include afforestation and conservation programmes on surplus agricultural land. Most of these policies and measures have been implemented for ecological, recreational and environmental protection reasons and should be reported under LUCF. Activities implemented in the 1990s are likely to have more significant impacts upon total emissions during the first commitment period than those implemented later,

because of the relatively slow growth of trees in many temperate climates. These policies and measures included the permanent cover programme (CAN); support for afforestation of unused agricultural areas (CZE) and reforestation (ESP).

- Policies and measures to reduce CO_2 emissions include promotion of biomass as a source of renewable energy, emphasizing the link between the agricultural and energy sectors (AUT, SWE); cultivation of oilseed crops (AUT) and start-up grants for energy forests (SWE).

Research-based policies and measures

250. Research-based policies and measures are very important as they have the potential to provide the new technologies that will form the basis of future policies. Many Parties referred to research activities in general (e.g. USA) whilst others were specific about the exact objectives (JPN) and methods (FRA, NZL). In particular, new technologies have been sought to: (a) reduce emissions of N_2O from agricultural soils and from the excessive application of nitrogen fertilizers; (b) reduce methane emissions from enteric fermentation through fodder management and the introduction of enteric bacteria; (c) better understand and monitor the dynamics of GHGs.

D. Policies and measures having a negative impact on emission trends

251. Policies and measures promoting agricultural intensification are likely to result in increased emissions of methane from manure management (NZL) and increased emissions of N_2O from fertilizer use (CAN). The production of fertilizers, particularly nitrogenous fertilizers, is also very energy intensive (CAN). However, the impact of increased agricultural production on agricultural emissions depends on the individual circumstances of the Parties.

E. Conclusions

252. The majority of Parties reported policies and measures that will have both direct and indirect effects on emissions in the agricultural sector. Parties reporting policies with broader objectives tended not to quantify the environmental effectiveness, whilst more targeted policies and measures were more easily quantified. Several Parties also reported research-based policies that have the potential to deliver new and improved opportunities to reduce emissions from agriculture in the future. Several Parties reported sequestration-based policies and measures in the agricultural sector whereas these should be reported under the LUCF sector, where sequestration is provided for.

253. Overall, the Parties reported decreasing emissions from the agriculture sector as a result of both non-climate driven and climate-specific policies and measures. These decreases helped Parties to reverse GHG emission trends but not sufficiently to offset growth in other sectors. Several Parties reported increases in emissions due to the rising demand for animal products, which resulted in an increased contribution of emissions of CH_4 and N_2O to the national total emissions.

254. Many Parties expect agriculture to make significant contributions to the reduction of long-term emission trends. These expectations are based on the indirect effects of portfolios of policies and measures that are not specifically related to climate change (for example market reform), and direct and indirect benefits from more specific policies and measures (for example control of nitrate pollution). Difficulties in quantifying indirect GHG benefits precluded the provision of transparent descriptions of how reported agricultural policies and measures will influence future emission trends.

255. Very few Parties provided sufficient detail on how they were currently monitoring the effects of policies and measures in agriculture and how they planned to do so in future. Estimates of the effects of policies and measures in agriculture were based on more or less detailed macroeconomic predictions of

economic activity, livestock numbers and fertilizer use. Several Parties cited uncertainty in N_2O and CH_4 estimates as a complicating factor.

VIII. LAND-USE CHANGE AND FORESTRY

A. GHG profile

Total emissions and removals

256. Amongst Annex I Parties, the LUCF sector removed 10 per cent of total aggregate emissions (excluding LUCF) in 2000. The Baltic and Scandinavian States reported high net removals compared to their total emissions (LVA, 40 per cent; EST, 42 per cent; NOR, 34 per cent; FIN, 16 per cent; SWE, 39 per cent). Other Parties with large net removals included the United States, 13 per cent of national total; France, 12 per cent; Poland, 11 per cent; New Zealand, 31 per cent; and Canada, 2 per cent. These Parties have in common substantial forest lands and well established forest industries. Parties with small net sequestration included Belgium and the Netherlands, the United Kingdom being the only Party reporting a small net source of 0.5 per cent of total GHG emissions. All these Parties have small land areas and small forest lands.

