Taking action on Climate Change

Together, we can do it.

Climate Change:

The Federal Investment

1997 – 2002
Comprehensive Report

Government of Canada Gouvernement du Canada

Canada

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June 2003

ISBN: M174-3/2002E
Catalogue 0-662-33972-X

This publication is also available at **www.climatechange.gc.ca**

Ce document est également offert en français sous le titre :

Changements climatiques : l'investissement fédéral 1997-2002 Rapport d'ensemble

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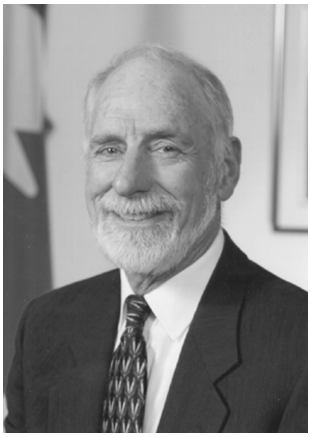
Ministers' Message

We are pleased to provide Canadians and, in particular, our fellow parliamentarians with the first comprehensive report on the Government of Canada's investment in climate change from 1997 to 2002.

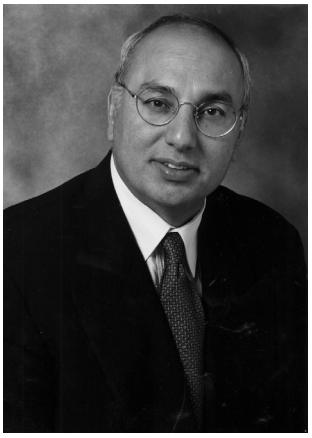
Canadians take the issue of climate change very seriously. In acting on their behalf, it is extremely important that the Government of Canada be able to accurately measure, account for, and evaluate its climate change efforts in a comprehensive way, and report to them on progress. This report is our first effort to provide this overall accounting and establish a precedent for future reporting.

This benchmark report examines the period before the Kyoto Protocol was ratified—a period focused on building partnerships and laying the foundation for understanding and addressing climate change. From this solid foundation we were able to develop and begin implementing the *Climate Change Plan for Canada*.

This plan, combined with the initiatives and measures highlighted in this document and our continuing partnership with other levels of government, the private sector and individual Canadians, will enable us to meet our climate change commitments together. We look forward to documenting our progress in future climate change reports.



The Honourable David Anderson, P.C., M.P.
Minister of the Environment



The Honourable Herb Dhaliwal, P.C., M.P.
Minister of Natural Resources Canada

I. Introduction

What is Climate Change?

Climate describes the long-term average of day-to-day weather, including seasonal extremes and variations, for a specific location or a region. In many respects, climate is what we expect, and weather is what we get.

Climate change is a long-term shift or alteration in the climate of a specific location, region, or the entire planet. The shift is measured by changes in some or all of the features associated with average weather, such as temperature, wind patterns, and precipitation.

Greenhouse gases are found naturally in the Earth's atmosphere; they trap the sun's heat close to the planet's surface. Without them, this heat would escape into space and the Earth would not be habitable. Changing the concentrations of these greenhouse gases changes our climate.

Scientific research shows that excess greenhouse gases from human activities are increasing the concentration of these gases in the atmosphere. The most common greenhouse gas is carbon dioxide, which is released through the burning of fossil fuels (coal, oil, and natural gas) and through deforestation and land degradation.

The resulting change in temperature causes changes in weather patterns. Impacts will be felt in every part of the country, affecting agriculture, coastal zones, communities, food supply and infrastructure. The potential for more frequent extremes in weather, such as floods, droughts and severe storms, lends further urgency to the issue. It is also becoming clear that climate change will affect health, as a result of possible increases in weather-related, insect-borne, and tropical diseases.

The Government of Canada has made a significant financial and human resource investment in the issue of climate change. Since 1997, $1.7 billion has been dedicated to addressing climate change.[1] This dedicated funding to climate change also leverages additional funding and activity by industry, other levels of government, and non-governmental organizations.

Climate Change: The Federal Investment presents an overview of the activities and results that the federal government has undertaken and achieved in addressing climate change between 1997 and 2002. The Report focuses on specific initiatives launched or proposed during this period, as well as ongoing program activities.

This report demonstrates the Government of Canada's commitment to address climate change domestically and internationally, and Canada's strategic and integrated approach. It explains the importance of various initiatives and why the Government supports them, and presents specific

[1] In the Budget of February 2003, the Government of Canada allocated an additional $1.7 billion over five years in support of implementing the *Climate Change Plan for Canada*, released in November 2002

highlights. It includes examples of past and present climate change activities and expenditures across the federal government and affiliated organizations, as well as details of federal financial investments in specific initiatives (see Annex 1). The report also provides links to other government performance reports and climate change publications.

In keeping with the Government of Canada's commitment to transparent and complete performance reporting, *Climate Change: The Federal Investment* presents relevant and timely information that demonstrates the linkages both between federal objectives and achievements, and among resources, strategies, and results.

Recognizing that the investment in climate change is long-term and, therefore, more likely to produce concrete results over an extended period of time, this report identifies ongoing progress and short-term results, as well as challenges and opportunities in longer-term measuring and reporting.

Accounting for, reporting on, and evaluating the results achieved through the federal investment on climate change becomes even more important with Canada's ratification of the Kyoto Protocol in December 2002. Canada will be required to comply with a variety of international monitoring, reporting, and review requirements.

The *Climate Change Plan for Canada*, released in November 2002, makes a commitment to the Canadian public to report periodically on the Plan's successes and on its evolution as it meets new challenges.

The results expected from the implementation of the Plan will be evaluated on an ongoing basis to ensure that Canadians benefit not only through a healthier environment, cleaner air, and lower energy costs, but also from new jobs and innovation.

A. The Federal Investment Since 1997

Canada and more than 160 other countries negotiated the Kyoto Protocol in December 1997. There was little indication at that time that addressing climate change would become one of the most intricate challenges in public policy development since the *North American Free Trade Agreement* or universal health care.

Climate change is a complex issue with diverse and far-reaching impacts on our environment, economy, and social well-being. Reducing greenhouse gas emissions will affect how we drive our cars, build our cities, operate our industries, and manage our forests and agricultural lands. Paramount was the need to take early action and raise general awareness about the scientific background and possible impacts of climate change among Canadians, stakeholders, and decision makers.

In just five years there has been progress not only in understanding climate change, but also in refining our response to it—that is, the combination of policies, international positions, and other actions we must take to address it. The approach formulated by Canada and its provinces and territories is multi-faceted: flexible, to adapt to new knowledge; inclusive, to engage all partners; and integrated, to ensure maximum results from each and every effort. It makes climate change better understood, identifies it as a real issue on the country's agenda, and defines a clear set of actions and path forward to implementation.

A significant accomplishment made during this time period was the design and implementation of the National Climate Change Process, with the federal government working in conjunction with the provincial and territorial governments, industries, environmental organizations, and other stakeholders. The process brought together experts from across Canada and representatives from all levels of government to a series of issue tables to learn as much as possible about potential options to reduce Canadian greenhouse gas emissions and about the implications of these emissions. Attempting to forge a consensus of this kind on future policy action on climate change is unprecedented anywhere in the world.

Supporting this process was an enhanced capacity to carry out climate change science and participate in international science efforts that has maintained Canada's continued high credibility among climate researchers around the world. Since 1997, acceptance of the reality of climate change has risen considerably among governments, industry, and the public, and has helped to shape policies and international negotiating positions. For example, science led to international recognition that Canada's vast forests and peatlands, if properly managed, offset its greenhouse gas production by acting as carbon "sinks". From this science came a new negotiating position for Canada.

In order to make informed decisions during international negotiations, it is essential that socio-economic and environmental impacts be understood. While there were limited databases available in 1997 to feed such decisions, in the relatively short period of time since, the Government of Canada has created a series of decision-making tools that will be further enhanced in years to come. Also, while adaptation to the impacts of climate change was not considered a priority in 1997, there is a growing body of research that will help Canadians understand the impacts, their vulnerabilities and the need for adaptation.

The establishment of the Climate Change Secretariat as a coordinating body within the Government of Canada was another major undertaking during this period. The Secretariat is the mechanism by which the many issues associated with climate change are addressed across government, and encourages coherency in policy, international, and federal/provincial/territorial approaches to the issue.

Above all, federal investments helped to build the knowledge base on climate change and to engage stakeholders through a multi-faceted approach focused on: raising awareness of the issue to promote individual and collective action; using the most comprehensive science base possible to inform domestic and international policy decisions; effective planning to adapt to the impacts of climate change; and fostering the development of technologies to reduce greenhouse gas emissions. In addition to intergovernmental cooperation, there now exists a working partnership between the public and private sectors on approaches to the issue.

There are several key areas for future focus. For one, while technology advancements have been made, wide-scale reductions in emissions from such advancements are not yet at hand. However, the importance of innovation in technology has been recognized, along with the time required to achieve concrete results. For example, cellulose-based ethanol and clean coal technology are areas of federal long-term investment in innovation.

All Canadians have a role to play in reducing greenhouse gas emissions. Attitudinal and behavioral changes will require a long-term effort. Various steps have been taken to raise public awareness, but more needs to be done to broaden public engagement and action. The challenge is to make energy efficiency a “blue box” issue—that is, to make it as second nature to Canadians as taking their recycling boxes to the curb each week.

Over the past five years, significant strides have been made in understanding the issue of climate change and bringing it, and the need to take action, to the attention of all levels of government, the private sector, other stakeholders, and Canadians. Building on earlier efforts, federal investments have enabled Canada to break new ground through the National Climate Change Process, stakeholder engagement, and international negotiations, which have resulted in the development of the *Climate Change Plan for Canada* and Canada’s ratification of the Kyoto Protocol. The Plan will continue to evolve as Canadians and their governments work together to create the healthy environment and economy we want for ourselves and for future generations.

B. History of Climate Change Action

The history of climate change action in Canada demonstrates the federal government's commitment to addressing this issue. The following is a summary of this history; more detailed information on specific initiatives is found in subsequent sections of this Report.

International Overview

- In **1972**, the first United Nations Conference on the Human Environment identified climate change as a pressing issue. A series of international meetings in the years that followed continued to highlight the concern. One such meeting was the Conference on the Changing Atmosphere, which was held in Toronto in 1988 during what was then the warmest summer on record.

- In **1990**, the Intergovernmental Panel on Climate Change (IPCC) released its first assessment report, which played an important role in establishing the Intergovernmental Negotiating Committee for the *United Nations Framework Convention on Climate Change* (UNFCCC) by the United Nations General Assembly.

- In **1992,** Canada joined more than 150 nations from around the world at the Earth Summit in Brazil in agreeing to address the emerging issue of climate change by signing the UNFCCC. Under the UNFCCC reporting process, signatories to the convention provide periodic national communications. The most recent, *Canada's Third National Report on Climate Change,* was published in 2001, and can be viewed at http://www.climatechange.gc.ca/3nr.

- In December **1997**, the Kyoto Protocol was adopted after nations acknowledged that the targets established under the 1992 UNFCCC would not be sufficient to fully tackle the problem of climate change. Under Kyoto, Canada and other industrialized nations agreed to adopt specific targets and reduce their collective greenhouse gas emissions by 5.2 per cent over 1990 levels between 2008 and 2012.

- In November **1998**, a new round of international negotiations was launched, resulting in the 2001 Bonn Agreement, which signed off on the most controversial issues, and recognized forest and agricultural sinks as a Kyoto mechanism. This is fundamental for Canada achieving its Kyoto target. Building upon this agreement in **2001**, all parties agreed to a final comprehensive legal and technical package of decisions known as the Marrakesh Accords. The Accords serve as a detailed rule book for the Kyoto Protocol that provides the basis for parties to make ratification decisions.

The Canadian Process

All levels of government in Canada have worked together to develop a national response to climate change. Throughout the late 1980s and early 1990s, federal, provincial, territorial and municipal governments were involved in a wide range of activities such as research, greenhouse gas reductions (mitigation), public education, and outreach. In the late 1990s, this effort was enhanced through the establishment of the National Climate Change Process, which brought all

levels of government and stakeholders together to address the issue in a coordinated and collaborative fashion. Information on the national process is available at http://www.nccp.ca/.

Since 1997, the Government of Canada has invested approximately $1.7 billion in federal funds to develop new climate change programs and enhance existing ones in an effort to meet its various climate change commitments.

- The federal Budget of February **1997** provided $60 million over three years for new initiatives to improve energy efficiency in buildings and to promote renewable-energy systems.

- Immediately following the negotiation of the Kyoto Protocol in December **1997**, Canada's First Ministers agreed to establish the National Climate Change Process to examine the consequences of the Protocol and to provide for the full participation of the provincial and territorial governments with the federal government in the Protocol's implementation and management.

- In **1998**, the Climate Change Secretariat was formed as the coordinating mechanism for the further development of Canada's response.

- The **1998** federal Budget provided $150 million over three years for the Climate Change Action Fund (CCAF) to support early actions to reduce greenhouse gas emissions, to reach out to the public, and to increase understanding of the impacts, costs and benefits of implementing the Kyoto Protocol and the options open to Canada.

- In **1998**, a Joint Meeting of Ministers of Energy and the Environment approved a process to develop a national implementation strategy, and the establishment of 16 issue tables/working groups from industry, academia, non-governmental organizations, and governments. This process, completed in **2000**, brought together 450 experts and resulted in the development of over 200 recommendations designed to reduce greenhouse gas emissions and increase Canada's knowledge base. Further information is available at: http://www.nccp.ca/.

- The **2000** federal Budget provided $625 million for climate change activities, including the CCAF renewal, the Green Municipal Enabling and Investment Funds, Sustainable Development Technology Canada, and others. Further information is available at: http://www.fin.gc.ca/budget00/bp/bpch5_1e.htm#Environmental.

