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Report on the in-depth review of the national communication of Canada

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Under Articles 4 and 12 of the Convention, Parties are required to prepare national communications on their implementation of the Convention. Guidelines for the preparation of national communications and the process for their review were agreed on by the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change, by its decisions 9/2 and 10/1, and by the Conference of the Parties, at its first session, by its decisions 2/CP.1 and 3/CP.1 (see FCCC/CP/1995/7/Add.1). In accordance with these decisions, a compilation and synthesis of the first 15 national communications from Annex I Parties was prepared (A/AC.237/81).

When reviewing the implementation of the Convention by Parties, the subsidiary bodies and the Conference of the Parties will have this report available to them in English as well as the summary of the report in the six official languages of the United Nations. (These bodies will also have before them the executive summary of the first national communication of Canada and country-specific information drawn from a compilation and synthesis report covering all countries that have submitted national communications.)

I. Summary¹

1. The in-depth review was carried out during the period April to August 1995 and included a visit by the team from 29 May to 2 June 1995. The team included experts from Mexico, the Czech Republic, Japan and the Organisation for Economic Co-operation and Development (OECD). Canada submitted its National Report on Climate Change in February 1994, and the National Action Program on Climate Change (NAPCC) in March 1995, and additional background material was made available to the team.
2. The team recognized Canada's important role internationally in exploring formats and contents of such reports prior to the adoption of guidelines. It found that the communication and updates/supplements in general respected the guidelines. The measures described in the national report provide examples of activities under way in Canada, including federal, provincial, municipal and private sector initiatives, rather than a fully comprehensive description. During the visit specific information was given on emissions of non-CO₂ gases and sinks. Limited information was communicated on the effects of measures.
3. Important factors influencing Canada's high intensity of energy use per capita (8 tons of oil equivalent in 1990 compared to an average of 4.8 in OECD member countries) and high emissions of CO₂ (17 tons CO₂ per person in 1990 compared to an OECD average of 12) are its size, settlement patterns and cold climate, major indigenous energy reserves, major and growing energy-intensive industry, relatively low energy prices and an export-oriented economy. Furthermore, the population growth rate of up to 1.5 per cent per annum is the highest among OECD member countries and is an important factor behind historical and expected growth in the economy and of emissions. Emissions vary considerably among the provinces and territories due to differences in the use of hydro, thermal and nuclear power, settlement patterns, industrial and resource bases. Canada is heavily dependent on energy-intensive exports. Its economy is based on an integrated North American market. Some policies and measures, such as energy efficiency, are aimed at North American harmonization.
4. Jurisdiction over policies and measures is shared at federal, provincial and municipal levels, and practices vary amongst provinces. Consequently, federal policy is developed through consultations between the various levels of government, and other stakeholders (business and environmental non-governmental organizations) are also closely involved. Canada provided information on both federal programmes and actions at the provincial level, but the information was not meant to be exhaustive for the latter. Canada's mitigation measures include regulatory and information programmes and other new initiatives, but also have a large voluntary component. The federal Government is taking a consensus-building approach. Efforts to bring all stakeholders on board are beginning to bear fruit, and the

¹ In accordance with decision 2/CP.1, the full draft of this report was communicated to the Canadian Government, which had no further comments.

NAPCC of 1995 established a common platform from which Canada's response to climate change can be developed further. The team found that this highly consultative process appeared essential for identifying responsibilities and options for detailed action.

5. The 1995 NAPCC included a new initiative called the Climate Change Voluntary Challenge and Registry Program (VCR). This was at the signatory stage at the time of the team's visit, and can be seen as an outreach programme establishing a common platform for the voluntary approach. Activities under existing programmes could be reported under the VCR. The team also noted that the Canadian federal Government is no longer financially supporting new "megaprojects" in the energy sector.

6. Canada has committed itself to stabilizing net greenhouse gas (GHG) emissions at 1990 levels by 2000. However, the revised outlook referred to in the NAPCC, which includes existing measures, projects a 13 per cent growth in GHG emissions from 1990 to 2000 unless there are new initiatives including those in the NAPCC such as the Voluntary Challenge and Registry Program. The team found the assumptions underlying the projections reasonable, although the assumed growth of emissions of gases other than CO₂ may be high compared to international trends for these gases. There is now a broad consensus among governments that in order to close the stabilization gap further options need to be developed. A multi-stakeholder group has been analysing further measures. Canada is investigating the economic, social and environmental effects of measures undertaken to mitigate GHG emissions, and also how performance indicators could be used to assess progress in this field. Progress in achieving the target will be reviewed domestically in December 1996. The team concluded that, if the Government at that time finds that Canada is unlikely to reach its target without more aggressive action, there will be limited time to implement and see the full effects of new initiatives by 2000, even if the NAPCC is seen as a flexible instrument allowing for prompt action.