257. In total, 1990 net sequestration by Annex I Parties removed 1,477,400 Gg CO_2 eq. or 13 per cent of their total emissions. In 2000, this figure fell to 1,261,200 Gg CO_2 eq., or 10 per cent of their total emissions (based on 1990 and 2000 data from AUT, BEL, CAN, CHE, CZE, ESP, EST, FIN, FRA, GBR, LVA, NLD, NOR, NZL, POL, SVK, SWE, USA; Parties not reporting all the required data were excluded from the analysis, except for JPN, where 1995 data were used).

258. Most Parties expected small increases in net sequestration in 2010 or reductions in the size of the net source (GBR). Exceptions were Belgium and the Czech Republic, which reported no change and the United States, which reported an expected reduction in the size of the net sink from 1,205,000 Gg in 2000 to 1,053,000 Gg in 2020 (a 13 per cent decrease). Other Parties did not report projections in this sector. Canada, for example, assessed the potential effect of policies in LUCF, but cited uncertainties in eligibility and accounting rules, and Austria included forestry in the agriculture sector, despite the reporting guidelines.

259. GHG emissions and sequestration in the LUCF sector consist of emissions and removals of CO_2, and emissions of N_2O and CH_4 arising from afforestation, reforestation, deforestation, revegetation, cropland and grazing land management, fires and decomposing biomass, harvesting of wood, long-term storage of carbon in products and landfills and changes in soil carbon.

Carbon dioxide

260. In all Annex I Parties, anthropogenic CO_2 emissions and removals in LUCF are dominated by changes in forest and other woody biomass stocks. Sequestration in this pool exceeds sources of CO_2 from other pools in all Parties except the United Kingdom. Most Parties reported small emissions of CO_2 from forest and grassland conversion and/or relatively small amounts of sequestration in soils, abandoned managed lands and other sinks (CAN, EST, FRA, GBR, JPN, LIE, LVA, NZL, POL, SWE, USA). Canada and the United States[37] reported significant reductions in removals in the forest and woody biomass pool and, in addition, the United States reported reduced removals in soils and other sinks when compared to 1990. These amount to a reduction in sequestration of 140,000 Gg in 2000 compared to 1990.

[37] The United States noted that these reductions stem from inconsistency in input data and methodological issues.

261. The drivers behind these reductions included historical land-use changes, slowing growth of maturing forests, increases in harvesting and emissions from biomass and soils associated with earlier land clearance. The drivers behind the increased CO_2 sequestration reported by many other Parties included historical and ongoing afforestation and reforestation programmes, age structure of forests, forest protection, soil conservation, abandonment of agricultural land and agricultural land management regimes.

Nitrous oxide and methane

262. Emissions of CH_4 and N_2O from LUCF were small and accounted for only 0.1 per cent of aggregated global emissions in 2000 (excluding LUCF). CH_4 emissions fell by 1.3 per cent while emissions of N_2O rose by 4.4 per cent between 1990 and 2000. While uncertainties in estimating emissions of these gases are likely to mask trends, improvements in fire management should reduce N_2O and CH_4 emissions (NZL). In some countries, however, fires form an important element of long-term ecological stability (e.g. SWE) and other policies encourage the use of fire on a controlled basis.

B. Implementation issues

Reporting issues

263. Almost all Annex I Parties, except for Liechtenstein and Monaco, reported policies in the LUCF sector. Many of these policies were implemented for a variety of primary objectives other than climate change. Yet, some Parties highlighted the role of the LUCF sector in reducing total GHG emissions (CAN, EST, JPN, NZL, POL, USA). Almost all of the policies addressed emissions and sequestration of CO_2 with very little emphasis on N_2O and CH_4. Out of around 40 policies and measures in the LUCF sector included in the database, 75 per cent have been implemented, 10 per cent adopted and the rest planned, reflecting the fact that a few Parties are developing additional measures to meet the Kyoto targets, to be implemented if the first batch of measures fails to deliver the required emission reductions (e.g. EST, HRV, JPN).