- In October **2000,** building on the results of the issue tables/working groups, the Government of Canada announced *Action Plan 2000*, a $500 million investment over five years focusing primarily on measures to reduce greenhouse gas emissions. Further information is available at: http://climatechange.gc.ca/english/whats_new/action_plan.shtml.

- In October **2000**, *Canada's National Implementation Strategy on Climate Change* was released. This marked the first time that the federal, provincial, and territorial governments had formally articulated a common approach for addressing this cross-cutting issue. It was developed as a shared risk-management strategy centered on five key themes: enhancing awareness and understanding; promoting technology development and innovation; governments leading by example; investing in knowledge and building the foundation; and encouraging action. The Strategy can be viewed at http://www.nccp.ca.

- *Canada's First National Climate Change Business Plan*, also released in October **2000**, lists objectives under each area of the National Implementation Strategy and the actions underway or under consideration by federal, provincial, and territorial governments. *Progress Report: Canada's First National Climate Change Business Plan* was released in late 2001, and *Canada's National Climate Change Business Plan 2002* was issued in the spring of 2002. The three documents can be viewed at http://www.nccp.ca/.

- As of December **2000**, a total of approximately 665 policies and measures directly related to climate change had been implemented or planned by federal, provincial, and territorial governments. These were outlined in *A Compendium of Canadian Initiatives: Taking Action on Climate Change.*

- In preparation for a decision on the ratification of the Kyoto Protocol, Canadians were asked during the summer and fall of **2002** to respond to four options on the Government of Canada's commitments on greenhouse gas emissions through the *Discussion Paper on Canada's Contribution to Addressing Climate Change*. The paper is available at: http://climatechange.gc.ca/english/actions/what_are/canadascontribution/index.html.

- In November **2002**, the Government of Canada released the *Climate Change Plan for Canada.* The report can be found at: www.climatechange.gc.ca.

- In December **2002,** Canada ratified the Kyoto Protocol.

In recent reports to Parliament by the Auditor General of Canada, including that of the Commissioner of the Environment and Sustainable Development, it was recommended that the Government of Canada produce a report that brings together the many actions, activities, and reporting processes of its departments to provide a clearer picture of the federal response to climate change. As the lead departments on this issue, Environment Canada and Natural Resources Canada committed to undertake a comprehensive federal report of climate change actions and programs.

II. Approach

The Government of Canada's approach to addressing climate change maximizes the use of existing core departmental programs while supplementing them with targeted investments in key areas.

A. Elements of the Federal Investment

This report presents an overall picture of various initiatives and ongoing government activities that demonstrate the federal investment in climate change. It is designed to show results over the period from 1997 to 2002—during which time there was a substantial increase in federal financial investments in climate change.

The National Implementation Strategy recognizes that jurisdictions have the authority to develop specific programs and the flexibility to reflect their unique circumstances. As a result, various initiatives contain a federal investment yet have unique governance mechanisms and accountability arrangements. This report captures summary information from many of these initiatives.

Following is a snapshot of the initiatives and programs that represent the recent federal investments in climate change, either through direct activity, contribution, or partnership. Details of activities, achievements, and results are found in subsequent sections of the Report.

- **Government of Canada departments** have a wide variety of climate change activities that are integrated into their official programs as identified in Reports on Plans and Priorities, and whose results are reflected in their departmental performance reports. Details and results of such activities in the principal departments addressing climate change are found in Annex 2.

- The **Climate Change Action Fund** (CCAF) was established in the 1998 Federal Budget with $150 million allocated over three years—a commitment that was renewed in Budget 2000 to continue to promote early action and improve the understanding of climate change in Canada. It provides funding for the national process, federal coordination and analysis, technology demonstration and development, public education and outreach, and science, impacts, and adaptation work. Further information is available at: http://www.climatechange.gc.ca.

- The ***Government of Canada Action Plan 2000 on Climate Change*** is a five-year, $500-million initiative that lays the groundwork for long-term behavioural, technological, and economic change. It comprises 45 measures that target key sectors accounting for 90 per cent of Canada's greenhouse gas emissions. Although its focus is mitigation, it also advances knowledge and foundation-building in climate science, impacts and adaptation, northern and aboriginal communities, and technological innovation. Further information is available at: http://climatechange.gc.ca/english/whats_new/action_plan.shtml.

- **Energy-efficiency and renewable energy programs:** In February 1997, the Federal Budget provided $60 million over three years (commencing in April 1998) for new initiatives to improve energy efficiency in new commercial buildings, encourage commercial building retrofits, provide for energy-performance assessments of houses, and stimulate demand for cost-effective, commercially available renewable energy systems for space and water heating/cooling. This funding was renewed for a further three years in Budget 2000.

- **Purchases of electricity from emerging renewable energy sources in Prince Edward Island and Saskatchewan** for federal buildings include an investment of $17 million ($15 million of which is from Budget 2000 with an additional $2 million from *Action Plan 2000)* that has assisted in the development of wind power as an alternative energy source. Further information is available at: http://www2.nrcan.gc.ca/es/erb/english/View.asp?x=464.

- **Wind Power Production Incentive:** Budget 2001 introduced a 15-year $260-million production incentive for electricity produced from qualifying wind-energy projects to further support the establishment of a viable renewable energy industry. Further information is available at: http://www.canren.gc.ca/programs/index.asp?CaID=107&PgID=622.

- **Tax Incentive for Renewable Energy and Energy Efficiency:** Budget 2001 proposed to broaden the eligibility criteria for income tax incentives that apply to renewable energy and certain energy efficiency projects. Currently, eligible projects qualify for accelerated capital-cost-allowance treatment in Class 43.1 of the *Income Tax Regulations*. Finance Canada administers this $5 million investment.[2] Further information is available at: http://www.fin.gc.ca/activty/consult/class431-2e.html.

- **Fuel cell and hydrogen technology funding**, announced in 2002, supports *Canada's Innovation Strategy*. The National Research Council will increase funding for fuel-cell research and development at its Vancouver Institute by a total of $20 million over the next five years. This investment will strengthen the Institute's active fuel-cell testing and demonstration program, and serve as a showcase for innovative Canadian technologies and companies. Further information is available at: http://ic-ci.nrc-cnrc.gc.ca/main.html.

- The **Canada Climate Change Development Fund** promotes activities to combat the causes and effects of climate change in developing countries, while helping to reduce poverty and encourage sustainable development. The $100 million fund, announced in Budget 2000, supports a portfolio of 46 projects throughout all

[2] The definition of small hydro projects in Class 43.1 will be changed from projects with an average annual generating capacity not exceeding 15 megawatts to projects with a rated capacity not exceeding 50 megawatts.

regions of the world through an approach that combines technology transfer and capacity building. Further information is available at: http://www.acdi-cida.gc.ca/climatechange.

The federal government has also provided funding to the following non-governmental agencies to address specific aspects of Canada's action on climate change:

- The **World Bank's Prototype Carbon Fund** includes a Canadian investment of $15 million, announced in Budget 2000, to undertake Clean Development Mechanism and Joint Implementation[3] projects, with carbon credits earned to be returned to the investors. http://www.prototypecarbonfund.org/splash.html.

- **Green Municipal Funds** were created in Budget 2000 to stimulate municipal investments in innovative environmental infrastructure projects and practices to achieve cleaner air, water, and soil, and to protect the climate. The Federation of Canadian Municipalities (FCM) administers the Funds at arm's-length from the Government of Canada. The original endowment of $125 million was doubled in Budget 2001. Environment Canada and Natural Resources Canada provided the endowments to the FCM in equal amounts of $125 million each. Further information is available at: www.fcm.ca

- The **Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)** was established in Budget 2000 with a $60 million grant to the Canadian Meteorological and Oceanographic Society. CFCAS makes strategic university-based research investments in targeted areas important to the health, security, and well being of Canadians. As of September 2002, CFCAS investments included over $20 million for climate change and greenhouse gas research. Further information is available at: www.cfcas.org.

- **Sustainable Development Technology Canada** was created by the *Canada Foundation for Sustainable Development Technology Act*, which received Royal Assent in June 2001. The purpose of this arms-length foundation is to stimulate the development and demonstration of Canadian technologies related to climate change and air quality. The Foundation was endowed with a $100 million investment by the Government of Canada. Further information is available at: http://www.sdtc.ca/.

[3] The Clean Development Mechanism and Joint Implementation projects are mechanisms created under the Kyoto Protocol where Canada or Canadian firms can generate permits by investing in emissions reduction or sinks projects in developing countries that have ratified the Protocol or in industrialized countries.

III. Results and Highlights from Initiatives

This section provides detailed information relating to federal incremental funding provided for climate change initiatives implemented from 1997 to 2002. Annex 1 lists them in table format.

A. Climate Change Action Fund

The Climate Change Action Fund (CCAF) was established by the Government of Canada in the 1998 Federal Budget, with $150 million allocated over three years to help develop a national implementation strategy and to support early actions to respond to climate change.

The federal Climate Change Secretariat undertakes the central administration of the CCAF. There are lead departments for each component of the Fund, some of which involve a large number of partners. Environment Canada and Natural Resources Canada are the overall lead for the CCAF. Departments engaged to date include: Agriculture and Agri-Food Canada, the Canadian International Development Agency, the Department of Foreign Affairs and International Trade, Finance Canada, Fisheries and Oceans Canada, Health Canada, Indian and Northern Affairs Canada, Industry Canada, Statistics Canada and Transport Canada.

The CCAF operates on the basis of the following principles: to build, where possible, on existing initiatives and mechanisms; to lever and share costs with provinces and territories and the private sector; to ensure concrete milestones and demonstrable results; and to establish transparent processes that engage all federal departments, as well as agencies and external stakeholders.

During the period from 1998 to 2001, the CCAF had four integrated components: Foundation Building; Technology Early Action Measures (TEAM); Science, Impacts and Adaptation (SIA); and Public Education and Outreach (PEO). Recognizing that additional work is needed to ensure that Canada can meet its Kyoto commitments, the Government of Canada replenished the CCAF in Budget 2000 with a further $150 million in funding that ends in fiscal year 2003-2004. For the second mandate, there are five integrated components: Building for the Future; International Policy and Related Activities; TEAM; SIA; and PEO.

Among the primary achievements of the CCAF was its investment in the National Climate Change Process. Following the negotiation of the Kyoto Protocol in December 1997, Canada's First Ministers directed the federal, provincial, and territorial Ministers of Energy and the Environment to establish a national process to examine the consequences of the Kyoto Protocol. The CCAF also supports the policy and analytical work of the federal-provincial-territorial National Air Issues Coordinating Committee on Climate Change (NAICC-CC).

In 1998, a national secretariat, comprising federal, provincial, and territorial officials, was established to support and assist in the development of Canada's climate change response, and to establish a broad communications link with the public and stakeholders. The Climate Change Secretariat was created to coordinate both the national and federal processes. The Head of the Secretariat reports to the Deputy Ministers of Environment Canada and Natural Resources Canada, as the Ministers of these two departments co-manage the federal response to climate change.

Significant accomplishments of the CCAF in the first three years included:

- establishing 16 issue tables/working groups that brought together more than 450 experts from industry, academia, non-governmental organizations, and government over a period of two years to review seven key sectors of the economy and eight cross-cutting strategies, and provide options for responding to climate change;
- developing and launching *Canada's National Implementation Strategy on Climate Change, Canada's First National Climate Change Business Plan*, and the *Government of Canada Action Plan 2000 on Climate Change*;
- carrying out climate change economic analysis and modelling that enabled jurisdictions to compare and assess likely economic impacts of various options for meeting Canada's Kyoto target;
- demonstrating climate change technologies that support sustainable economic development, with a total investment of $529 million accomplished on the strength of a $60-million federal investment through TEAM;
- funding cost-shared research that significantly increased the knowledge base on climate system functions, potential impacts, and adaptation techniques; and
- developing and implementing a variety of innovative awareness-raising initiatives, including publications, exhibits and research, that reached over two million Canadians.

Responding to the Challenge: The Climate Change Action Fund (CCAF) 1998-2001 Report can be viewed at: http://www.climatechange.gc.ca/.

Major accomplishments during 2002 included:

- engaging key decision makers at all levels of government, industry, and within other stakeholder communities, in assessing options for Canada to meet its Kyoto commitments;
- developing the *Canada's National Climate Change Business Plan 2002;*
- developing options for a potential domestic emissions trading system;
- carrying out analysis and modelling work to evaluate the economic and environmental consequences of climate change policy initiatives and to inform the decision on the Kyoto Protocol ratification;
- establishing a network of regional outreach "hubs" to raise public and community awareness at the provincial, territorial and local levels through partnerships involving all levels of government and stakeholders. Hub pilots were established in Alberta, Saskatchewan, Yukon, the Northwest Territories, New Brunswick, and Nova Scotia, and development work began in British Columbia, Manitoba, Newfoundland and Labrador, and Prince Edward Island;
- establishing partnerships with industry, and community and international organizations to encourage investment in technologies that reduce greenhouse gas emissions. A total of 18 new projects were launched under TEAM with a CCAF investment of $19 million and $287 million in total investments. Another achievement was the design of the System of Measurement and Reporting to TEAM (SMART), a system that evaluates the technical performance, impacts, and benefits of TEAM-funded projects;

- realizing climate science investments made under the first three years of the CCAF, including a national plan for climate system monitoring, establishment of a climate impacts scenarios facility, research to improve climate models and improve our understanding of the role of forests and agricultural lands in climate and carbon balance, and further studies in the Arctic and on extreme weather. Through the CCAF extension, work was initiated on climate system process studies, continued support was provided for the climate scenarios facility, and significant resources have been devoted to enhancing our climate modelling capacity;
- completing CCAF-funded research projects in the area of impacts and adaptation, including important new findings on agricultural adaptation, winter recreation impacts in Ontario's lakelands tourism region, and health-related issues in Nunavik and Labrador that were developed using traditional knowledge; and funding 19 new projects focused on climate change concerns related to water resources and food supply. The results of the CCAF-funded projects are highlighted in *Climate Change Impacts and Adaptation: A Canadian Perspective*, which also provides a review of the latest findings from Canadian impacts and research (for more information, see http://adaptation.nrcan.gc.ca); and
- funding projects through the CCAF Reserve, established to respond to new opportunities or unforeseen funding pressures that fall outside the scope or budgets of core areas of the CCAF. Examples include projects carried out under the Prairie Adaptation Research Collaborative, which advances knowledge of the vulnerability of the Prairies to climate change, and Agriculture and Agri-Food Canada's Prairie Farm Rehabilitation Administration partnership, which studies agricultural sources of greenhouse gases and management practices that could mitigate climate change effects.