7. Forty-five per cent of Canada is covered by forest. While the contribution of this sector, especially with regard to anthropogenic influence, is still highly uncertain, it seems that it shifted from being a large net sink to becoming a lesser net source of emissions around 1990. Pests and forest fires are contributors to loss of carbon from this reservoir. Recognizing that most of the forest area is believed to be unaffected by human interference, the team still concluded that development of net anthropogenic emissions or sequestration from this sector could be significant inside a net approach. Thus, Canada's ongoing efforts to build an adequate inventory will be crucial to develop and monitor relevant mitigation and adaptation strategies.

8. Canada is contributing its full share to the 1994-1996 replenishment of the Global Environment Facility (GEF), and was also a contributor in the pilot phase. The official development assistance (ODA) level in 1993 was 0.45 per cent of the gross national product (GNP), according to OECD statistics. Approximately 80 per cent of ODA is managed by the Canadian International Development Agency and mostly disbursed through bilateral development projects. All Canadian ODA projects are subject to the Canadian Environmental

Assessment Act, requiring assessment, and, where appropriate, mitigation of the environmental impacts.

9. The team found that Canada is making a considerable contribution to the scientific understanding of climate change. Given the variety of climatic conditions within its frontiers, research on vulnerability and effects is particularly important in an international context. Canada has not implemented specific adaptation measures as such, although some areas are considered sensitive to shifts in extreme events, sealevel rise, precipitation patterns and temperature changes.

10. The wide involvement of stakeholders in developing Canada's response to climate change is crucial to public awareness of the issue. There are also examples of information materials and education programmes that are noteworthy, although it was recognized that education and public awareness efforts need to be coordinated. Activities in that respect will be achieved through the efforts of the education work group of the Canadian Council of Ministers of Environment and the communications/public education work group of the National Air Issues Coordinating Committees.

I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

11. Canada ratified the Convention on 4 December 1992. The original national communication was received on 7 February 1994, and additional background information by 21 September the same year when guidelines had been more fully developed. The National Action Program on Climate Change (NAPCC) was received on 28 March 1995. The in-depth review of these national communications was carried out during the period May to August 1995, including a country visit from 29 May to 2 June 1995. The members of the review team were Ms. Julia Martinez (Mexico), Mr. Jan Pretel (Czech Republic), Mr. Naoki Matsuo (Japan), Mr. Laurie Michaelis (OECD secretariat) and Mr. Peer Stiansen (UNFCCC secretariat, Coordinator).

12. The team recognized that Canada had played a leading international role in the development of guidelines for reporting by volunteering to produce an early report (February 1994), which was submitted before the INC/FCCC guidelines were agreed upon. The development affecting climate change policies since receipt of the original communication was the NAPCC.

13. Canada's territory is the second largest in the world and is mainly located in climatic zones with high heating requirements. It has a large amount of forest (45 per cent of total land area), wetland and permafrost area. Canada has a high population growth rate (recently as high as 1.5 per cent per year, largely due to immigration) compared with OECD countries outside North America and a low population density. It also has low-density urban settlement patterns, generating relatively high transportation demand. Ninety per cent of the population lives within 160 kilometres of Canada's southern border.

14. Canada's trade-oriented economy is based on an integrated North American market. This integration is seen as placing some constraints on what Canada could do unilaterally in terms of measures. There could be costs in applying measures significantly different from those of the rest of the region. Canada's technology markets in particular are highly integrated with, and dependent on, those of the rest of North America. Many of Canada's measures, in particular energy efficiency standards, are aimed at North American harmonization. The team noted that new North American initiatives in the climate field are envisaged, although the establishment of the North American Free Trade Agreement in 1993 has not yet affected climate policies.

15. Canada has a high energy use per capita (8 tons of oil equivalent per person in 1990 compared to an average of 4.8 in OECD member countries) and the level of carbon dioxide (CO₂) emissions per capita (17 tons in 1990 compared to an OECD average of 12) is high despite the fact that 75-80 per cent of the electricity is generated from hydro and nuclear plants. This CO₂-free electricity is used to satisfy base load in major parts of the country, while marginal electricity is often generated from fossil fuels. The energy prices for end-users are also low relative to most other OECD countries. Canada has a large and diverse indigenous energy resource base, which, combined with the forest and mineral resources, provides crucial input for energy-intensive Canadian industry. Canada has recently seen rapid industrial growth, a substantial part of that growth being in energy-intensive industries that are major electricity users. Since the bulk of electricity is produced without CO₂ emissions, this development is not reflected in the emissions inventories in the same way as for countries more dependent on fossil fuels. There is limited trade in electricity between provinces due to regulatory factors, but there are substantial exports (6 per cent of electricity production). The overall decrease in energy intensity (energy input/gross domestic product) has been 17 per cent from 1973, compared with 24 per cent for the OECD average, according to the International Energy Agency.