Policy objectives and policy trends

264. Policies and measures in the LUCF sector are strongly linked to other domestic policies implemented by Parties, such as land-use management within the agricultural sector (e.g. all Annex I Parties with afforestation / reforestation and conservation policies in the agricultural sector); biodiversity and wildlife conservation; soil and water conservation; resource supply (NOR, NZL, USA); sustainable forest management; rural development and protection from pests and fires.

265. Policies concerning afforestation and reforestation activities were predominant in the LUCF sector, being reported by 15 Parties. Seven Parties, according to the database, reported policies designed to improve forest management, such as forest stewardship (USA) and forest management certification (SWE). Few Parties reported policies other than afforestation under the land-use change component of LUCF. Exceptions included policies designed to increase carbon sequestration in soils through promotion of the use of green manure crops (JPN) and conservation programmes (CAN). Five Parties reported research-based policies. Both Canada and New Zealand reported steps to implement carbon trading schemes that recognize the value of carbon stored in eligible sinks, and both these Parties also reported specific forest management and afforestation projects. These are significant steps towards the inclusion of the LUCF sector in domestic and international emissions trading schemes.

266. With the exception of trading regimes, none of these policies are particularly innovative. Developing new technologies in the fight against pests and fire may make forest protection systems more effective. Research into carbon dynamics and accounting regimes in the products and waste pools may also help Parties to include these pools in their national inventories (subject to approval by the COP). In

principle, policies and measures in this sector are replicable although they would need to be tailored to suit individual circumstances.

Policy instruments

267. The policies and measures in the LUCF sector were implemented using a range of instruments including regulatory (to enforce replanting following harvesting and stop forest clearance, EST), fiscal (linking energy taxes to afforestation, e.g. NLD), economic (financial compensation for converting agricultural land to forest, BEL), voluntary agreements (sustainable forest management certification, SWE) and specific projects (CAN, NZL). The first three instruments are more common, reflecting the fact that many LUCF policies and measures are based on the provision of subsidies, grants and tax incentives. Specific projects can have significant impacts upon a Party's total GHG emissions (for example the East Coast Forestry Project in New Zealand aims to offset about 3 per cent of New Zealands's 1990 CO_2 emissions).

Estimates of effects

268. Nine Parties reported quantitative assessments, most of which were recorded in the database. Some Parties provided brief details of the assessment approach, for example, predictions of carbon stock changes based on predicted activity levels (e.g. CZE) and forest growth with and without the additional policies and measures (e.g. NZL).

269. Only three Parties reported the environmental effectiveness of LUCF policies and measures in the context of their Kyoto targets (CZE, JPN, NZL). New Zealand expected the LUCF sector to offset around 55 per cent of gross CO_2 emissions from energy and industrial sources between 2000 and 2009 and Japan expected sinks to deliver approximately 30 per cent of its Kyoto target. The LUCF sector sequestered approximately 15 per cent (plus 2 per cent in soils) of the United States' annual CO_2 emissions. Other Parties reported small contributions or did not quantify contributions. Canada did not quantify contributions due to uncertainties associated with the inclusion of activities and the accounting regimes.

C. Framework and description of policies

270. A framework for the classification of LUCF policies and measures could include: (a) policies and measures that deliver increased sequestration through activities in the LUCF sector, including a subset of policies (particularly afforestation and reforestation since 1990) that will count towards Kyoto targets; (b) policies and measures that aim to reduce emissions of CO_2 and non-CO_2 GHG in the LUCF sector; and (c) research-based policies and measures that aim to increase the understanding of carbon dynamics, improve monitoring capacity and develop new and innovative solutions.

Policies and measures to increase sequestration of CO_2

271. Several Parties reported the development of national forest strategies and programmes promoting a wide range of measures likely to contribute to an overall increase in carbon stored in forests and forest products (EST, EUR, FIN, JPN, SWE). Many Parties reported a range of afforestation and reforestation policies (BEL, CAN, CZE, ESP, EST, FRA, GBR, HRV, LVA, NLD, NOR, NZL, POL, SVK, USA). Many Parties also reported policies to increase removals through improved forest management using regulatory and voluntary measures such as sustainable forest management, forest stewardship and forest management certification (EST, HRV, JPN, LIE, LVA, SVK, SWE, USA). Japan reported the promotion of urban tree planting.