Furthermore, over the last several years the CCAF has provided funding to the key departments involved in international activities related to the negotiation of the *United Nations Framework Convention on Climate Change* (UNFCCC) and the elaboration of the operational rules of the Kyoto Protocol. These included the Department of Foreign Affairs and International Trade, Environment Canada, and Natural Resources Canada. This funding ensured that Canada's voice was clear and effective by increasing the substantive analysis of key issues that were essential to achieving Canada's negotiating objectives and to influencing other countries to support Canadian interests.

Canada has also carried out important work on issues related to developing countries, including the analysis and development of possible options for future mitigation commitments and policies in these countries. Canada's leadership on issues of priority to developing countries was instrumental in crafting a balanced package of decisions that resulted in the Marrakesh Accords. These Accords secured the "ratifiable package" for Kyoto and include the rules for the Protocol's implementation. As a Francophone country, Canada led engagement and advocacy activities with developing countries, including the Francophone Group.

Canada played a key role in launching the debate over the shape of future climate change regimes in various international fora, and in successfully encouraging developing countries to participate more fully in policy discussions to address this global challenge. The CCAF also ensured the provision of ongoing legal expertise in the formulation of the final texts related to

the ratification, implementation, and entry-into-force of the Kyoto Protocol. Moreover, it made it possible for Canada to support the UNFCCC process through the organization of meetings, workshops, and other activities to foster international cooperation, and constructive participation in climate change activities.

More details of activities and achievements from the CCAF are provided through its annual reporting process.

B. Action Plan 2000

The *Government of Canada Action Plan 2000 on Climate Change*, announced in the federal Economic Statement of October 2000, is a major initiative of Canada's action on climate change.

A five-year, $500-million initiative, *Action Plan 2000* targets key sectors, and is expected to achieve an estimated annual reduction of 65 megatonnes of greenhouse gas emissions by 2010 (45 megatonnes in domestic reductions and 20 megatonnes of private-sector reductions generated through international projects facilitated by the Clean Development Mechanism and Joint Implementation Office). While focused primarily on greenhouse gas mitigation, *Action Plan 2000* also advances knowledge- and foundation-building in climate science, impacts and adaptation, northern and Aboriginal communities, and technological innovation.

A horizontally-managed initiative led by Natural Resources Canada and Environment Canada, *Action Plan 2000* involves seven federal departments and 45 specific measures in distinct but interrelated sectors. It also provides funding to the BIOCAP Canada Foundation to help foster research networks and provide a bridge between the government and non-governmental organizations that are addressing biosphere greenhouse gas management.

Action Plan 2000's first 18 months focused on developing program details, implementing programs, initiating partnerships with other levels of government and stakeholders, and increasing stakeholder and public awareness. While the program was not expected to yield any emission reductions in the first year of operation, modest reductions (approximately 0.61 megatonnes) were reported in the transportation, electricity, buildings, and industry cross-cutting sectors. These initial reductions indicate that the *Plan's* measures have begun to show tangible results, and are generating significant interest in the stakeholder community. In fact, during fiscal year 2001-02, *Action Plan 2000* entered into partnerships that have resulted in formal commitments valued at approximately $79 million.

Highlights of early successes and areas of promise across a variety of sectors are provided below.

The Transportation Sector's Urban Transportation Showcase Program, launched in June 2001, involves partners from other levels of government in showcasing the potential of innovative, integrated, and sustainable transportation strategies and practices in Canadian cities. Its goal is to test and measure the impacts of strategies to reduce greenhouse gas emissions from transportation and to lay a foundation for the adoption of effective integrated strategies in urban centres across the country by 2010. Municipalities, industry associations, and communities have shown significant interest in this initiative as evidenced by the 48 expressions of interest received in response to a call for proposals. An announcement of the successful proposals to be funded will be made in 2003.

Another achievement under the Future Fuels Program is the renewal of the National Biomass Ethanol Program (NBEP). It provides for $140 million in contingent lines of credit to encourage financing for three to six new ethanol plants. Designed to reduce greenhouse gas emissions by encouraging an increase in ethanol production and the use of low-level ethanol blends in gasoline, it aims to increase Canada's production capacity by up to 750 million litres per year from the current 175 million litres per year. Consultations with stakeholder groups are underway, several provinces have expressed an interest in federal-provincial collaboration, and plans are being developed to build a major plant.

Another effort encouraging active partnerships is the Oil and Gas Sector's CO_2 Capture and Storage Initiative, which aims to optimize and commercialize the capturing and storing of CO_2 as a means of reducing Canada's greenhouse gas emissions. Several activities are currently underway, including an effort with the Petroleum Technology Research Centre to implement a research project on the geological storage of CO_2 in partially depleted oil reservoirs for use in enhanced oil recovery (the International Energy Agency Weyburn Monitoring Project). The federal government is also working with the provinces of Alberta and Saskatchewan to promote CO_2 capture and storage, and to support industry efforts to develop commercial projects. The Sequestration of Oil Sands Tailings project is producing particularly positive results, exerting strong leverage with both industry and the province.

CO_2 capture and storage also figures prominently in the innovative Pilot Emission Removals, Reductions and Learnings (PERRL) initiative, which was launched in October 2002. This $15 million pilot program is designed to provide Canadian companies and organizations with an economic incentive to undertake immediate reductions in greenhouse gas emissions. Through PERRL's reverse auction process, the Government of Canada will buy verified greenhouse gas emission reductions from eligible projects on a fixed price per tonne basis. The projects will come from four strategically important sectors including CO_2 capture and geological storage, landfill gas capture and combustion, renewable energy, and biological sequestration. Proposals for the first auction round were accepted until mid-December, 2002, and the selected projects could be generating emission reductions as early as the end of 2003. The remaining auction rounds are anticipated to occur by the fall of 2003, and emission reductions from successful projects will be purchased through PERRL until the end of 2007. For more information, see http://www.ec.gc.ca/perrl/.

Solutions to reducing greenhouse gas emissions are also being developed through science and technology. Research and development are the core of the Technology Development and Innovation Program (TDIP), which addresses a wide range of climate change initiatives, including landfill-gas utilization, clean coal combustion, the generation of energy from animal waste, sustainable communities, and fluid transport in such major industrial sectors as cement and aluminum manufacturing. TDIP is fostering high-level research and development in climate change technology at the university, provincial, and federal levels through several granting processes. Solutions are also arising from Technology Roadmaps on fuel cells, oil sands, sustainable fuels and chemicals from biomass, clean coal technologies, and CO_2 capture and storage—where industry champions lead the process.

Action Plan 2000 also builds on successful climate change initiatives supported through the ongoing federal investment. For example, in the Buildings Sector, various initiatives play an important role in helping Canada reduce greenhouse gas emissions by educating and encouraging Canadian consumers and businesses to adopt and implement energy-efficient practices into everyday thinking and construction.

The Commercial Institutional Building Retrofit Program (an extension of the Energy Innovators Initiative) encourages owners and operators of existing commercial and institutional facilities to reduce operating costs and energy use through investments in energy efficiency. As of December 2002, 41 organizations had received incentives to implement energy retrofit projects, and 85 more proposals were approved to support planning projects, resulting in a 0.22 megatonne reduction in greenhouse gas emissions.

Another program, the Energy Efficient Housing Initiative (EEHI), has evaluated the energy efficiency of 52,000 existing households across Canada through its EnerGuide for Houses program. As a result of subsequent retrofits, the average household cut its energy costs by $480, and reduced its CO_2 emissions by 2.0 tonnes per year. The EEHI also has a component for new housing.

The ENERGY STAR® "best of class" energy-efficiency labelling for equipment and appliances has been introduced to Canada, and is a catalyst to engage the participation of many jurisdictions, utilities, manufacturers, and retailers in efforts to reduce greenhouse gases.

In order to demonstrate federal leadership in addressing climate change, the Government of Canada is also reducing greenhouse gas emissions from its own operations through its Federal House in Order Initiative. Federal funding for House in Order operations, which was made available through financial contributions of two specific sectors and four specific Action Plan measures totals $44.2 million over five years. The initiative, which is co-led by Natural Resources Canada and Environment Canada, commits the 11 highest-emitting federal departments and agencies to collectively reduce their greenhouse gas emissions by 31 per cent over 1990 levels by 2010. Departments and agencies will achieve their targeted reductions through fuel switching and energy-efficiency improvements to buildings and fleets, and through the procurement of emerging renewable electricity certified by a third party as having low environmental impact (i.e. the EcoLogo^{M}). In addition, all federal entities are invited through the Leadership Challenge to participate by undertaking emission-reduction activities within their own operations. To date, the federal government has achieved cumulative greenhouse gas emission reductions of 21 per cent over 1990 levels. More details are available at: www.fhio.gc.ca.

Initiatives are also underway to develop strategies and options for addressing climate change in Canada's north. The Aboriginal and Northern Climate Change Program is designed to engage Aboriginal people and northerners in climate change activities, and to undertake specific initiatives that address energy needs. The program's emphasis is on capacity building, alternative energy sources, energy efficiency, and best practices. It also supports selected pilot communities

in examining opportunities for energy efficiency and renewable-energy technologies through the development of comprehensive community-based strategies that explore both supply and demand options. Climate change consultations and information workshops have been held with various groups and organizations, including the Assembly of First Nations, Inuit Tapiriit Kanatami, Inuit Circumpolar Conference, Council of Yukon First Nations, and territorial governments. A number of educational and renewable-energy and energy-efficiency projects have also been funded.

The establishment of the Clean Development Mechanism and Joint Implementation Office (CDM/JI), based at the Department of Foreign Affairs and International Trade, was another accomplishment under *Action Plan 2000*. The Office facilitates participation by Canadian companies in emission reduction projects in other industrialized countries, as well as in developing countries. To date, the Office has conducted outreach and organized CDM/JI workshops and training seminars for Canadian embassy staff in 24 countries. The CDM/JI projects create export and technology transfer opportunities for leading-edge Canadian companies, while international emission credits help Canada meet its climate change commitments. The Office has advised 500 Canadian businesses of over 100 project opportunities; completed a number of essential market, feasibility, and baseline studies; and conducted yearly regional round tables and regular meetings with the Canadian private sector. It also fosters relationships with host-country governments that often lead to bilateral agreements that promote and facilitate CDM. To date, 10 Memoranda of Understanding have been completed, and nine more are underway.

Canadian participation in the market mechanisms of developing countries made great strides through the Canadian International Technology Initiative, the second international initiative under *Action Plan 2000.* This effort integrated technology-promotion officers into Canadian embassies in Mexico, New Delhi, and Warsaw to facilitate the expansion of market opportunities through the promotion of Canadian climate change technologies. Workshops and missions held in Mexico and India, conducted jointly with the CDM/JI Office and involving Canadian businesses, were successful at bringing companies together. Another initiative promoted through Canadian embassies is the Canadian Environmental Solutions web site, which contains information on more than 1000 environmental companies—in English, French, and Spanish. Part of the Canadian Technology Showcasing initiative, the site was recently updated to include information on climate change technologies.

Climate science research initiatives were launched on biological greenhouse gas sinks to provide information that will allow Canada to take full advantage of its carbon sink potential. Measures were also taken to address key gaps in Canada's systematic climate monitoring networks, particularly in the North. The key areas of focus were the atmosphere, oceans, and cryosphere (snow, ice, and glaciers).

Finally, the Impacts and Adaptation Program launched the Canadian Climate Impacts and Adaptation Research Network. Comprising six regions and seven sectors (agriculture, coasts, forests, fisheries, health, landscape hazards, and water resources), the network hosted 10 workshops in its first 18 months, reaching out to engage researchers, industry, and decision makers in the issue. The Program also funded activities to assess the latest information and make it available to Canadians. In addition to the *Climate Change Impacts and Adaptation: A Canadian Perspective*, it supported the participation of leading Canadian researchers in the international Arctic Climate Impacts Assessment, which will report in 2004.

In the coming fiscal year, *Action Plan 2000* efforts will focus on program delivery for all measures, with additional reductions in greenhouse gas emissions anticipated in specific sectors.

C. Energy-Efficiency and Renewable Energy Programs

The federal Budget of February 1997 provided $60 million over three years for new initiatives to improve energy efficiency in buildings and to promote renewable energy systems. This funding was renewed in Budget 2000.

The following four programs were announced:

- The Commercial Building Incentive Program provides financial incentives for building owners to use energy-efficient technologies and practices in designs for new commercial and institutional facilities. Over 200 buildings have qualified for the program to date, covering more than one million square metres of floor space.

- Energy Innovators Plus expanded an earlier program to allow more organizations to take action to reduce both operating costs and greenhouse gas emissions through energy-efficient retrofits to existing buildings. Since 1992, the Energy Innovators initiative has recruited more than 600 organizations that represent approximately 30 per cent of the floor space in commercial and institutional sectors.