16. The team noted also that the role of government is being reoriented towards creating a level playing field in the economy and towards reducing public spending and debt. Federal spending is being radically reduced, and the climate change strategy will have to be further developed within this context. Spending is also being reduced at the provincial and municipal level. The Canadian federal Government is no longer financially supporting new "megaprojects" in the energy sector.

17. A feature of Canada is the strong role, reflected in the legislative structure, of provincial and territorial governments in creating the framework for energy, transport, land-use, industry (licensing) and forestry sectors, which is of particular relevance to the development of climate change policy. Provinces and territories have different targets and practices in these matters. Because of this situation, development of a consensus approach to federal decision-making, involving the provincial governments, is crucial. Historical reasons have also made it necessary to seek a consensus on measures where the federal Government formally has the legislative power.

18. In developing the NAPCC, stakeholder involvement was ensured through the National Air Issues Coordinating Mechanism comprising senior provincial and federal officials, building upon a history of five to six years of working on climate change through various interdepartmental groups and committees, generally involving stakeholders in and outside the governments. The team recognizes that through the NAPCC there is now agreement on a platform from which to develop further policies and measures, and that this highly consultative process is crucial to identifying responsibilities and options for detailed action.

19. Canada's national commitment is to stabilize net GHG emissions, aggregated on a global warming potential (GWP) basis, at 1990 levels by 2000. This commitment is reaffirmed in the NAPCC. Federal and provincial energy and environment ministers meet regularly to review progress and evaluate options for further progress. Since the team's visit one meeting took place in November 1995. The next is scheduled for December 1996, when the first review of Canada's programme is expected to be released.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

20. The national report covers all major GHG and precursors. Additional information on some other GHGs such as sulphur hexafluoride (SF₆) was made available to the team, as were some revised estimates of 1990 figures. The team concluded that in giving this information Canada had followed the guidelines. The team recognizes Canada's efforts to develop as accurate an inventory as possible, and realizes that this work entails revisions of the 1990 figures based on new and better information. Based on the Intergovernmental Panel on Climate Change (IPCC) 1994 GWPs, CO₂ accounts for 79 per cent, methane (CH₄) 13 per cent, nitrous oxide (N₂O) 5 per cent and other gases 2 per cent of the emissions. Canada has not adjusted its inventory for variations in factors such as temperature and electricity exports or imports, although 1990 was a warmer year than average and Canada made net exports of electricity.

21. Two separate methods of estimating emission levels were used. A top-down approach was used for emissions of CO₂, CH₄ and N₂O, based on regional and national statistics and using emission factors and a mass-balance approach. Emission factors and related activity levels are organized by sector, using data from Statistics Canada and elsewhere. All the information is contained in the addendum to the national communication (supplementary tables). A bottom-up approach was used for emissions of nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC), based on the Residual Discharge Information System (a computerized database used to maintain data on major emission sources). The standard IPCC tables have been provided but some items remain to be completed. The inventory data were prepared in consultation with provinces and industry. The 1990 GHG emission estimates presented in the national communication were calculated in consultation with provincial ministries of environment and energy, Environment Canada, Natural Resources Canada and industrial associations. Fuel carbon emission factors were derived on a province-by-province basis. Methane emissions

were estimated based on methodologies similar to those approved by the IPCC, including specific models.

22. The figures given in the communication for anthropogenic emissions of **CO₂** in 1990 were not changed in the revision and are estimated at 460 500 Ggs. Transportation accounted for 32 per cent, electricity generation 20 per cent, industry 16 per cent and residential use 9 per cent, commercial sources 5 per cent, producer consumption 9 per cent, other stationary sources 3 per cent, and industrial processes 6 per cent. The uncertainty in these figures was estimated at ± 4 per cent, at a confidence level of 95 per cent. The team noted that Canada's anthropogenic **CO₂** emissions have been growing during recent decades, peaking in 1989 at 490 000 Ggs after being temporarily down to 380 000 Ggs in 1983. In 1993 the level was 465 000 Ggs. Despite the fact that 75-80 per cent of the supply stems from hydro and nuclear power, the team also noted the substantial emissions from electricity generation caused by the high consumption of electricity. The differences in per capita emissions among provinces are due to their differing energy and industrial structures. Finally, the team noted that emissions from transportation and heating were broadly proportional to population in the provinces.

23. Canada was unable to provide the review team with an estimate of the emissions or sink capacity associated with **land-use changes and forestry** for 1990. There are major uncertainties in the actual emission levels associated with different types of land-use and changes in land use. Canada has carried out research into these emissions and provided some results in the inventory documentation.