272. Few policies and measures aimed at increasing carbon sequestration in soils were reported in the LUCF sector. Japan reported promotion of the use of green manure. Canada reported specific policies in

the agricultural sector that will influence carbon sequestration in soils (e.g. no-tillage regimes, conversion of arable lands to pasture) and expected agricultural soils to function as a net sink in 2010 (soils in CAN are currently a net source). Canada also predicted that agricultural soils could sequester 160,000 Gg CO_2 over a 20-year period, if appropriate and broad changes were made to land management. The United States reported that agricultural soils currently offset about 2 per cent of its total annual GHG emissions and estimated that removing environmentally sensitive farmland from production will offset 56,000 Gg CO_2 annually. Many forms of improved environmental practice in the agricultural sector (e.g. organic farming, use of organic fertilizers, manure management etc.) will also increase carbon storage in soils, although Parties did not report or estimate these benefits.

Policies and measures to reduce emissions of GHGs

273. Specific policies and measures to reduce emissions of CO_2 and non-CO_2 GHGs were seldom reported. Latvia intended to restrict conversion of forest land to other uses and thereby reduce CO_2 emissions. Austria reported strengthening the protection of existing forests. Slovakia noted steps to protect the carbon stored in forest soils. Canada and New Zealand emphasized means to improve the protection of forest resources from fire and pests. In some countries, however, fires form an important element of long-term ecological stability (e.g. SWE) and other policies are encouraging the use of fire on a controlled basis.

Research-based policies and measures

274. Austria placed emphasis on research to better understand adaptive strategies within areas of high conservation value. Belgium reported research into carbon sequestration in forests. Also, Canada and New Zealand reported research-based policies seeking to improve methods of fire control and thereby reduce emissions of non-CO_2 GHGs. Norway reported research into carbon storage in buildings, furniture, landfills and other wood products. New Zealand reported research and development of a carbon monitoring tool based on satellite imagery and ground truthing. Other Parties reported more general research, extension and outreach programmes.

D. Policies and measures having a negative impact on emission trends

275. Policies and measures promoting sustainable forest management may result in the replacement of faster-growing conifers by slower-growing broad-leaved species (which therefore sequester less carbon in a given time, SWE). The promotion of controlled burning is also likely to reduce carbon storage in the short to medium term whilst at the same time protecting biodiversity and natural ecosystems and increasing carbon storage in the long term (SWE). Policies promoting the use of timber resources (e.g. JPN) may result in increased harvests of timber. Even under sustainable management practices where these areas are replanted, emissions from harvests are likely to exceed removals from growth up to the end of the first commitment period.

E. Conclusions

276. Parties reported a range of policies and measures in the LUCF sector focusing on afforestation, reforestation and forest management. There was much less emphasis on the role of other LUCF activities such as cropland and grazing management, revegetation and the role of soils in carbon sequestration. Only a few Parties reported policies and measures to reduce emissions, for example from soil management and land clearance. Parties reported a range of research-based policies and measures including some that have potential to improve understanding of carbon dynamics and others tackling fire and pest control. Whilst several Parties expected their portfolios of policies to be effective, few reported quantitative estimates of the effects of individual policies and measures. In view of the inherent accounting difficulties due to the complexity of the sector, progress in estimating these effects could help to shape climate change policy in the sector, given that some reported policies and measures (notably

sustainable forest management and forest management certification) may have relatively insignificant or even negative impacts upon net sequestration in the LUCF sector.

277. Increased sequestration in 2000 compared to 1990 helped many Parties to slow the growth of GHG emissions. In Norway, this sequestration was sufficient to make total 2000 emissions (including LUCF) less than total 1990 emissions (including LUCF). Reductions in net sequestration increased total emissions in several Parties (e.g. CHE, CAN, FIN, USA). For two Parties (CHE, FIN), total 2000 emissions excluding LUCF were less than corresponding 1990 emissions, but total 2000 emissions including LUCF were greater than corresponding 1990 emissions.