- The EnerGuide for Houses program encourages Canadians to improve the energy performance of their homes and to make informed decisions when buying new homes or making improvements to existing ones. Over 50,000 homes have been evaluated under the program to date, potentially saving over 60 kilotonnes (.06 megatonnes) of greenhouse gases.

- The Renewable Energy Deployment Initiative (also partially funded under *Action Plan 2000*) promotes the use of renewable sources of energy from the sun, earth, and biomass for space heating/cooling and water heating. It provides funding to stimulate demand for renewable-energy systems, and undertakes market development initiatives to address barriers to their deployment, develop infrastructure, and provide information.

D. Electricity from Emerging Renewable Energy Sources in Prince Edward Island and Saskatchewan

In Budget 2000, the Government of Canada announced that it would procure $15 million worth of renewable energy in Saskatchewan and Prince Edward Island over the next 10 years to help develop wind power as an alternative energy source for federal buildings. The initiative builds on several highly successful pilot projects that were undertaken by Natural Resources Canada and Environment Canada in Alberta.[4]

As the country's single largest enterprise, the Government of Canada is a major energy consumer. One way of reducing its impact on the environment is to use electricity that comes from emerging, renewable energy sources—such as wind, water, sun, wood, and other forms of biomass—that emit no or few greenhouse gases.

In October 2000, the Government of Canada signed an agreement with SaskPower, Saskatchewan's electricity supplier, to contribute $12.4 million toward the production of electricity from wind in Saskatchewan. As a result, about two-thirds of the electricity consumed by Government of Canada facilities in Saskatchewan is now wind-powered.

An agreement was also signed with Maritime Electric Inc., committing the federal government to spend $4.6 million over 10 years to purchase 13 million kilowatt hours of wind power annually. Two million dollars of this purchase comes from the *Government of Canada Action Plan 2000 on Climate Change*. This investment could mean a yearly reduction of approximately 11 300 tonnes (.01 megatonnes) of greenhouse gas emissions from federal facilities alone.

[4] Natural Resources Canada and Environment Canada are buying sufficient green power from Enmax, the City of Calgary's electric system, to meet their requirements in Alberta. To date, these purchases have resulted in annual reductions of about 11,000 tonnes of greenhouse gas emissions. The success of the agreement subsequently led Enmax to launch Greenmax, an offering of wind energy to its residential and commercial customers.

E. Wind Power Production Incentive

The Government of Canada's Wind Power Production Incentive (WPPI), announced in the December 2001 federal Budget, encourages electric utilities, independent power producers, and other stakeholders to gain experience in this emerging and promising energy source.

WPPI will provide financial support for the installation of 1000 megawatts of new capacity over the next five years. The incentive will cover approximately half of the current cost premium, compared to conventional sources, for the development of wind farms where there are good wind resources in Canada. The incentive will be available to electricity producers for the first 10 years of a project.

An initial incentive payment of 1.2 cents per kilowatt hour of production, gradually declining to 0.8 cents per kilowatt hour, will be introduced for eligible projects commissioned after March 31, 2002, and before April 1, 2007.

Natural Resources Canada is implementing the program with the goal of ensuring that energy producers in every province and territory are able to access its benefits. The WPPI encourages participation from prospective producers in all regions, and is expected to lever approximately $1.5 billion in capital investments across Canada. The terms and conditions of the initiative benefited from the input of 50 stakeholders during technical consultations in 2002. In addition, the initiative is expected to motivate provincial and territorial governments, electric utilities, retailers, and power consumers to act and participate in similar programs.

By displacing other electricity sources, the wind-power capacity installed under WPPI, along with the continued momentum of wind energy, is projected to reduce greenhouse gas emissions by three megatonnes annually by 2010.

By the end of 2002, over 75 letters of interest had been registered by organizations across the country, with two projects coming on stream in fall 2002.

F. Canada Climate Change Development Fund

The Canada Climate Change Development Fund (CCCDF) was established in July 2000 as part of the Government of Canada's International Strategy on Climate Change. The goal of the Fund is to contribute to Canada's international objectives in climate change by promoting activities in developing countries that address the causes and effects of climate change, while at the same time contributing to sustainable development and poverty reduction.

The Fund is a five-year, $100-million initiative administered by the Canadian International Development Agency (CIDA). While CIDA is responsible for the everyday management of the CCCDF, a governance board made up of representatives of several federal departments provides the Agency with strategic advice and ensures coherence between this initiative and other federal climate change activities. Departments include the Climate Change Secretariat, the Department of Foreign Affairs and International Trade, Environment Canada, Industry Canada, and Natural Resources Canada, with Agriculture and Agri-Food Canada and Finance Canada participating as required.

The CCCDF aims to combine technology transfer with a capacity-building approach, and finances projects under four program areas: emissions reductions, adaptation, carbon sequestration, and core capacity building for climate change.

The bulk of the Fund was committed through two rounds of project selection in August 2000 and May 2001. Conceptual proposals were submitted by the Canadian private sector, non-governmental organizations, universities, and international organizations. Following full project design and contractual negotiations with proponents, project implementation is underway, with 45 projects being funded throughout all regions of the world as of the end of 2002.

Examples of CCCDF emission reduction projects include work underway in Western China on solar energy for rural electrification and in Brazil on greenhouse gas reduction through improved energy management practices in the industrial sector. Examples of capacity-building projects include the promotion of energy efficiency in the industrial and commercial sectors in Honduras and assistance to Tunisia for a strategy to mitigate greenhouse gases through wise energy use and the development of renewable energy sources. In East Timor and Indonesia, projects are being carried out on carbon sequestration, while a similar effort in Paraguay has the added benefit of conserving rare habitat in the country's interior Atlantic forests. Adaptation projects aimed at reducing vulnerability to climate change are underway in Bangladesh and the Caribbean.

The CCCDF has also played a part in international climate change negotiations, where Canada has demonstrated its leadership in and commitment to assisting developing countries in combatting the causes and effects of climate change—not only through CCCDF projects, but also through contributions to the Least Developed Countries Fund recently established through the *United Nations Framework Convention on Climate Change*.

G. World Bank's Prototype Carbon Fund

The Government of Canada has invested $15 million in the World Bank's Prototype Carbon Fund. Launched in 2000, the Fund is a public-private partnership aimed at catalyzing the market for project-based greenhouse gas emission reductions. Canada is one of six governments and 17 private sector companies that contribute to the Fund's total capital of $180 million.

The strategic objectives of the Fund are to:

- demonstrate how project-based emission reductions can promote and contribute to sustainable development and lower the cost of complying with the Kyoto Protocol;
- provide opportunities to "learn by doing" through the development of policies, rules, and business processes for the achievement of emission reductions under the Clean Development Mechanism and Joint Implementation (Canada's Department of Foreign Affairs and International Trade regularly disseminates information to Canadian entities on lessons learned); and
- work in partnership with public and private sectors to mobilize new resources for sustainable development and address global environmental problems through market-based mechanisms.

A board of directors that includes representation from participating organizations governs the Fund, while the Canadian International Development Agency and the Department of Foreign Affairs and International Trade oversee Canada's investment. Participants in the Fund have the right of first refusal for purchasing additional credits from projects.

Results of the 2001-02 year include:

- negotiation of 14 emission-reduction purchase transactions totalling over US $35 million;
- development of a strong and diversified project pipeline that cleared 26 proposals for emission-reduction purchases by the Fund Participants Committee, valued at about US $106 million;
- standardization of carbon finance documentation and contracts that include a comprehensive template for emission-reduction purchase transactions that incorporates risk mitigation instruments; and
- provision of expanded capacity-building opportunities and dissemination of experience and research through the delivery of 832 training days in Asia, Latin America, Central and Eastern Europe, and Southern Africa.

H. Green Municipal Funds

The Government of Canada established the Green Municipal Funds (GMF) in the February 2000 Federal Budget with an endowment of $125 million to the Federation of Canadian Municipalities (FCM). The Funds were created to stimulate municipal investment in innovative environmental infrastructure projects and practices to achieve cleaner air, water, and soil, and to protect the climate. The endowment was doubled to $250 million in Budget 2001. Environment Canada and Natural Resources Canada provided the endowments to the FCM in equal amounts of $125 million each. Program delivery to all Canadian municipalities was delegated to the FCM, which operates at arm's length from the federal government.

The following two complementary components comprise the Green Municipal Funds:

- The Green Municipal Enabling Fund (GMEF) is a $50-million fund ending in 2007 that provides cost-shared grants for feasibility studies that assess the technical, environmental and/or economic feasibility of innovative environmental projects. Grants cover up to 50 per cent of eligible costs to a maximum of $100, 000.

- The Green Municipal Investment Fund (GMIF) is a $200-million, permanent revolving fund that provides financing to municipal governments or their partners to underwrite the capital costs of innovative environmental infrastructure projects that meet the same environmental goals as the GMEF. Grants may also be provided for highly innovative projects.

Green Municipal Funds seek projects that have the potential to improve environmental performance by at least 35 per cent and that generate measurable environmental and economic benefits that could be replicated in other Canadian communities. The Funds are governed by a 15-member council, comprising five representatives from the FCM, five from the Government of Canada, and five from non-governmental institutions and the private sector. The Council oversees the FCM's administration of the Funds, develops and approves evaluation criteria, makes project and feasibility study recommendations, and ensures that contributions and investments are appropriately balanced among regions and project categories, and between urban and rural areas. The FCM Board of Directors, with delegated GMF decision-making authority, reviews council recommendations and decisions. Council recommendations are approved by the Board unless they contain certain technical errors.

Chief among the activities of the GMF are the approval and funding of projects and studies that stimulate investment in environmentally advanced municipal-infrastructure projects and improve municipal environmental practices. Other activities include communications, monitoring, and reporting.

The Federation of Canadian Municipalities is currently developing a comprehensive, results-based management framework to track projects, report on outcomes, and quantify the environmental impacts of completed GMIF projects. It is also developing additional tools, such as an Internet-based environmental management software system to help small and rural communities apply to the GMF. Over time, the Federation's Sustainable Communities

Knowledge Network will offer GMF participants (including municipal governments, non-profit organizations, academics, and private-sector representatives) access to detailed information on completed projects and case studies, in order to share knowledge and best practices across the country.

According to the FCM's annual report, the key results of the GMF for 2001-02 were:

- a success rate of 61 per cent for applicants seeking funding from the Enabling Fund, compared to a seven per cent success rate the previous year;
- the commitment of over $5.8 million worth of grants to 132 feasibility studies by the Enabling Fund;
- the approval of eight projects by the Investment Fund; and,
- an even balance between urban and rural projects.

The doubling of funds in Budget 2001 allowed the introduction of several improvements to the amended Funding Agreements. These include reduced interest rates for municipal GMIF loans and additional eligible-project categories. Establishing a results-based management and reporting system also strengthened accountability and transparency provisions.

Next steps for the Green Municipal Funds involve funding more projects in a broader range of categories, completing feasibility studies, and implementing study recommendations and associated GMIF projects. Although it is too early to report on pollution reductions achieved since the Fund were implemented, the Federation expects that projects executed over the next 12 to 24 months, coupled with the implementation of a comprehensive reporting system, will lead to the intended results.

I. Canadian Foundation for Climate and Atmospheric Sciences

The Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) was established by the Government of Canada in 2000. Entrusted with a $60-million investment budget to be disbursed over six years, its investments target university-based research projects and networks focused on extreme weather, air quality, climate change, and marine environmental prediction.

Successful applications must meet rigorous standards of scientific excellence, be focused on important national issues, lead to relevant results, and demonstrate strong collaboration with other researchers, institutions, and organizations. The CFCAS requires all of its grant recipients to report regularly on their progress and to make research data available to the scientific and professional community in a timely and open manner.

Environment Canada is the federal government lead for the CFCAS, with the Foundation's Board of Trustees composed of experts in climate and atmospheric sciences from Canadian universities and public- and private-sector organizations. The Canadian Meteorological and Oceanographic Society appoints all members, one quarter of whom must be senior administrators with the Government of Canada. The Chairperson is the Chief Executive Officer of the CFCAS. In 2001, the Canada Customs and Revenue Agency granted the Foundation status as a registered charity under the *Income Tax Act*, allowing it to attract funding for specific initiatives from non-federal sources.

The CFCAS acknowledges the Auditor General's concerns about foundations (April 2002), including the recommendation for enhanced government scrutiny of operations and greater accountability to Parliament. The Foundation has a transparent reporting structure and adjusts it, wherever appropriate, to further increase the transparency of its operations and more effectively demonstrate value for money.

As of September 2002, CFCAS investments included over $20 million for research on climate change and greenhouse gases. Key activities for fiscal year 2001-2002 included a funding competition, the shared or sole organization of three climate workshops/seminars, and the allocation of $27.87 million to support 26 projects and 12 networks. These projects and networks involve 268 university researchers, as well as collaborators in public and private organizations in every region of the country.

CFCAS grants have attracted matching support in cash or in kind from universities, federal research laboratories, and the private sector—effectively doubling the impact of the Foundation's investment. Three research networks attracted over $10.4 million in matching support from the Natural Sciences and Engineering Research Council. These contributions recognize the networks' innovative research and training activities, as well as their potential contribution to society and the development of public policies.

Canada's future prosperity depends heavily on the next generation of researchers. Over half of CFCAS grant funds support graduate-student training or enable postdoctoral fellows to gain advanced research expertise. As of September 2002, this constituted an investment of $22 million in Canada's future.

Research Networks Funded by CFCAS

The following seven climate-science research networks have been awarded CFCAS funding to date:

Fluxnet-Canada, led from Laval University, is linked to international efforts to understand the carbon cycle and its impact on climate. Scientists across Canada are working together to understand how the cycling and storage of carbon by forests and peatlands relates to climate change and climate variability, and how it is affected by activities such as commercial logging.