24. The **carbon reservoir in forests** is roughly estimated at 12 Gt of carbon (equivalent to 44 000 000 Ggs of **CO₂**) in forest biomass, 88 Gt (equivalent to 323 000 000 Ggs of **CO₂**) in soil and 0.6 Gt (equivalent to 2 200 000 Ggs of **CO₂**) in forest products. In the original communication, forest land is described as a significant net sink. The team was presented with information indicating that forest land had changed from being a sink with a capacity of approximately 200-260 000 Gg **CO₂** per year until about 1970, after which the sequestration rate fell rapidly so that by 1989 analysis indicates that forests had become a net source of about 60 000 Gg of **CO₂**. Figures for 1990 and after have not been released; forest land is now thought to be a net source of **CO₂** although there are major uncertainties. This change is believed to be attributable primarily to increased forest fires and pests, while harvesting is seen as having had a limited effect. While Canada has an active fire and pest control programme which can contribute to its commitments under the UNFCCC, Canada's forest area is vast and most of it is believed to be unaffected by anthropogenic interference. Canada is currently examining possible causes for the increased incidence of forest fires over the last 20 years. Factors to be examined include climate and weather variations, changes in type and age of trees, better reporting of fires and more people visiting wilderness areas. Canada continues its work to build an inventory of the anthropogenic carbon budget in its forests. This work is important in providing a foundation on which to develop forestry-related adaptation and mitigation strategies.

25. 1990 emissions of **methane** have been re-estimated at 3099 Ggs as compared with 3736 in the original communication, largely because of a downward revision of the estimates of emissions from landfills. Oil and gas production accounted for 40 per cent of the emissions, agriculture 29 per cent, landfills 25 per cent and coal mining 3 per cent. Emissions associated with energy transformation were not always presented in the IPCC format, because of differences in the detail of the methane inventory and the data processing method used for the submission. The emission factors were based on Canadian research. The uncertainty in CH₄ emission figures is in the region of ±30 per cent with a confidence level of 90 per cent.

26. 1990 emissions of **nitrous oxide** have been re-estimated at 99 Gg, compared with 92 Gg in the original communication. Fuel combustion, mainly in transport, accounted for 50 per cent of this, industrial sources 38 per cent, and fertilizer use 11 per cent. N₂O emission figures for transport are based on choice of an emission factor significantly higher than that used by other countries, which is justified through research in Canada and France. The uncertainty in N₂O emission figures is in the region of ±40 per cent with a confidence level of 85 per cent.

27. Emissions of **perfluorocarbons (PFC)** are estimated at 1.4 Gg of CF₄ and 0.144 Gg of C₂F₆ (1.8 per cent of total GHG emissions) for 1990. Recent measurements in Canada are in line with the emission figures reported. Emissions of **hydrofluorocarbons (HFC)** were assumed to be zero in 1990. SF₆ emissions made up 0.51 per cent of total GHG emissions in 1990, which represents 0.120 Gg of SF₆ (or 2990 Gg in CO₂ equivalent).

28. Emissions from **international marine and aviation transport (bunker fuels)** are reported separately. The team noted that the estimates are based on fuel sales data, which because all fuels are not necessarily bunker fuels, have a considerable level of uncertainty.

III. POLICIES AND MEASURES

29. Canada's National Report on Climate Change of 1994 described a range of measures implemented since 1990. The NAPCC of 1995 also described additional initiatives taken since 1990. The measures in both documents are aimed at reducing emissions associated with energy use, land-use and industrial processes, and also at the enhancement of sinks. The measures described in the national report provide examples of activities under way in Canada including federal, provincial, municipal and private sector initiatives. The NAPCC establishes the framework for future action and presents some new initiatives, building on existing activities.

30. The team concluded that measures described in the national report and the National Action Program in principle cover the full range of gases and sectors, although Canada still recognizes the need to improve the understanding of inventories and mitigation options in the land-use change and forestry sector, and for some gases other than CO₂, to develop adequate measures.

31. The National Action Program emphasizes voluntary action by individuals, industry, public organizations and others, but also includes regulatory and information programmes. Measures in the National Action Program, which is primarily a strategic document, are described in a qualitative manner, with few details on the amount of current emissions from the activity affected, the precise nature of the measures, the anticipated effects of the measures or the current state of implementation.

32. Indicators of progress in implementation and effects of measures are being developed and will be included in the first formal review of the National Action Program to be completed by November 1996. Canada will continue to review progress in meeting its stabilization goal and additional measures that may be required.

33. The federal Government's policy on GHG mitigation is guided by a number of principles including leading by example (that is, putting the government house in order; the "greening" of government) and creating the conditions for action by others. In the climate change context, moving towards a level playing field for energy supply options is seen as particularly important. The team recognized as important, and also interesting to other countries, the work of a multi-stakeholder task group that has produced a report on barriers and disincentives to sound environmental practices in government, addressing several energy sector issues.

34. A framework for identifying subsidies on energy use has been developed under the auspices of the National Air Issues Coordinating Committee. The Government continues to analyse specific subsidies in the context of a level playing field. The team sees this type of research as important in drawing up an effective strategy for climate change mitigation. It also commends the Task Force on Economic Instruments and Disincentives, established in June 1994, for its role in carrying out a systematic review of government policies to identify barriers and disincentives.