278. Several Parties expected significant contributions to the lowering of future emission trends to come from the LUCF sector. Importantly, a few Parties quantified these contributions in terms of LUCF activities implemented since 1990, with the specific intention of assessing the contribution of these policies and measures to their Kyoto targets. Other Parties' expectations were not based on quantified estimates using the accounting rules and some reports did not suggest a full understanding of the accounting rules. Policies and measures implemented over the next few years can still influence net sequestration during the first commitment period but some Parties reported uncertainties over eligibility and accounting rules as a barrier to further action.

279. Several Parties reported LUCF estimates and predictions based on existing net growth rates (growth minus harvesting) under different scenarios reflecting activity levels and/or growth rates. New Zealand, for example, reported increases of carbon in planted forests net of emissions from harvesting and other emissions from land-use changes. Sweden predicted sequestration net of improved growth rates and different levels of harvest. Emissions of non-CO_2 GHGs were of less significance and the Czech Republic, for example, assumed they remained level throughout the first commitment period. There was little mention of methodologies for monitoring and reporting emissions, although New Zealand specifically reported the development of a monitoring tool for the LUCF sector.

IX. WASTE

A. Emission profile

280. The greenhouse gas emissions from the waste sector for most Parties included in this analysis ranged from 2 per cent (CZE) to 8 per cent (NOR) of the total GHG emissions expressed in CO_2 equivalent. The highest shares were reported by Japan (14 per cent) and Latvia (13 per cent).

281. Between 1990 and 2000, most of the Parties reported decreases from the waste sector ranging from a few per cent to –40 per cent. Increasing trends were reported by a few Parties (BEL, CAN, ESP, LVA, NOR, POL). The extremes were –53 per cent (FIN) and +184 per cent (LVA). Most Parties expected emissions from waste to continue to decrease in the future, e.g. Sweden expected emissions to fall by 55 per cent in 2010 compared to 1999.

282. The most important greenhouse gas in the waste sector is CH_4 from landfills, which was reported by all Parties. Additional GHG sources reported by only some Parties are CH_4 and N_2O emissions from waste water treatment plants as well as CO_2 and N_2O emissions from waste incineration. The underlying driver behind the increase in emissions is the increasing amount of waste generated. This was, however, partly offset by factors such as the increasing share of waste being recycled and incinerated, the treatment of waste before landfilling and the recovery of landfill gas.

B. Implementation issues

Reporting issues

283. All Parties implemented measures in the waste sector. Policies and measures included activities directly affecting the emissions from waste-related sources but also general waste management policies influencing the waste streams and quantities, and therefore influencing indirectly GHG emissions.

Policy objectives and policy trends

284. Many of the policies and measures reported in this sector addressed broad environmental objectives, such as ensuring clean air, preventing soils and underground water from being contaminated, and avoiding odours. However, these policies have a significant indirect impact on climate change and, in particular, on GHG emission levels. In this context, waste separation and waste recycling were initiated for general environmental reasons, while the treatment of landfill gas was initiated primarily to reduce greenhouse gas emissions.

285. Linkages to other policy objectives exist, particularly for pollution prevention principles. Waste incineration has been an important emitter of dioxins and mercury in the past. Pollutant emissions from waste incinerators remain of concern in several countries. Recycling of organic wastes and sewage sludge for soil amendment may spread pollutants in these wastes to land. Here, certain rules on source separation and pollutant monitoring need to be applied to lower this risk. Integrated environmental policies need to take both concerns, climate change and pollution prevention, into account to optimize the environmental effect. However, these linkages were rarely mentioned explicitly in the national communications.

286. Compared to the second national communications, the third communications mentioned broadly the same range of measures related to the waste sector. Both measures aimed directly at landfills (i.e. reducing landfill gas emissions, regulating the waste disposed) and preventive measures (i.e. minimization and recycling) were reported. It is worth noting that the NC3 placed more emphasis on preventive measures.

Policy instruments

287. The most important policy instruments for the waste sector, in general, are regulations, where technological requirements are set for landfills or recycling activities. These include standards as well as policy targets. For example, the United States introduced a stringent landfill rule, including performance standards and emission guidelines, which required the largest landfills to collect and combust the landfill gas. It was estimated that this rule would reduce landfill CH_4 emissions by about half in 2000.