The **Canadian Surface Ocean Lower Atmosphere Study** (SOLAS), led from Dalhousie University, is a major international initiative aimed at improving our understanding of marine and atmospheric biogeochemical processes, which will lead to better predictions of changes in ocean biogeochemistry resulting from climate change. In July 2002, satellite imagery detected chlorophyll from plankton growth in an area of ocean that had been fertilized with iron by a Canadian SOLAS research team. The iron had stimulated the plankton to pull carbon dioxide out of the atmosphere.

Climate Variability: Its Causes and Predictability (CLIVAR), led from McGill University, is developing new analytical tools to help separate natural climate variability from changes caused by human activities. It will also produce seasonal forecasting tools for use by the Canadian Meteorological Centre, and help clarify how the oceans and atmosphere influence each other. The network contributes to a major international effort on climate variability.

The **Modelling of Clouds and Climate Network** (MOC2), led from the University of British Columbia, is part of a major international effort to improve understanding and forecasting of the relationship between clouds and climate.

Modelling of Global Chemistry for Climate, led from the University of Toronto, is working to develop a capability, unique in the world, both for modelling the global chemical climate of the atmosphere, and for corresponding data assimilation.

The **Canadian Regional Climate Modelling Network**, led from the Université du Québec à Montréal, is a set of interrelated research projects intended to improve understanding of regional processes in the climate system.

The objectives of the **Canadian Global Coupled Carbon Climate Model** (GC3M), led from McGill University, are to develop and test an integrated carbon-cycle model—including terrestrial, oceanic, and atmospheric components—for inclusion in a sophisticated climate model developed by the Canadian Centre for Climate Modelling and Analysis. Researchers are also studying the role of carbon dioxide and methane in regulating the climate system, and modelling the climate implications of different emissions scenarios.

J. Sustainable Development Technology Canada

Sustainable Development Technology Canada (SDTC) is an arm's-length foundation created under the *Canada Foundation for Sustainable Development Technology Act.* The Government of Canada appointed the chairperson and initial directors and members of the Foundation in March 2002. SDTC appointed the remaining directors and members pursuant to the *Act* in November of that year.

The objective of the Foundation is to stimulate the development and demonstration of Canadian technologies related to climate change and air quality. The Foundation also acts as a catalyst for creative and collaborative solutions designed to deliver positive environmental and economic benefits to Canadians.

SDTC has received an initial endowment of $100 million from the Government of Canada. Eligible recipients are partnerships that include the private sector and academic and non-governmental organizations. Eligible projects are aimed at advancing the development and demonstration of new technologies—in particular, those related to climate change and air quality.

The Foundation had issued two calls for Statements of Interest by December 2002. Response has been positive, with over 500 replies to the first two calls. In November 2002, SDTC announced that eight projects from the first call, totalling $6.61 million, had been selected for funding.

IV. Accountability and Reporting

Canada has distinct management, accountability, and reporting responsibilities concerning climate change activities. These requirements apply not only at the international, national, and federal levels, but also to the various third-party organizations funded through the federal investment, and to special initiatives such as the CCAF and *Action Plan 2000*. In addition, each department charts the progress of ongoing climate change programs in its annual performance report and other program-specific reports. References and links to these various reports are noted throughout this document.

A. International Reporting

As a party to the *United Nations Framework Convention on Climate Change* (UNFCCC), Canada must meet international reporting obligations related to greenhouse gas emission inventories and to carbon sources and sinks. National greenhouse gas inventories are the measure against which all countries will be judged when reporting under the UNFCCC and the Kyoto Protocol in the future.

Currently, parties to the Convention are required to report and publish an annual *National Inventory Report.* These reports consist of an inventory of greenhouse gas emissions and removals that includes an analysis of sectoral emission trends and detailed information on the methods and procedures used to estimate national emissions. The procedures include information on the use of good estimation practices such as quality assurance and control, internal verification procedures, uncertainty analyses, key-source identification, and trends correlations. In addition, eight trends fact sheets have been prepared to help decision makers and Canadians understand why greenhouse gas emissions are changing. The annual *National Inventory Reports* and the *Trends Fact Sheet Series* can be found at http://www.ec.gc.ca/pdb/ghg/.

Under the UNFCCC process, and in addition to the requirement to submit and publish the *National Inventory Report*, Canada and all signatory countries issue periodic comprehensive national communications on their climate change status. The most recent national communication, *Canada's Third National Report on Climate Change,* was published and submitted to the UNFCCC in December 2001 and can be found at: http://www.climatechange.gc.ca/3nr.

B. Federal, Provincial, and Territorial Reporting

The Energy and Environment Ministers have met regularly to ensure ongoing jurisdictional engagement, with a focus on analytical and policy work related to the Kyoto Protocol. In April 1998, they agreed that the National Air Issues Steering Committee—made up of federal, provincial, and territorial deputy ministers of Energy and the Environment—would manage the development of Canada's national response to climate change and provide advice to the Ministers. The National Air Issues Coordinating Committee-Climate Change (NAICC-CC)—consisting of assistant deputy ministers in these same departments and jurisdictions—was given responsibility for developing the national response. The NAICC-CC has created a number of working groups to provide oversight and policy development with respect to the federal,

provincial, and territorial issues concerning climate change. Further information is available at: http://www.nccp.ca.

Under the National Implementation Strategy, federal, provincial, and territorial governments have agreed to develop a series of annual business plans that specifically outline actions taken individually, in partnership, or collectively to respond to climate change. More than 300 initiatives were identified by the various jurisdictions and reported in *Canada's First National Climate Change Business Plan* (released in October 2000). Roughly the same number of new actions were reported in the business plan that was released in 2002.

C. Federal Governance

While responsibility for specific program and service delivery continues to rest with each federal department or agency, there is increasing emphasis on horizontal coordination and partnership. Inclusive interdepartmental committees—most chaired by the Climate Change Secretariat—have been established to provide policy and program direction and advice, particularly for initiatives such as the Climate Change Action Fund and *Action Plan 2000*.

Overall governance of climate change issues rests with the Deputy Ministers Committee on Climate Change, which is co-chaired by the Deputy Ministers of Environment Canada and Natural Resources Canada. Ongoing policy and programming direction is provided primarily through the Climate Change Management Committee, which is composed of assistant deputy ministers of policy from Environment Canada, Natural Resources Canada, Department of Foreign Affairs and International Trade, the Privy Council Office, and Finance Canada. Assistant deputy ministers with corporate or program responsibilities related to *Action Plan 2000* make up the Interdepartmental ADM-level Management Committee (IMC), which serves as the Plan's Board of Directors. Other horizontal interdepartmental committees are established as necessary at various levels and within specific functions to oversee the federal initiatives.

V. Performance Measurement and Reporting

A. Current

Because the Government of Canada is committed to transparent reporting and clear accountability, a series of results-based management and accountability frameworks (RMAFs) were developed when various initiatives were first approved.

For example, when the Climate Change Action Fund (CCAF) was approved in 1998, individual frameworks were developed for each of its four blocks, and an umbrella framework was created for the overall initiative. These were revised and updated when the Fund's extension was announced in 2000. An umbrella RMAF was also developed for *Action Plan 2000*, and specific RMAFs for individual measures of the *Plan* were established by participating departments.

Frameworks include profiles of planned activities; summaries of expected outputs, outcomes, and impacts; and outlines of accountabilities and reporting responsibilities. Performance measures to support day-to-day management, measures of longer-term outcomes and impacts, and evaluation issues are also listed. In fact, the first phase of the CCAF was evaluated before it was extended, and future evaluations are planned for both the second phase of the Fund and *Action Plan 2000*. The two initiatives also periodically report on progress to Ministers, while other accountability and reporting mechanisms are in place with third parties supported by the federal investment.

Environment Canada and Natural Resources Canada sponsor or co-sponsor four arrangements involving private foundations that contribute to climate change science, sustainability, and municipal actions. In keeping with various recommendations made in the *Auditor General's Report* of April 2002, a number of actions are underway in both departments to strengthen the reporting transparency and accountability to Parliament of such sponsorships.

Another demonstration of the Government's commitment to measuring, evaluating, and reporting on results is found in the TEAM component of the CCAF. To ensure the credibility and accelerate the market acceptance of the projects it funds, TEAM has developed the System of Measurement and Reporting to TEAM (SMART) to verify greenhouse gas impacts and performance. SMART was developed through consultation with Canadian and international experts and is designed to be a cost-effective method of establishing the performance of greenhouse gas mitigation projects. Several companies have been engaged to participate in a pilot study to refine this process.

Additional guidance on consistent approaches for measuring and estimating greenhouse gas emissions, reductions, and removals by Canadian climate change initiatives is provided by the Greenhouse Gas Verification Centre. The Centre, co-led by Environment Canada and Natural Resources Canada, is a cross-cutting measure under *Action Plan 2000* that assists domestic

government and industry initiatives in developing methodologies, protocols, and standards. The Centre is also facilitating the creation of a "greenhouse gas verifier" certification, so that Canadian climate change initiatives can obtain third-party audits of their greenhouse gas reductions or removals. Proposals are also in place to aid in the assurance of comparable rigour in the reporting of greenhouse gas emissions across *Action Plan 2000* measures

B. The Path Forward

The Government of Canada is committed to reporting to Canadians on the overall impact of the federal investment in climate change. The fact that this investment was designed mainly to meet commitments between 2008 and 2012, however, means that it is too early to provide comprehensive performance information.

Greenhouse gas emissions are more likely to decline gradually than to change dramatically from one year to the next. It is only as periodic reports on the federal investment unfold that the sound approach being taken to meet Canada's reduction targets will be proven effective.

It is clear, from the intense activity that has taken place in the development of climate change policy since 1997, that this complex issue requires a complex suite of actions and solutions. In addition to megatonne reduction numbers, progress must be measured by the size of the effort, the commitment of partners, and the variety of approaches and actions being taken to achieve overall goals. Because these achievements are presented primarily as outputs and activities, efforts will be made to quantify them as a measurement of results.

Accounting for and reporting on results has become even more important with Canada's ratification of the Kyoto Protocol in December 2002. As noted in the *Climate Change Plan for Canada,* the Government of Canada is investing in measurement and verification technologies that will enable Canada to comply with its monitoring, reporting, and review obligations under the Kyoto Protocol.

The Government of Canada and its partners are also exploring the development of an umbrella cross-government performance framework for climate change initiatives and activities, linking actions to expected outcomes, practical indicators, and relevant measurements. This will complement the *Climate Change Plan for Canada* and will provide a more integrated measurement and reporting strategy to enable the Government of Canada to collect relevant, understandable, and comparable information for consolidated reporting on the federal investment. Among other things, the framework will help make it possible to assess and measure the extent to which:

- technological advancements and behavioural change have made a difference in emissions, and whether the difference is significantly linked to the choices of Canadian consumers;
- federal funding has made a difference in levering additional monetary and in-kind support from partners and stakeholders in both the public and private sectors;
- the co-benefits of investing in climate change are understood, communicated, and achieved, so that Canadians can clearly see the results of their actions; and
- Canada is working to develop the knowledge base needed for future climate change negotiations and to help Canadians adapt to the impacts of climate change.

As part of the performance framework, the risks associated with implementing various activities and initiatives will be documented, measured, and addressed in a realistic and timely manner, thus enhancing the government's ability to direct resources for maximum effectiveness. As new ideas emerge, new technologies are developed, and better approaches are suggested, the Government of Canada will be in a position to shift resources from less effective actions to those with greater potential to deliver emissions reductions. This will also allow the Government of Canada to build on contingencies, assess progress, and adjust its approach and level of investment.

The Government of Canada is committed to measuring and reporting on how every megatonne of reduction will be accounted for under the ratification of the Kyoto Protocol. A mechanism is being considered that would take into account the horizontal nature of the climate change investment, and the fact that many of the activities are delivered by other government departments and third parties in a highly decentralized approach to program delivery.

The Government of Canada is aware of the broad challenge faced by all countries in the comprehensive identification, monitoring and reporting on climate change issues, including those of attribution of greenhouse gas emissions and allocation of potential reductions, as well as projecting future impacts.

The Government of Canada and its partners are committed to collecting more specific financial and non-financial information in order to report on progress toward objectives in a cohesive fashion, so that each comprehensive performance report is a picture of progress toward the goals set for achieving Canada's climate change commitments.

Through the implementation of an umbrella framework and the integration of performance results that are currently being measured and reported on by various players, the Government of Canada will be well positioned to address the concerns expressed by the Commissioner of the Environment and Sustainable Environment, Office of the Auditor General.

VI. Annexes

Annex 1: List of Federal Initiatives

Year Announced	Full Name of Initiative	Total $ (millions)	Lead Organization	Duration (years)	End Date
1997	Energy-Efficiency and Renewable Energy Programs	60	Natural Resources Canada	3	2000/2001
1998	Climate Change Action Fund	150	Natural Resources Canada Environment Canada	3	2000/2001
2000	Action Plan 2000	500	Seven federal departments	5	2005/2006
	Climate Change Action Fund (extension)	150	Natural Resources Canada Environment Canada	3	2003/2004
	Energy-Efficiency and Renewable-Energy Programs (funding renewal)	60	Natural Resources Canada	3	2003/2004
	Electricity from Emerging Renewable Energy Sources in Prince Edward Island and Saskatchewan	15	Natural Resources Canada	10	
	Canada Climate Change Development Fund	100	Canadian International Development Agency	4	2004/2005
	World Bank's Prototype Carbon Fund	15	Canadian International Development Agency Department of Foreign Affairs and International Trade	3.5	June 2003
	Green Municipal Enabling Fund	25	Federation of Canadian Municipalities	5	2006/2007
	Green Municipal Investment Fund	100	Federation of Canadian Municipalities	5	N/A
	Canadian Foundation for Climate and Atmospheric Sciences	60	Environment Canada	6	2005/2006
	Sustainable Development Technology Canada	100	Sustainable Development Technology Canada	5	2005/2006
2001	Wind Power Production Incentive	260	Natural Resources Canada	15	2016/2017
	Green Municipal Enabling Fund (replenishment)	25	Federation of Canadian Municipalities	5	2006/2007
	Green Municipal Investment Fund (replenishment)	100	Federation of Canadian Municipalities	5	N/A
	Tax Incentive for Renewable Energy and Energy Efficiency	5	Department of Finance	N/A	N/A
2002	Fuel Cell and Hydrogen Technology, National Research Council	20	Industry Canada	5	2007
		TOTAL 1745			

Annex 2: Additional Results and Highlights from Departments

This annex provides details of the primary ongoing federal programs that address climate change. These programs are in addition to the $1.7 billion invested in the specific federal initiatives noted in Annex 1. These programs are presented by relevant department, and highlight the last several years' most notable activities and achievements.