35. Various measures and strategies for climate change mitigation have been evaluated over the years in Canada. The National Air Issues Coordinating Mechanism established a group which developed a catalogue of more than 80 possible measures to mitigate GHGs, published in a report released in 1994. The effects of these measures on GHG emissions and the economy were evaluated, although this report was not published in time for the review. It was not clear to the team how the federal Government and the provinces would follow up this work in terms of implementing these measures for their intended purpose. It should be noted that carbon taxes are not under consideration for the time being in Canada, and major shifts in the tax system aimed at reducing emissions are not envisaged in the short to medium term.

36. At the federal level, the main new initiative described in the National Action Program is the Climate Change Challenge Voluntary and Registry Program (VCR), which is aimed at all Canadians but targets industrial and commercial enterprises and federal, provincial, territorial and local governments in particular. The VCR was endorsed by all energy and environment ministers by late 1994, and the first "Memoranda of Understanding", developed as a complement to the VCR between the Canadian Government and major

business associations have recently been signed. At this early stage of implementation, it is not clear what new actions will be taken as a result of this programme and consequently what effect it will have on GHG emissions. It is expected that industry will be able to make the largest contributions. The team noted that the VCR is a sort of "outreach" programme, which builds on other existing programmes and will report on their activities. As an example, it is expected that existing voluntary agreements related to energy efficiency in businesses will be reported under the VCR. The need for coordination is recognized. Draft guidelines for reporting on actions were circulated to the stakeholders, and final guidelines were completed in the summer of 1995.

37. Federal measures also include the development of new energy efficiency standards and labelling under the Energy Efficiency Act as well as the continuation of existing programmes. A range of federal efficiency and alternative energy programmes rooted in the Act are in place and are reported on to Parliament annually. Around half of the effect of such programmes is expected to be efficiency improvements. Standards are applied extensively in order to eliminate products with the poorest energy efficiency from the market. Dissemination of new technology is encouraged through "leading by example" by the government and through other information-based measures. Measures by provinces include a wide range of fiscal, regulatory, planning and other instruments. The team sees Canada's ongoing development of comprehensive statistics on energy use as crucial for developing and monitoring the policy.

38. In the energy and transformation industries sector (which accounted for 16.3 per cent of the GHGs emitted in 1990), utilities in Canada have a history of developing and using integrated resource planning and demand side management techniques. Surplus capacity of electricity has, for example, led to a decision to close one nuclear power unit and has reduced the potential for developing new supply options in the short to medium term, including renewables and combined heat and power stations, and also reduced the incentive for conducting demand side management programmes. Such programmes are now focused more on provision of information than on financial incentives. Despite the overcapacity, two major utilities, Ontario Hydro and TransAlta Corporation, have set targets to stabilize GHG emissions by 2000 at 1990 levels, and they are pursuing these through such actions as purchasing renewable energy and expanding this capacity, improving the efficiency of operations, promoting energy initiatives by customers and developing GHG offset projects. Ontario Hydro has also committed itself to reducing 2005 levels by 10 per cent compared to 1990.

39. Canada has a history of considerable government involvement in the energy sector, particularly in the financing of projects for the extraction of fossil fuels as well as in developing other energy sources. Some of these projects may have pushed the Canadian emissions higher than they would have been without this interference in the market. The redirection of policies has also included a decision by the federal Government that it will no longer be financially supporting new "megaprojects" in the energy sector, although there are contractual obligations to be fulfilled under existing ones.

40. The fossil fuel production industry is one of the first areas to be targeted under the VCR, with a signature from the producers' association already in place. The team noted the importance of this target group both for CO₂ and for CH₄ emissions, given the growth in activities that is envisaged.

41. Emissions from **industry** (27.2 per cent of GHGs emitted in 1990) are expected to show the highest growth. The VCR and related voluntary approaches, for example the Canadian Industry Program for Energy Conservation, are seen as playing an important role in improving energy efficiency and reducing energy costs in industry by raising corporate awareness and inviting top-down commitment.

42. Energy efficiency measures have been targeted the **residential and commercial sectors** (11.3 per cent of GHGs emitted in 1990, excluding electricity), especially in buildings, with publicity campaigns to encourage energy efficient practices in new buildings and retrofits. More than half the energy is used for space heating. Pursuing the philosophy of "leading by example", the Government runs a federal buildings initiative involving private sector energy management companies and private financing for the project's capital expenditure. The team also noted the voluntary standard R-2000 Program, which is regularly strengthened to identify more energy-efficient residences. The programme includes partnerships with suppliers. The R-2000 Home Program and model energy-efficient building code provisions have contributed to improving the energy efficiency of new housing in Canada. The average new house uses up to 35 per cent less energy today than a new house constructed in 1980. Building codes were to be strengthened in 1995. Canada intends to build on its experience with voluntary action, with, for example, programmes targeting commercial buildings (C-2000) and retrofitting (RenoSense).