288. Economic instruments were also applied or planned by several Parties. Most common among these instruments was the landfill tax. This tax ranged from Sw F 15 (US$ 9) per tonne of waste (CHE) to NKr 300 (US$ 33) per tonne. Cost-effective initiatives with the aim of reducing the amount of household waste for disposal were reported by the United States, which introduced a residential Pay-As-You-Throw Initiative. Other economic instruments, e.g. emissions trading or subsidies, were usually not seen as attractive policy instruments for the waste sector and few voluntary agreements were reported.

289. Education and training were mentioned in the context of waste minimization and recycling strategies directed towards the consumer and also towards companies in the waste sector. Enhanced research and development and emission monitoring programmes by the Parties received little attention.

Estimates of effects

290. Several Parties reported an assessment of the environmental effectiveness and the applied methodology. Often the evaluation was based on simplified approaches and spreadsheet models based on per capita developments and projections of CH_4 emissions from landfills. Some Parties outlined the effectiveness of key single measures, while others gave only aggregated figures on a sectoral level. Norway estimated that the treatment of landfill gas and recycling activities reduced GHG emissions by similar amounts.

291. Only a few Parties provided data on the cost of measures. The EC had commissioned a comprehensive study on available GHG abatement measures and the related costs for all greenhouse gases in all relevant sectors. This study concluded that a substantial share of options to reach the Kyoto target were low-cost options, including sharp reductions in the waste sector. For this sector, low-cost measures would allow a 40 per cent reduction of the 2010 baseline emissions from the sector. A significant proportion thereof was related to landfill emission reductions. The study was based on bottom-up cost curves collected for all sectors within the EU.

C. Framework and description of policies

292. Several options for reducing the environmental risks of waste, including improved handling and disposal as well as recycling and minimization are available. All these options are competing and have their advantages and disadvantages related to environmental performance and cost. To prioritize the options, several Parties (AUT, EUR, SWE) have introduced a hierarchy in their waste management strategy.

293. The hierarchy of sustainable waste management establishes the following order of activities: waste minimization, source separation, waste reuse, material recycling, energy recycling (i.e. incineration) and safe disposal. The intention of this hierarchical approach is to reduce and separate waste at the source as much as feasible, then to recover as much of the waste resources as possible and, finally, to treat and dispose of the waste in a safe manner. Not all Parties have elaborated all these steps but all have at least addressed one or more elements of it. The description of the policies reported by Parties below follows the waste management principles outlined above.

Policies aimed at waste minimization and recycling

294. A range of policies and measures concerning waste minimization and material recycling were reported. The separate collection of waste fractions and the stimulation of the recycling of organic and other types of waste through regulation and waste management plans, including waste targets, was encouraged by many Parties (AUT, BEL, FIN, FRA, GBR, HRV, JPN, LIE, LVA, NOR, NZL, SVK, SWE, USA). Waste minimization and prevention of waste generation was implemented by several Parties (AUT, BEL, EST, FIN, JPN, NOR, NZL, USA) through national waste strategies and programmes.

295. Regulations were adopted for several waste fractions: packaging and associated waste (CZE, ESP, EUR), material recovered from used cars (EUR), electrical and electronic equipment waste (EUR) and sewage sludge (EUR, POL). Preventive measures were reported on consumer education and proactive behaviour related to waste (SWE) and on promoting the use of recycled products (JPN).

296. The build-up of the waste management infrastructure was of concern to a few Parties (CAN, HRV, SVK). The infrastructure development included both solid waste and waste water and included subsidies for municipal investments. Measures concerning waste water included the generation of biogas and its utilization in waste water treatment plants and improved sewage treatment (CZE, JPN, NZL,

POL). Occupational training programmes for operators of waste and waste water facilities were reported by Poland.