Agriculture and Agri-Food Canada

The Canadian agricultural sector has the potential both to reduce its greenhouse gas emissions and sequester carbon through the adoption of beneficial management practices.

In the last few years, Agriculture and Agri-Food Canada (AAFC) has established several climate change programs. Activities related to science, technology, and economic analyses are helping to improve: the understanding and quantification of greenhouse gas sources and sinks; the quantification and verification of removals and emissions of greenhouse gas from the agricultural sector; the understanding of economic impacts of climate change on farms; and the design of domestic emission-reduction trading schemes. Other activities are designed to increase awareness among producers of potential impacts, improve adaptation, reduce vulnerability, and help meet Canada's international commitment under the Kyoto Protocol. Two notable examples of programs are the Climate Change Funding Initiative (CCFI) and the Climate Change Skills and Knowledge Transfer program.

The CCFI is designed to improve scientific understanding of the agricultural sector's contribution to greenhouse gas emissions. The initiative has four major focuses:

- to develop and increase the pool of experts in the field of climate change in Canada by supporting projects involving graduate students in climate change science;
- to create science networks in which integrated teams of experts and industry partners address fundamental knowledge gaps and technology development;
- to disseminate information and bring together experts to share results and develop priorities for future action; and
- to set in motion the coordination of climate change activities in Canadian agriculture within the Canadian Agri-Food Research Council that will continue beyond the CCFI program. http://www.carc-crac.ca.

The Skills and Knowledge Transfer program assists farmers in understanding climate change issues and in identifying best management practices that they can employ to reduce greenhouse gas emissions. Activities supported by this program include:

- coordinating and developing grassroots provincial teams to raise farmers' awareness of climate change issues;
- developing information tools such as fact sheets, presentations, videos, and a web site;
- holding provincial workshops on greenhouse gas reducing activities; and
- hosting a national conference for provincial teams, to heighten their understanding of climate change issues.

AAFC’s Prairie Farm and Rehabilitation Administration (PFRA) also carries out climate change activities that have the potential to reduce greenhouse gases. The following are several examples:

- The Shelterbelt Centre conducts scientific research on carbon sequestration in shelterbelts—tree lines that serve as windbreaks on open land. Areas of study include marginal land improvement, hybrid poplar plantations, wetland and riparian areas, snow management, and wind-reduction energy savings. The Centre also plays an important role in the identification and communication of plantings that promote economic security, environmental

sustainability, and rural development. Since its creation, some 500 million trees have been distributed for farmstead, field, wildlife and agro-forestry plantings.

- The Land Management Division, through its Pasture Program, is actively incorporating climate change issues into its operations. The 0.9 million hectares of federally managed land is monitored and performance rated based on its ecological condition. Resource management changes are tested and evaluated for implementation to achieve improved ecological condition scores. Improved conditions result in long-term sustainable forage production, which equates to more carbon being sequestered. PFRA land and range management staff are working to improve the science of carbon sequestration on native rangeland and seeded pastures.

- The Prairie Agroclimate Unit links the forecasting of seasonal climate variability to longer-term climate adaptation. Regional and site-specific assessments have been carried out that show changes in both frost-free days and growing season (earlier seeding and a longer season). By working with AAFC's Research Branch, Environment Canada, and Natural Resources Canada, PFRA is communicating the impact of the changing climate to the prairie agriculture sector and local communities.

- PFRA's network of offices and centres in the prairie provinces are involved in the development, health, and sustainability of soil and water resources. The promotion and adoption of best management practices in these areas can result in both economic and environmental benefits—including reductions in greenhouse gases. Examples include the management of marginal cropland, the conversion of land to permanent forage and tree cover, the use of permanent cover lands to sequester carbon, fertilizer and manure management, energy and nutrient efficiencies on irrigated lands, and conservation tillage.

In addition, various activities are underway that enable AAFC to share knowledge and technologies with the international community through scientific, technical, and educational capacity building. The Department's Research Branch is currently collaborating with the Mexican government on a research and development project to improve crop productivity, prevent soil erosion, and increase carbon sequestration.

Further information on these and other programs is available at:
www.agr.gc.ca/policy/environment; www.agr.gc.ca/pfra; www.carc-crac.ca;
www.agr.gc.ca/progser/rdmi_e.phtml; and
www.agr.gc.ca/policy/adapt/national_initiatives/nemsi.phtml.

The Canadian International Development Agency

The purpose of Canada's official development assistance is to reduce poverty and contribute to a more secure, equitable, and prosperous world by supporting sustainable development in developing countries. The Canadian International Development Agency (CIDA) is the federal department primarily responsible for delivering this assistance.

In the short term, a solid foundation of capacity building and technology transfer is required to enable developing countries to take part in the global effort to combat climate change. In the longer term, raising awareness and increasing action on climate-related activity will enable these countries to achieve their development objectives in a sustainable manner.

Many CIDA projects combat climate change while at the same time realizing other benefits in such areas as health, food security, and energy efficiency. Access to new energy technologies and services, for example, not only provides communities and industries with an increased energy supply, but also reduces greenhouse gas emissions and improves local air quality.

In addition to projects under the Canada Climate Change Development Fund (described above), CIDA funds numerous bilateral initiatives that, directly and indirectly, reduce greenhouse gases and assist developing countries in adapting to the adverse effects of climate change.

The Agency also makes contributions to multilateral agencies for international climate change work. For example, it provides funds to the Global Environment Facility, which, among other activities, provides financial support for climate change mitigation and adaptation initiatives in developing countries.

A few examples of climate change-related CIDA-funded projects that do not fall under the Canada Climate Change Development Fund include the following:

Remote Sensing in South America

GlobeSAR-2 (RADARSAT) is an initiative executed by the Canada Centre for Remote Sensing Technology and RADARSAT International to transfer remote-sensing technology to South America. Because RADARSAT is capable of distinguishing between different surface textures related to vegetation and soil, its use will result in a greater ability to assess, monitor, and adapt to climate change impacts such as drought, desertification, flooding, and changes in coastline, ground cover, and soil productivity.

Energy-Sector Management in Latin America and the Caribbean

The goal of the United Nations Development Programme/World Bank Energy Sector Management Assistance Program in Latin America and the Caribbean is to reduce global greenhouse gas emissions and improve local air quality in urban centres by accelerating the introduction of cleaner fuels. Efforts are aimed at assessing the impacts of new environmental requirements, increased petroleum product demand, sector reform, and changes in trade patterns in the downstream sector on the refining industry.

Cuba-Canada Environmental Restoration Partnership

This initiative, focused on 700 hectares of parkland in Havana, Cuba, is enhancing the local capacity to address climate change issues, as well as regenerating a carbon sink. Strong community involvement is at the core of efforts to deliver focused environmental education programs to Havana schoolchildren, and establish a permanent plant nursery in a denuded area of the Almendares River.

Tree Link, Southeast Asia

Launched in response to the disastrous 1997 forest fires and recent flooding, this project supports the development and implementation of policies and practices for forest renewal, conservation, and protection. Improved management practices help prevent forest fires caused by increased temperatures, improve the overall health of the ecosystem, and preserve and enhance the livelihoods of the people who depend on this valuable natural resource.

Energy Efficiency in Buildings, China

Rapid economic growth in China has increased energy demands for space heating and cooling, and hot water. Energy consumed by buildings is expected to grow by six per cent per year, far outstripping projected energy production increases of two to four per cent. This project will reduce energy usage and greenhouse gas emissions by assisting China's Ministry of Construction in developing energy-efficiency standards for buildings, based on Canadian technology. Added benefits include improved local air quality, resource conservation, and transfers of technology to other sectors.

North Sulawesi Water Resources Institutional Development Project, Indonesia

This project strives to improve management, design, construction, monitoring, and flood control in the water sector. Moving toward more sustainable water management will increase the capacity of local groups to adapt to the effects of climate change, such as drought, floods, and extreme weather events.

Southern Africa Development Community Industrial Energy Management Project

This project is increasing the capacity of consulting engineers, industrial firms, and educational institutions to develop industrial energy management programs, undertake energy-efficiency projects, and offer education and training programs in energy conservation and management. Building the capacity of local professionals is a sustainable means of preventing and reducing greenhouse gas emissions, as well as local air pollutants.

Environmental Rehabilitation and Food Security in Mali

Mali has experienced several years of drought and desertification, which are the main causes of food insecurity in the region. In recent years, the task of land management has been decentralized, and is now a local responsibility. This project builds capacity in local institutions for environmentally sound natural resource management, and supports specific interventions that relate to both desertification adaptation and improved food production.

Further details can be found at: http://w3.acdi-cida.gc.ca.

The Department of Foreign Affairs and International Trade

The Department of Foreign Affairs and International Trade (DFAIT) is actively involved in international climate change activities, both from a policy and negotiations perspective and in the implementation of the Kyoto mechanisms. Canada's Clean Development Mechanism and Joint Implementation Office (CDM/JI), located within DFAIT, is the federal government's focal point for CDM and JI activities. It was created to enhance Canada's capacity to take advantage of the opportunities offered by undertaking greenhouse gas reducing projects in developing and industrialized countries. (For more information on the Clean Development Mechanism and Joint Implementation Office, see page 18.)

DFAIT's negotiators and legal experts played a key role in the negotiation of the Marrakesh Accords that elaborate the rules for the Kyoto mechanisms, compliance, and the developing countries package. DFAIT also represents Canada and the other Annex 1 Parties at the UNFCCC CDM Executive Board. Canada's ratification of the Kyoto Protocol places DFAIT in a position, together with Environment Canada, to take a leadership role in articulating a forward-looking international agenda on climate change. DFAIT is currently fostering dialogue and cooperation on climate change issues with many other countries, including those that have ratified the Kyoto Protocol and others that have not. DFAIT plays a leading role in furthering Canadian interests in the management of complex developing country issues related to climate change. This involves working closely with posts to develop advocacy strategies, as well as to undertake analytical work and develop negotiating positions.

The Department's network of missions abroad plays a key role in the negotiation of bilateral agreements between Canada and other countries on climate change. Canadian Embassies and Consulates report on domestic developments and local negotiating positions in preparation for international climate change negotiations, as well as perform an important advocacy role in seeking host country support. They work cooperatively with Canada's CDM/JI Office, to seek eligible climate change project opportunities for Canadian companies and promote these possibilities among local and Canadian firms, assisting them in acquiring emission reduction credits from the Kyoto mechanisms. They also build relationships with host countries and help identify the capacity-building requirements of the developing countries or economies-in-transition with respect to the Kyoto mechanisms.

Environment Canada

Environment Canada (EC) plays a lead role in supporting Canada's commitment to reduce greenhouse gas emissions and minimize the impact of climate change on our ecosystems and society. Working in close partnership with businesses, institutions, governments, universities, environmental non-governmental organizations, and individual Canadians, all of EC's services and regions are involved in delivering on climate change priorities.

Policy Coordination and Economic Analysis

EC established the Climate Change Bureau (CCB) in 1998 to coordinate the development of Canada's climate change policy, both domestically and internationally, in cooperation with other federal departments. The Bureau has worked to engage stakeholders and coordinate the

development of climate change measures within EC. It also serves as the Public Education and Outreach Program secretariat for the Climate Change Action Fund (CCAF-PEO).

Through the CCB, Environment Canada contributed to the successful negotiation of the Bonn Agreement and Marrakesh Accords, which underpin the Kyoto Protocol. The Department is instrumental in monitoring international developments and working with organizations around the world, such as the OECD, to encourage action on greenhouse gas reduction. Through its efforts, Canada has reached a joint statement with the United States to expand and intensify bilateral efforts to combat climate change.

EC's Economic and Regulatory Affairs Directorate (ERAD) works collaboratively to provide an economic foundation for action on climate change. It coordinates economic analyses of the costs and benefits of climate change policies, and examines alternative design options for a domestic emissions trading system. ERAD also forges linkages among federal departments and academia in order to address gaps in this economic information. In addition, the Directorate is responsible for the Pilot Emission Removals, Reductions and Learnings (PERRL) initiative, which is part of Canada's *Action Plan 2000*. ERAD provides policy leadership and program authority for the initiative, while the program's operations are carried out by EC's Environmental Protection Service.

Regional offices play an important role by delivering national programs, championing new technologies and projects, transferring knowledge, delivering elements of the CCAF-PEO program, and helping people make responsible decisions about the environment.

Meteorological Service of Canada

As part of its core activities, EC demonstrates leadership on climate science. EC's Meteorological Service of Canada (MSC) focuses its climate change research on monitoring and analysis, processes and modelling, and impacts and adaptation (http://www.msc-smc.ec.gc.ca/your_environment_e.html). MSC scientists across the country work together and in partnership with other government departments and agencies, universities, the private sector, and international organizations to provide Canadians with up-to-date scientific information and advice on climate change. In addition to its ongoing activities, the MSC provides the Liaison Office for the Science component of the Climate Change Action Fund and *Action Plan 2000*.