43. The **transportation sector** accounted for 27.1 per cent of GHGs emitted in 1990, 31.5 per cent of CO₂ and 37 per cent of N₂O. The projections reflected in the national report included tighter fuel economy standards for cars (better "corporate average fuel economy" - CAFE) in the United States, with a similar voluntary standard ("corporate average fuel consumption" - CAFC) in Canada, as an influence that would reduce transportation fuel use. The National Action Program reported that CAFE standards were no longer expected to become stricter and that energy intensity in the Canadian car fleet would therefore fall more slowly than had been anticipated. Other economic factors were also involved, however, in the lower growth apparent in the revised projections compared with what was previously reported.

44. Transport fuel and vehicle purchase taxes and other fees vary between provinces, and gasoline taxes are significantly higher than in the United States, but lower than in other OECD countries. As an example of provincial measures, Ontario has introduced a "feebate" system, under which car purchasers pay a tax, or receive a rebate, according to the fuel economy of the car they are buying. At present, the size of the tax or rebate is limited, but the team sees such innovative measures as potentially effective if they are developed further, especially since the trend recently has been towards vehicles and light trucks with lower fuel efficiencies. An information initiative about energy efficiency options targeting private motorists was launched in October 1994. A fleet energy programme is ready for launching in

1995, and a voluntary programme that targets vehicle manufacturers is also under implementation.

45. Research and development (R&D) and implementation programmes are encouraging the use of alternative fuels, which provide the energy source for a considerable number of vehicles. Some cities have introduced transport control measures such as reducing provision of city centre parking space and establishing bus lanes to ensure the smooth running of public transport. The federal Government extended an excise tax exemption in 1992 to the ethanol portion of low level ethanol-gasoline blends to provide ethanol with the same tax treatment as other alternative fuels.

46. The NAPCC mentions several approaches to sink enhancement and emission mitigation in the **forestry and agriculture** sectors. The programme mentions only one initiative that is being implemented, under which a utility is encouraging farmers to use practices that increase soil carbon; other measures are at the analytical stage. Still, Canada's fire, insect and disease protection methods have an effect in emissions in these sectors.

47. The team noted that 93 per cent of forested land is public property, almost all of it in the hands of provinces and territories that lease it out to forestry companies. However, Canada's forest area is vast and much of it is natural forest without anthropogenic interference. Canada is working to build its anthropogenic inventory of net emissions from forests as a foundation for the development of adaptive and mitigative strategies. There appears to be a potential to develop sink-enhancement measures which can contribute to Canada's commitment to limit net greenhouse gas emissions. The team was informed of a considerable tree planting programme instigated by the Government, and of reporting routines to Parliament on forestry activities.

48. The options for reducing **HFCs, PFCs and SF₆** together with **nitrous oxide emissions from industrial sources and methane from landfills** are being explored in Canada. Evidence from other countries indicates that there could be cost-effective measures in this area.

49. The consensus-building approach adopted by the federal Government will inevitably take some time to have a noticeable effect on GHG emissions. However, the effort to involve all stakeholders is beginning to bear fruit, and there is now a broad consensus among governments that in order to close the stabilization gap further options need to be developed.

50. The NRCC estimates the impact of the federal energy efficiency and alternative energy initiatives and related provincial initiatives at about 3 per cent of CO₂ emissions in 2000. No further quantification was provided for measures included in the NRCC or NAPCC.

51. Canada is investigating the economic, social and environmental effects of measures taken to mitigate GHG emissions but has only to a limited extent communicated information on these effects to the UNFCCC or to the review team. The federal Government is working

on indicators to assess progress in climate change mitigation. At the time of the team's visit, the Government was aiming to have a blueprint for these indicators available for review by the meeting of federal and provincial energy and environment ministers in November 1995; the actual indicators will be used for the review of policies and measures to be undertaken by December 1996. Given the limited time left to 2000, the team saw these meetings as important opportunities for ministers to review Canada's commitments and the actions taken to meet them, and it also noted that the NAPCC is seen as a flexible instrument allowing for prompt action. Still, many new measures could yield more the sooner they are implemented, and the time left to develop, implement and benefit from the full effect of new initiatives is limited.

IV. PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

52. Canada provided projections of its emissions of energy-related CO₂, CH₄ and N₂O in 2000 and 2020. The estimates for these sources were revised in the update to Canada's Energy Outlook (October 1994). The NAPCC builds on the update when giving figures for 2000 on a GWP basis in accordance with the recommendations made by the IPCC in 1994.