Policies aimed at waste incineration

297. Measures on waste incinerators targeted increasing the share of waste incineration compared to landfilling (AUT, CHE, ESP, HRV, NLD), improving energy recovery from waste incinerators (AUT, FRA, JPN) and strengthening standards for waste incinerators and improvement of their combustion efficiencies (BEL, JPN). Tax-related measures included a tax on waste incinerated (NOR) and a tax exemption for electricity generated by waste incinerators (NLD).

Policies aimed at waste disposal

298. Improved control of landfill emissions was the most frequently implemented measure with an immediate effect on GHG emissions. It usually comprised capture and treatment of landfill gas. Many Parties have planned or implemented such activities (AUT, CAN, CZE, BEL, ESP, EUR, FIN, FRA, GBR, HRV, LVA, NLD, NOR, NZL, POL, SVK, SWE, USA).

299. Additional measures directly targeting landfills included the closure of uncontrolled landfills (ESP, EST, HRV, NZL, POL), the regulation of technologies and management related to landfills (AUT, CZE, EST, GBR, HRV, NOR, NZL, POL, SVK), the reduction of, or ban on, landfilling of organic and other waste fractions (AUT, BEL, CHE, CZE, EUR, FRA, GBR, LVA, POL, SWE) and the regulation of the pre-treatment of waste before landfilling and of its organic content (AUT). Taxes and charges on landfilling of packaging and other waste were implemented by several Parties (AUT, BEL, CHE, FIN, GBR, NOR, SVK, SWE).

D. Conclusions

300. In the waste sector, Parties placed the emphasis on controlling emissions from landfills, regulating the type of waste to be landfilled and improving landfill infrastructure. Parties with a less developed waste management infrastructure, e.g. some EIT countries, tended to stress the move from uncontrolled waste dumps to centralized, controlled landfill sites, while Parties with a well developed infrastructure emphasized the pre-treatment and control of waste to be landfilled as well as waste minimization and recycling strategies.

301. Several Parties accorded the highest priority to waste minimization and material recycling (AUT, EUR, SWE). Waste incineration was commonly seen as a more environmentally friendly option than landfilling. Further improvements in the performance of incinerators, e.g. better heat and electricity recovery, were also outlined. Policies and measures related to waste water treatment plants were rarely mentioned.

302. The policies and measures were often effective in reducing the GHG emissions from the waste sector, but the magnitude of the effect varied among Parties. Addressing the CH_4 emissions from landfill gas and shifting from landfilling to waste incineration has an immediate but limited positive effect.

303. Minimizing and redirecting waste streams and introducing taxes also have a limited immediate effect but may lead to more substantial reductions in the long term. It remains unclear whether the Parties that favour incineration will effectively be able to reduce emissions further and to what extent those Parties favouring the waste minimization and material recycling will be able to substantially reduce their emissions in the future.

304. The effect of measures in the waste sector was reported by several Parties and the assessment was mainly based on simplified approaches and spreadsheet models. Cost estimations were only

reported by a few Parties. The data available suggested that reducing landfill gas emissions is a low-cost option, which could be associated with objectives other than climate change.

X. OVERALL CONCLUSIONS

Is there evidence that Annex I Parties were successful in finding a mix of effective policies to control GHG emissions?

305. In their NC3, Parties summarized almost a decade of experience in identifying and implementing climate change policies. During that decade, climate change rose in importance in the national policy agenda and climate change objectives were integrated into the objectives of many sectors, notably the energy sector, to various extents. Also, linkages were established between climate change issues, including energy and mobility, on the one hand and sustainable development on the other.

306. Although, with few exceptions, climate change policies were driven by objectives other than climate change, e.g. enhancing economic performance through energy market liberalization, improving local air quality through emission and vehicle efficiency standards, or improving economic efficiency through restructuring and privatization of markets in EIT countries, these measures assisted many Parties in finding ways to achieve emission reduction gains and moderate emission growth between 1990 and 2000. Some climate-driven policies and measures also led to significant emission reductions from specific sources. For example, N_2O emissions were significantly reduced by the measures targeting the chemical industries, which have also proven to be very cost-effective.

Were Parties able to change the emission trends in the past and to achieve the aim of the Convention?