Key ongoing activities include the following:

> **Climate Monitoring:** Long-term observations of air, water, and ice conditions are essential to understanding the atmosphere and climate. The MSC has been gathering this kind of data continuously and systematically for decades, both through its national network of climate observing stations, and through volunteer climate observers. Since 1975, the MSC has operated Canada's only program for systematically measuring carbon dioxide and other greenhouse gases. Further information is available at: (http://www.msc-smc.ec.gc.ca/climate/index_e.cfm); http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=1&Lang=eng).

Climate Analysis: By analyzing long-term data collected from across the country, MSC scientists have detected changes in our climate. For example, temperatures in southern Canada have increased significantly over the past 100 years. Over the past 50 years, western Canada has warmed, the northeast has cooled, and there has been a 5 to 35 per cent increase in annual precipitation (most of it concentrated in northern Canada).

The MSC also draws on information and analyses to create products used by researchers, industry, and the public. One such product is the Internet-based *Climate Trends and Variations Bulletin*, which summarizes climate conditions across the country and highlights observed trends and can be accessed at: http://www.msc-smc.ec.gc.ca/ccrm/bulletin.

Climate Processes: MSC scientists and their partners are investigating how different elements of the climate system—the atmosphere, clouds, oceans, sea ice, and land surface—relate to each other. They are also studying the role that forests, agriculture, wetlands, and oceans play in the global carbon cycle.

MSC scientists contribute to the international Global Energy and Water Cycle Experiment by investigating the flow of water and energy in the Mackenzie Basin. Led by MSC, the Cryosphere System in Canada project has improved the measurement, monitoring, and modelling of snow and ice. Through collaborative projects in Saskatchewan's Prince Albert National Park, MSC scientists and their colleagues have been examining how carbon uptake and release by the boreal forest varies over time. Such information will help establish the potential for carbon sinks in Canada. For further details: http://www.msc-smc.ec.gc.ca/crb/research_e.cfm.

Climate Modelling: Global climate models (GCMs) are sophisticated computer programs that simulate the climate system and let researchers peer into the past or future. Canada's climate modelling activities are based at the MSC's Canadian Centre for Climate Modelling and Analysis in Victoria, British Columbia. Further information is available at http://www.cccma.bc.ec.gc.ca/research/research.html. The Centre has developed three generations of GCMs that enable scientists to make credible predictions about the magnitude, rate, and timing of climate change and its possible impacts. These models have been used in simulations to estimate conditions up to a thousand years in the future.

International experts consider the MSC's climate models to be among the best in the world. The Intergovernmental Panel on Climate Change (IPCC) relied on Canadian model outputs in the *Third Assessment Report-Climate Change 2001*. The outputs were also used in the U.S. *National Assessment of the Impacts of Climate Variability and Change*.

Climate Impact Scenarios: The MSC created and continues to provide leadership for the Canadian Climate Impacts Scenarios Facility to provide researchers with climate impact scenarios, scenario construction advice, and training. The Facility draws on information and advice from similar activities internationally, including work within the IPCC. Climate impact scenarios use the output of a variety of climate models, such as

temperature and precipitation, to create an image of possible future conditions with respect to the 1961-90 baseline climate. The scenarios are tailored to the needs of researchers in such fields as agriculture, forestry, fisheries, and health, and are also used in impacts and adaptation studies. For further details: http://www.cics.uvic.ca/scenarios/.

Impacts and Adaptation Research: Impacts and adaptation research determines how climate change will affect Canadians, identifies their vulnerability and how they can adapt. The MSC's involvement in this area has resulted in several ground-breaking studies, including the 1998 *Canada Country Study* – the first national assessment of how climate change will affect Canadians and their social, economic, and biological environments. Examples of recent research include examining the impacts, vulnerabilities and adaptations within the Okanagan River Basin, and involving scientists from the MSC, the University of Waterloo, and the U.S. Environmental Protection Agency, in an investigation of climate change effects on Great Lakes water levels and water quality. For further details: http://www.msc-smc.ec.gc.ca/airg/index_e.cfm.

Science Assessment: Scientists from the MSC helped to prepare the Third Assessment Report and other special reports of the Intergovernmental Panel on Climate Change, and have served on various Panel working groups. The MSC's participation ensures that Canada's scientific work and priorities are reflected in these efforts. Canadian policy-makers are brought up to date on research findings through the MSC's annual *CO_2/Climate Report*. For further details: http://www.mscsmc.ec.gc.ca/saib/climate/climat_e.cfm.

Environmental Protection Service

EC's Environmental Protection Service (EPS) is the Department's lead on the estimation, reporting, and review of the national greenhouse gas inventory; emissions registry; technologies, strategies, and measures for specific sectors (e.g., electricity and transportation); and climate change and clean-air linkages. Some examples of EPS activities in the area of climate change include:

National Reporting: Parties to the *United Nations Framework Convention on Climate Change* are required to prepare national communications reports. These communications consist of two separate components. Part I deals exclusively with inventories, and requires the publication and submission of an annual national inventory report. Part II requires periodic reporting on emission trends, projections, policies, and measures, as well as national circumstances and implementation activities.

EPS is responsible for all aspects of Part I, including: scientific and technical research on sources and sinks; the development of verification protocols for estimating and reporting; the negotiation of guidelines for reporting and review; and the provision of expertise to expert review teams. EC has published annual inventory reports since the mid-1990s.

Responsibility for Part II of national communications is shared with Natural Resources Canada. Canada published its first, second, and third national reports on climate change

in 1994, 1997, and 2002. EPS also represents Canada on the IPCC's Task Force Bureau, which is responsible for developing methods and guidance documents for estimating emissions and removals of greenhouse gases.

Technology: The Environmental Technology Centre develops, evaluates, and assesses technologies that reduce greenhouse gases. In-house programs have produced innovative emission reduction technologies, including the Microwave-Assisted Processes extraction technology for canola oil, liquefied petroleum auto-rickshaws for India, biodiesel, and green chemistry.

Canadian Environmental Technology Advancement Centres (CETACs) assist environmental small and medium-sized enterprises (SMEs) in commercializing their greenhouse gas emission-reduction technologies. In partnership with regional offices, CETACs are also engaged in the delivery of national eco-efficiency initiatives targeting industrial SMEs.

The Environmental Technology Advancement Directorate (ETAD), in partnership with Natural Resources Canada and Industry Canada, delivers Technology Early Action Measures to support the demonstration of climate-friendly technologies. It also oversees or provides direct input into a number of federal funding programs that target climate change and sustainable development, including Sustainable Development Technology Canada, Technology Partnerships Canada, the Green Municipal Funds, and the Program of Energy Research and Development. In addition, ETAD is involved in advancing bioprocesses and products that have the potential to increase industrial energy efficiency, reduce greenhouse gases, and, in some cases, remediate current effects of climate change.

EC has played a lead role in advancing landfill gas (LFG) capture and utilization in Canada over the last five years, working closely with the Federation of Canadian Municipalities and the Landfill Gas Industry Alliance. EC co-chaired the LFG Sub-Committee under the Municipalities Table of the National Climate Change Process.

EC has also played a lead role in advancing the voluntary green power market in Canada, starting in 1996 with the Environmental Choice Program's certification and labelling of green power; in 1997 entering into the first green power purchase agreement in Canada for EC's Alberta offices and laboratories; and continuing in collaboration with other departments to expand green power purchases by government and the private sector under *Action Plan 2000*.

Environmental Conservation Service

The Environmental Conservation Service focuses its climate change research on wildlife and aquatic ecosystems through the Canadian Wildlife Service (CWS) and the National Water Research Institute (NWRI).

The CWS is involved in a number of long-term projects to help evaluate the impact of climate change on birds. Research on Arctic seabirds has shown a change in diet from cold-water fish to ones that are characteristic of warmer waters, suggesting that northern fish communities may be

changing. Research is also being conducted on shorebirds nesting in the High Arctic—an area expected to experience substantial changes due to global warming—and on the impacts of climate variability on bird migration.

CWS also conducts research on long-term trends in polar bear ecology to provide data to assist in long-term conservation and management of populations. The polar bear has been assessed as a species of concern, related in part to impacts of climate change, which affects its habitat by reducing the total ice cover in the Arctic, thinning the permanent pack ice of the central polar basin, and changing the timing of freeze-up and breakup in more southerly areas, such as Hudson Bay.

The NWRI is concentrating its efforts on the impacts of climate change on water availability and quality in various regions of Canada, and on the transport and fate of contaminants in Canadian aquatic ecosystems. For example, in northern and western Canada, researchers are determining climate impacts on extreme events such as floods and low flows, particularly as they affect transboundary waters. In the Arctic, NWRI is leading the assessment of climate change impacts on Arctic freshwater ecosystems and hydrology and on river flow and inputs to the Arctic Ocean. On the Prairies, NWRI hydrologists are monitoring water balances in wetlands and generating hydrological models to analyze and predict the impacts of climate and land-use changes.

Fisheries and Oceans Canada

Fisheries and Oceans Canada has an obligation to participate in the resolution of broad issues, such as climate change, that extend beyond its immediate statutory obligations. As the federal lead on marine science, the Department makes a considerable contribution to the Government of Canada's overall climate objectives by heading and participating in national and international research programs on climate science and climate change.

In collaboration with other government departments, academic networks, and the international science community, the Department has developed a strong scientific knowledge-base of the total climate system. This includes an understanding of the interactions among the atmosphere, oceans, ice, and hydrological systems, and impacts on marine ecosystems and processes in Canada's three coastal oceans and two major seas.

The Department makes a continuing contribution to international programs for systematic long-term ocean monitoring. This is an expensive activity that, in Canada, is undertaken only by Fisheries and Oceans scientists, and involves comprehensive data management. Examples of activities related to this work include monitoring Arctic ice thickness and sea level, and detecting impacts of climate change and variability. Ocean monitoring carried out by Fisheries and Oceans in the north-east Pacific and the Labrador Sea is considered of supreme importance by the international scientific community, because of the key climatic processes that take place in these regions, and the length and quality of the data. The Department also recently joined project Argo, an international program to monitor the three-dimensional temperature and salinity structure of the global ocean in real time. This project is a key component of the ocean data set that will be essential to improving climate forecasting.

Fisheries and Oceans Canada collaborates with Environment Canada, Natural Resources Canada, and academic partners to undertake coupled ocean-ice-atmosphere modelling of the total global climate system. This improves the prediction of specific climate variations on time scales ranging from inter-seasonal to intra-decadal, and reduces uncertainties surrounding current inter-decadal climate forecasts.

Departmental science is improving knowledge of natural greenhouse gas cycles and climate change impacts on ocean ecosystems, fisheries, and aquaculture. It is also exploring the potential impact of technologies in the capture, treatment, transport, use, and ocean storage of carbon dioxide from large point-sources, and ways to increase the oceans' net uptake of greenhouse gases. The Department was a major partner in the recent Surface Ocean Lower Atmosphere experiment, which was sponsored by the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS). The experiment will contribute greatly to the understanding of ocean carbon cycle processes.

Further details can be found at: http://www.dfo-mpo.gc.ca/index.htm.

Health Canada

Established in 1998, the Climate Change and Health Office (CCHO) at Health Canada identifies the health and well-being impacts of climate change, assists in the design of adaptation strategies with provincial, territorial, and community health-care partners, and fosters research to improve understanding of how Canadians will be affected by climate change in the future.

The CCHO has established several external climate change health issue research networks as part of the Canadian Climate Impacts and Adaptation Research Network to help develop and disseminate a foundation of interdisciplinary evidence on important climate change and health issues (e.g., health effects of air pollution, water- and food-borne contamination, vector-borne and zoonotic diseases, extreme weather events, temperature-related morbidity and mortality, population vulnerability in rural and urban communities, and socio-economic impacts on the community). This allows researchers, partners in the health sector, and the Canadian public to gain a better understanding of the impacts of climate change on human health and well-being.

In March 2001, the CCHO held its National Health and Climate Change Science and Policy Research Conference, which was attended by private- and public-sector researchers, academics, and other stakeholders in the health community. After scoping out the strengths and limitations of current knowledge, methods, and data, participants identified the first broad priorities for the 10-year *Climate Change and Health Research Agenda.* Health Canada's research networks held workshops in 2002 to further define the needs and gaps in each specific research area of the Agenda, which will be continuously updated as new information is presented.

Health Canada's Health Policy Research Program recently provided over $700 000 in funding for three projects in the area of climate change and population health. These projects will further the integration of research and policy activities to support efforts to address the impacts of climate change on health and well-being in Canada.

Health Canada has developed a *Climate Change and Health Information Toolkit* to assist public health practitioners and policy makers in better understanding the health-related implications of climate change and in communicating information about climate change to health decision-makers in local communities. The Toolkit includes a series of fact sheets, an easy-to-adapt presentation, a policy primer, a brochure, and other sources of information.

On the international front, Health Canada has been working with the World Health Organization, the United Nations Environment Program, the World Meteorological Organization and other international experts to develop a common set of tools and methods for use by public health authorities who need to assess the health and social impacts of climate change and variability. These are being compiled in the *Climate Change Human Health Impact Assessment Guidelines*, which will be released in 2003 and made available to provincial/territorial ministries of health and interested public health groups.

Further details are available at: http://www.hc-sc.gc.ca/hecs-sesc/hecs/climate/welcome.htm

Industry Canada

Efforts to address climate change are woven throughout the activities of the Industry Portfolio, as detailed in the following examples.