53. The current projections indicate that, without new measures, aggregate GHG emissions in 2000 will be 13 per cent above those in 1990 (growing from 577 to between 645 and 655 Mt of CO₂ equivalent), and that growth in emissions will continue after 2000. This is largely due to economic factors and population growth, while energy efficiency and changes in the energy mix are expected to reduce the growth. Emissions per capita are projected to be stable to 2010. Since 1973, they have been fluctuating in a range of more or less 10 per cent around the average. Compared to the original communication, energy-related CO₂ emissions for 2000 have been revised from 510 to 518 Mt, energy-related CH₄ from 1290 to 1527 t and energy-related N₂O from 52 to 51 t.

54. These projections do not take account of the effects of new measures included in the NAPCC, such as the VCR, since these have not been estimated, but they do include the effects of most measures in place in early 1995. The revised projections do not reflect any stricter fuel efficiency standards for vehicles in North America, as the tightening of standards is seen as less likely than before. Consequently, if the background assumptions hold, emissions growth could be expected to be lower than the projected 13 per cent owing to the new initiatives in the NAPCC, but quantitative information was unavailable to the review team to indicate the feasibility for Canada of meeting its commitment to stabilize emissions in 2000 at 1990 levels. The federal and provincial governments are exploring how performance indicators could be used to complement the assessment of progress in climate change mitigation.

55. The aggregate figures in the NAPCC include non-energy emissions. Disaggregated figures for these sources were not included in the communication or the NAPCC, but were presented to the team. In the light of the actual development of PFC and other non-energy GHG emissions in other countries, the Canadian projections for these could be high.

56. Canada has not presented projections for emissions related to land-use change and forests, since the inventories are not yet fully developed and there is significant uncertainty regarding the anthropogenic effects in these sectors. The acquisition of the data will be important for Canada, given its commitment to a net approach to GHG mitigation. Recognizing that most of the forest area is believed to be unaffected by anthropogenic interference, the team still concluded that development of net anthropogenic emissions or sequestration from this sector could be significant inside a net approach.

57. The principal tool for the projections is an econometric energy market model. The modellers work closely with energy technology analysts to incorporate information based on technical studies and technology vintage models. The assumptions, including a gross domestic product (GDP) growth rate of 2.8 per cent for Canada and 2.6 per cent for the United States and an oil price of US\$ 20 a barrel, and the tools used for the projections are well-documented and were considered reasonable by the team.

58. The NRCC provides the results of sensitivity tests which show that a 1 per cent higher GDP growth rate beginning in 1993 and an oil price US\$ 5 a barrel lower starting in 1994 would increase the CO₂ emissions by 6 and 3 per cent respectively in 2000. The importance of variations in these and other factors is also stressed in other documents. The assumptions and results have been checked against those of other modelling exercises, which tended to give higher estimates.

V. EXPECTED IMPACTS OF CLIMATE CHANGE

59. Canada's territory covers several climatic zones and is potentially vulnerable to climate change in a variety of ways. Sectors based on renewable natural resources, such as agriculture, forestry and fisheries, are important to the Canadian economy and the impacts of climate change could be particularly great in these sectors. In recognition of this, Canada has a strong and comprehensive scientific research programme on the possible impacts of climate change, but also acknowledges that studies on the indirect effects of climate change on Canada will need to be pursued, particularly on the question of water resources.

60. Impacts could include lower precipitation in some areas, increased risk of forest fires and insect infestation, and hence decreased forest and crop productivity. Scientists will also explore the possibility that the incidence of forest fires is linked in some way to climate change. Changes in seawater temperature and circulation could affect fish populations. A serious possible impact is seen as coming from the increased frequency and strength of extreme events. Climate change will also cause changes in natural ecosystems through, for example, accelerated permafrost degradation.

61. Canada is carrying out some major case studies on impacts in the Mackenzie and St. Lawrence Great Lakes river basins and the prairies. The team concluded that Canada's research in the area of impacts and vulnerability, being both comprehensive and in depth, could be important also for other countries in similar climatic zones.

VI. ADAPTATION MEASURES

62. Canada is conducting a comprehensive R&D programme as well as taking action to improve information-sharing on the potential impacts of climate change and adaptation needs and strategies. This includes the development of communication and information networks. A separate task force under the Canadian Climate Program Board, the major coordinating body of the Canadian Climate Program, which covers all climate-related activities in Canada, has produced a comprehensive report on adaptation issues there. However, at present Canada is not taking any specific adaptation measures as such, although there is an autonomous adaptation to the already major experienced and expected variation in the natural conditions. Studies cover various regions and sectors (for example, forestry, fisheries) and include assessment of the impacts of multiple pollutants and stresses on ecosystems. Researchers are developing models for improved assessment of impacts and adaptation strategies. Stakeholders are also looking into practical measures such as changing species in forestry and into insurance matters, but a similar multi-stakeholder process to what is taking place in the field of mitigation has not yet been developed, although adaptation is also covered in the NAPCC.