307. Several Annex II Parties, including Finland, France, Sweden and Switzerland, returned their emissions in 2000 to their 1990 levels, excluding LUCF, or even reduced them, e.g. the EC and the United Kingdom, thereby contributing to attaining the aim of the Convention for Annex I Parties to return individually or jointly their 2000 emissions to 1990 levels. Nine other Annex II Parties exceeded their 1990 emission levels in 2000, and some of them slowed their emission growth or even stabilized their emissions after an initial emission increase in the early 1990s. Different factors seemed to have contributed to this trend, including milder winters and an economic slowdown. However, climate change related policies seemed to be partly responsible for stabilization and the significant slowdown of emission growth in all these countries. A number of Parties had clearly rising emission trends at the end of the decade.

308. The contribution of the EIT countries to the aim of the Convention was significant. It stemmed from the steep economic decline resulting from the transition from centrally planned to market economies, associated structural changes and a drop in emission levels. Of overriding importance, however, was the fact that in recent years most EIT countries enjoyed appreciable economic growth with visible decoupling of economic growth from emission growth.

Are these policies sufficient to form a framework and set a path to achieve significant emission reductions in the future?

309. Effective integrated climate strategies are now emerging from lessons learned over almost a decade of implementation of climate change policies and measures. These strategies are underpinned by a diverse and carefully designed policy mix. They focus clearly on climate mitigation but also contain elements of adaptation. Innovative policy approaches such as emission and green certificate trading are also likely to play an increasingly important role in these strategies.

310. There is evidence that many Annex I Parties bound by the commitments of the Kyoto Protocol, or intending to be so, are on track to design and implement integrated strategies that could achieve

significant emission reductions in the medium term. Whether these strategies will be successful in modifying these trends will depend on: how comprehensively they cover all important sources of emissions; whether they identify and use cost-effective options; and how effectively they acquire public support. Success will also depend on how Parties translate these strategies into specific programmes and action plans.

Given that all the Parties acknowledge the role of new technologies, is there a clear vision as to which are the most promising technologies in terms of climate mitigation and what could be the level of impact of these technologies on emission trends?

311. Much emphasis was placed by the Parties on the role of new technologies in modifying mid- and long-term emission trends. Examples of such technologies included fuel cells, carbon sequestration, abatement technologies for process-related CO_2 emissions, and, for some applications, viable substitutes for ozone-depleting substances controlled by the Montreal Protocol, other than HFCs, PFCs and SF_6. There was little indication, however, as to which are the most promising technologies to achieve significant emission mitigation and how research is targeting them. Also, there was little information on how the existing policies could persuade the markets to ensure an optimal uptake of new efficient technologies that are close to economic viability.

312. It was evident from the analysis of the information reported that new economically viable technologies are needed to put the growth of emissions on hold. They may not be critical for the first commitment period under the Kyoto Protocol, where the existing measures or measures to be phased in prior to this period, and the existing technologies could deliver most of the necessary emission reductions in virtually all Parties. However, the implementation of such technologies should at least start on a pilot basis in the first commitment period in order to deliver further emission reductions in the second period.

How do Parties monitor and evaluate the effect of policies and measures?

313. Many Parties considered the monitoring of implementation of policies and measures, and estimating of effects as a priority. Moreover, they noted that monitoring will be critical to ensure that policies are on track to deliver the effect expected or to trigger the strengthening of existing policies and the launch of new ones if necessary to meet the Kyoto targets. Still, Parties acknowledged methodological problems related to ex-ante and ex-post assessment, data quality and inevitable uncertainties associated with estimates of mitigation effects or cost, as the main reasons for not providing a comprehensive assessment of the effects of policies and measures in their NC3. Further refinement of methods for assessing the effects of policies and measures could help to overcome these problems and to make these methods consistent across Parties in terms of assumptions, approaches and results.

How do Parties report the information on policies and measures in their third national communications?

314. While the quality of reported information was considerably better in the NC3 than in previous communications, some gaps and ambiguities still remained. In order to ensure greater coherence and avoid gaps in future communications, the reporting and review process could benefit from: tightening of the UNFCCC guidelines; Parties being encouraged to follow these guidelines more strictly; and Parties being provided with a model of the information on policies and measures they are expected to report.

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