VII. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

63. Canada contributed to the Global Environment Facility (GEF) in its pilot phase and is contributing its full share to the 1994-1996 replenishment of the GEF. Its official development assistance was equivalent to about 0.45 per cent of GDP in 1993 according to OECD statistics. Canada reported a number of additional bilateral development projects which contribute to the objectives of the UNFCCC, including mitigation, adaptation and capacity building. Currently, the Canadian International Development Agency (CIDA) has a broad portfolio which includes a large number of fossil-fuel-related projects inherited from PetroCanada International. A change in this portfolio is envisaged as these projects reach completion. Projects undertaken by CIDA and the Ministry of Foreign Affairs and International Trade are increasingly screened for consistency with international environmental agreements. The personnel of these organizations are currently undergoing a major training programme to be able to undertake the task. Such screening does not at present apply to the Canadian Export Development Corporation.

64. Canada works through its representatives on the steering bodies of the World Bank Group and regional development banks to encourage the incorporation of the UNFCCC objectives in their lending policies.

65. The team noted that a considerable proportion of Canadian companies are multinational, and that this structure is seen as important for technology transfer, particularly in the manufacturing industry, but also in areas such as electricity production.

Joint implementation/Activities implemented jointly under the pilot phase

66. Canada supports the concept of joint implementation/activities implemented jointly under the pilot phase (JI/AIJ) as a voluntary approach to encourage private sector participation. Canada awaited the decisions of the Conference of the Parties at its first session before taking any initiatives on this issue. There are some projects under way as part of industry activities that could be reported as AIJ projects. Canadian policy is that straight land purchases should not be used for JI/AIJ purposes (for example, without a clear management regime for sustainable use). AIJ projects can be reported under the VCR. Currently, Canadian industry seems interested in building on its strengths in exploring this opportunity, which means that projects are likely to include the areas of, in particular, energy technology and energy management.

VIII. RESEARCH AND SYSTEMATIC OBSERVATION

67. Canada undertakes a range of research activities on climate change which are well organized and integrated with the international research community. The Climate Change Research Network, a collaborative effort including university, government and industry scientists from across the country, provides a well-coordinated base of expertise and knowledge for assessing Canada's vulnerabilities to the threat of climate change. Canada has also contributed extensively to the work of the IPCC. Canada is co-chair on one of the three IPCC Working Groups and has provided lead and supporting authors, as well as reviewers, for IPCC Assessment Reports.

68. The Canadian Climate Program (CCP) is a cooperative effort of federal and provincial agencies, the academic community and the private sector for all climate-related activities. The major coordinating body is the CCP Board, established in 1979. The CCP Board has an advisory role in relation to its parent bodies. It also provides reports and advice to Canada's federal and provincial environment ministries. Participants in the CCP Board are five federal government departments, provincial governments, universities, agencies and associations.

69. Major activities include: collection and analysis of climate data, climate modelling, policy research on GHG mitigation strategies, climate-change-related research in forestry, agriculture and forestry, as well as a significant number of socioeconomic impacts studies across Canada. The team recognized that Canada, given its size and natural conditions, plays an important international role in monitoring. It carries out continuous monitoring of CO₂, CH₄ and N₂O at four locations, and it also has a network of stations providing long and continuous historical temperature records sufficiently devoid of human interference to be trustworthy for analysis.

70. R&D into energy technology is carried out mainly by NRCan programmes. The Federal Program of Energy Research and Development ensures that other government departments also undertake R&D into energy-related matters within their respective sectors of the economy. In view of general government spending cuts, the overall funding has been decreasing and reassessment of the R&D programme is currently being undertaken with a

view to shifting the relative emphasis of public R&D spending from fossil fuels towards renewables and energy efficiency. However, substantial involvement with the private sector in the R&D activities, either in a cost-shared or a task-shared manner, accelerates market development. Some tax breaks are available for alternative technologies.

IX. EDUCATION, TRAINING AND PUBLIC AWARENESS

71. Canada's NRCC includes a description of public information programmes, training programmes for drivers, etc. It was also produced as a document to increase public awareness, and therefore covers general climate change issues in considerable detail. Given the focus of Canada's NAPCC on voluntary approaches, training is an essential component. The multi-stakeholder process is in itself important to public awareness, and wide public involvement is a general practice in Canadian political life.

72. School programmes are managed at the provincial and local levels of government. Some initiatives on school education programmes were mentioned in Canada's original communication, but not in the NAPCC. An example of federal/provincial cooperation and coordination is the air issues schools programme, funded through the National Air Issues Coordinating Committee, and supported by all the provinces and the federal government. There are also some independent school projects focusing on climate change that have been initiated by non-governmental organizations.

73. Environment Canada has produced publicity material including a series of leaflets, fact sheets, newsletters and a primer on global warming. The R&D programmes also have a public awareness aspect. Environment Canada recognizes the need for coordination of education and public awareness efforts on climate change. Non-governmental organizations are given financial support from the Government partly because of their role in providing information on climate change.

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