Canada Economic Development for Québec Regions

The Action Strategy for Greater Montréal invests in the development, demonstration, and commercialization of environmental and biotechnological solutions. Those that support climate change include site remediation, alternative vehicle technologies, urban waste management, and the use of satellite data to monitor air, water, and land conditions.

Small and medium-sized enterprises (SMEs) can access expertise on addressing climate change and other environmental issues by enrolling in the Enviroclub, while the Small Business IDEA PROGRAM provides financial assistance to SMEs and non-profit organizations (such as business associations) with a focus on environmental industries.

Canadian Space Agency

The Atmospheric Environment Program develops advanced sensors such as climate change and pollution monitoring instruments, while Earth Surface Environment activities involve satellite missions to provide atmospheric greenhouse gas data and information on soil moisture, deforestation, and ice cover. The Hurricane Watch Program and International Charter Space and Major Disasters Program are used to monitor severe weather incidents and mobilize necessary action.

Industry Canada

Industry sector-specific energy efficiency and greenhouse gas performance is being benchmarked under an *Action Plan 2000* initiative led by Natural Resources Canada. The results will be published on an energy-benchmarking web site on Industry Canada's flagship site,

Strategis. Under the EcoDesign Innovation Pilot Project, companies are assisted in identifying opportunities for process efficiency improvements and in implementing ways to reduce energy consumption and greenhouse gas emissions. The EcoSmart Concrete Project showcases the use of supplementary materials as a replacement for cement in concrete. The EcoSmart Building Design's Sustainable Building Prototype promotes market-driven solutions to sustainable building by demonstrating concepts and technologies that can be easily replicated in building design.

National Research Council

The National Research Council (NRC) pursues a wide variety of energy-efficiency programs, including the use of energy performance contracts and energy alternatives in its daily operations. The NRC's Canada Institute for Scientific and Technical Information contains over 600 books, reports, and conference proceedings on climate change.

The NRC also makes a significant contribution to climate change science. At the Institute for Aerospace Research, the Earth Atmosphere Energy and Trace Gas Exchange program is studying the exchange of energy and trace gases between the Earth's surface and the atmospheric boundary layer in an effort to contribute to long-range weather prediction and global climate models. The Institute's Gas Turbine Environmental Research Centre is carrying out ongoing research and development on aerodynamic efficiency to improve fuel performance, reduce emissions, and develop methodologies to facilitate the measurement and reporting of greenhouse gas emissions. At the NRC's Vancouver Institute, the Fuel Cell Program aims to create and demonstrate fuel cell and clean energy technologies for Canada.

Other NRC research and program areas include:

- developing visualization and animation tools for monitoring rising sea levels, rainfall, runoff, droughts, and floods;
- generating renewable bio-energy from biomass;
- reducing the climate change impacts of various manufacturing technologies;
- developing construction materials to reduce energy consumption in buildings;
- creating alternative materials to improve energy efficiency in vehicles; and
- fostering innovation with small and medium-sized enterprises to reduce fossil fuel use and greenhouse gas emissions.

Statistics Canada

Statistics Canada is working in partnership with the departments of Agriculture and Agri-food Canada and Natural Resources Canada to conduct surveys related to climate change in the areas of environmental farm management, energy balances, energy system renewal, and energy consumption in the oil and gas sector, industrial sector, and commercial and institutional buildings.

Technology Partnerships Canada

This federal technology investment fund has invested over $248 million in 22 climate change-related projects to date. Projects funded relate to energy efficiency and conservation, renewable fuels and electricity, clean transportation technologies, and fuel cell and hydrogen technologies.

Economic Western Diversification

The Western Diversification program has funded several important projects, including Petroleum Technology Research; the International Test Centre for Carbon Dioxide (CO_2) Capture; Agricultural Removal and Storage of Greenhouse Gases in Alberta; Greenhouse Gas Technology Showcase; Alpha 24-volt fuel cell-powered forklift demonstrations; an economic impact study of the fuel-cell industry in British Columbia and Canada; the Alberta Centre for Climate Change Technology; secretariat support to the Manitoba Climate Change Task Force; and the capturing and sequestering of CO_2 in Western Canada. A number of programs that were not designed with climate change in mind have also yielded positive results, including conference sponsorships, communication initiatives, and loan investment programs.

Further details can be found at: http://www.ic.gc.ca/cmb/welcomeic.nsf/icPages/Programs.

Natural Resources Canada

Energy Sector

The Energy Efficiency and Alternative Energy (EAE) program was implemented by Natural Resources Canada (NRCan)[5] in 1991 to assist the Government in responding to concerns about the effects of fossil fuel combustion and greenhouse gas emissions on climate change.

The EAE supports economically feasible increases in energy efficiency and the use of alternative energy sources by encouraging investment in corporate and consumer EAE opportunities, and engaging all sectors of the Canadian economy and society in rethinking and improving energy use. It uses a variety of instruments, including leadership, information, voluntary actions, financial incentives, research and development, and regulation. In all cases, it emphasizes partnership with stakeholders in other levels of government, the private sector, and non-governmental organizations.

[5] NRCan's EAE initiatives are managed by:

1. The **Office of Energy Efficiency** (OEE), which delivers market transformation initiatives to improve energy efficiency and the use of alternative transportation fuels;
2. The **CANMET Energy Technology Branch** and the **CANMET Mineral Technology Branch**, which deliver EAE research and development initiatives;
3. The **Energy Resources Branch**, which delivers market transformation initiatives for renewable energy; and
4. The **Science Branch of the Canadian Forest Service**, which undertakes research and development in the use of forest biomass for energy.

Supplementary funding in subsequent years enabled the Department to expand the scope of its EAE activities. Existing initiatives were broadened into new markets, additional sub-sectors were developed, complementary programs were launched, and new targeted programs were introduced (see Table 1 for a complete list of NRCan's EAE programs).

Established in 1974, the Program of Energy Research and Development (PERD) promotes the development and use of Canada's non-nuclear energy resources in a clean and safe manner, and the development of energy-efficient, renewable, and alternative energy sources and technologies[6]. Seventy-six per cent of PERD's current programs are aimed at finding technological solutions to Canada's climate change challenges.

NRCan manages PERD and operates it through 12 federal departments and agencies. Energy research and development activities are mainly focused on: diversified oil and gas production; cleaner transportation; energy-efficient buildings and communities; energy-efficient industry; reducing the environmental impacts of Canada's electricity infrastructure; and the impacts of climate change in the energy sector.
Following are examples of NRCan's ongoing EAE activities:

- Launch of the National Energy-Use Database, which improves knowledge and analytical expertise in the area of energy consumption and efficiency. The database has funded several surveys on energy consumed at the end-use level, the characteristics of energy-using equipment and buildings, the attitudes of Canadian consumers toward energy use, and the adoption of energy-efficient technologies.

- Canada's Energy Efficiency Regulations, under the authority of the *Energy Efficiency Act*, prescribe minimum energy performance requirements for over 30 products, consumption labelling requirements for eight major household appliances, and reporting requirements to ensure compliance with its provisions. Canada is considered a world leader in the application of these instruments, and this core responsibility of NRCan is largely responsible for significant reductions in the energy consumption of the prescribed products.

- The Canadian Industry Program for Energy Conservation (CIPEC), with a network of more than 4000 companies in Canada's mining and manufacturing sectors, reports on approximately 90 per cent of total secondary industrial energy demand through its 23 task forces. The number of CIPEC task forces that have established energy-efficiency improvement targets continues to rise. The aggregate CIPEC target is a one per cent overall improvement in industrial energy intensity per year through to 2005, which, to date, has been exceeded. From 1990 to 2000, industrial energy intensity improved by an average of 2.4 per cent per year, while emissions for 2000 were confirmed at 1.7 per cent above the 1990 base level.

- Initiated by the federal government, company average fuel consumption (CAFC) is an industry-wide, sales-weighted measure used to determine the average fuel consumption of the entire new vehicle fleet. The CAFC is calculated for each model year and expressed in

[6] PERD's annual budget is approximately $57.5 million.

litres per 100 kilometres (L/100 km). Between 1990 and 1999, the average CAFC of new passenger cars sold in Canada improved by 2.4 percent, dropping from 8.2 L/100 km to 8.0 L/100 km.

- Fuel Efficiency for Drivers aims to improve the energy efficiency practices of private motorists by influencing car purchase decisions, on-road driving practices and vehicle maintenance practices through the use of driver information. In 2000, nearly 250 new driver educators were using the driver kits provided by the program, reaching about 60,000 novice drivers.

- Eight per cent of the solution gas that Alberta's oil and gas industry produces is treated as a waste product and disposed of by burning or flaring. Current volumes (1.8 billion cubic metres per year) contribute significantly to greenhouse gas emissions. NRCan's Program of Energy Research and Development helps develop technologies to reduce flaring and the release of potentially harmful products of incomplete combustion into the atmosphere.

- NRCan continues to provide secretariat support to the industry steering committee that leads the Canadian Lightweight Materials Initiative (CLiMRI), a government-industry partnership aimed at developing and implementing advanced materials in transportation applications to reduce greenhouse gas emissions through improved vehicle efficiency. It is estimated that for every 10 per cent reduction in vehicle weight, there is a six to eight per cent improvement in fuel economy. This is equivalent to a reduction of about 17 to 20 kilograms of CO_2 per kilogram of weight reduction over the lifetime of the vehicle.

- Mine ventilation research being carried out under the Underground Mine Environment program is aimed at reducing energy consumption by adopting the concepts of ventilation infrastructure automation, network optimization, and management. Mining extraction consumes five per cent of the electricity used by all industries in Canada. Mine ventilation alone accounts for close to 40 per cent of this energy. A feasibility study at Inco's Creighton Mine in Sudbury is nearing completion, the results of which will determine the extent of potential energy savings and impacts on emissions.

- The International Centre for Sustainable Development of Cement and Concrete (ICON) continues to promote the use of high volume fly ash (HVFA) concrete in full compliance with performance requirements. ICON's collaboration with industrial partners and other federal and provincial agencies resulted in the use of HVFA concrete in many recent projects—including the Liu Centre for the Study of Global Issues on the campus of the University of British Columbia, and the computer science building at York University in Toronto. About 0.5 megatonnes/year of fly ash is used in cement and concrete applications in Canada per year (compared to a total cement production of about 13 megatonnes/year). ICON believes that the potential exists to increase the use of fly ash in concrete production to two megatonnes or more per year, thus reducing CO_2 emissions by the same amount. ICON, with the help of Canadian consultants and Indian organizations, leads the Canadian International Development Agency's efforts to reduce emissions in India.

- The Fuel Cell-Powered Mining Vehicles program aims to develop the technology to replace the use of diesel with hydrogen fuel cells to power underground mining vehicles. One benefit of the widespread adoption of fuel cell power would be a decrease in operating costs, because mine ventilation needs would be lowered by more than 35 per cent. A 4.5 ton prototype locomotive propelled by hydrogen fuel cells has been undergoing surface and underground testing by NRCan scientists since the beginning of 2002. NRCan scientists and engineers integrated the fuel cell with the locomotive and its control systems.

For more than 25 years, NRCan has encouraged the development and use of cleaner energy technologies such as fuel cells, solar power, wind power, bioenergy, alternative transportation fuels, and energy-efficient technologies. As part of NRCan's response to reducing greenhouse gas emissions, it has co-funded a number of innovative technology projects, including the Climate Change Action Fund's Technology Early Action Measures Initiative.

- NRCan facilitates national and international initiatives on the development and application of advanced combustion technologies. The goals of these initiatives are to generate power efficiently and reduce emissions to near zero. An example is the work being carried out with the Canadian Clean Power Coalition to investigate the feasibility of building a coal-burning power plant that would dramatically reduce all airborne pollutants and carbon dioxide.

- The goal of the Cleaner Hydrocarbons Initiative is to enable the sustainable growth of Canadian hydrocarbon production while reducing emissions. NRCan collaborates with the oil-sands industry on activities ranging from research into the fundamental chemistry of bitumen upgrading to hydro-transport and site restoration. Partnership activities include a Canada-Alberta alliance that encourages the oil-sands upgrading industry to adopt a wide range of technologies to improve processes and cut costs. In collaboration with industry, NRCan's National Centre for Upgrading Technology (NCUT) has steered the evolution of technologies to improve hydroprocessing, save energy, and reduce emissions.

For more than 25 years, NRCan has led the development of technologies to economically harvest Canada's immense supplies of renewable energy by encouraging the development of small hydro projects, ground-source heat pumps, active solar systems, solar electricity, wind energy, and more advanced biomass technologies. An example is NRCan's RETScreen™ International software, which is currently used by more than 20,000 users in 185 countries to assess renewable energy projects.

- NRCan has been working on distributed power technologies since the 1970s, encouraging the development of renewable energy systems such as wind, low-head hydro and photovoltaics, fuel cells, and various district heating technologies. These systems are capable of producing energy on site, offer efficiency gains of 30 to 40 per cent, and avoid power losses of six to seven per cent through transmission and distribution systems. An example of note is the effort of MicroPower Connect to address the interconnection issues of small distributed power sources.

- NRCan works in partnership with the alternative fuels industry to develop and commercialize technologies and fuels that are cleaner and more energy efficient. NRCan-supported

activities include the development of technologies, standards, and infrastructure; improved fuel storage systems; and advanced propulsion systems and engine controls. One of NRCan's principal goals is to encourage the growth of Canada's fuel cell and hydrogen industries. An example is Stuart Energy System Inc.'s hydrogen refuelling appliance, which consists of a water electrolyzer to produce hydrogen for zero-emission fuel cell vehicles.

- In an era of expanding economic activity, there is an unlimited demand for technological innovation in industry that improves energy efficiency, reduces waste, and optimizes industrial processes. Through such industry support programs as Industrial Energy R&D and its collaborative technology innovation activities, NRCan has fostered the development and use of eco-efficient processes. This includes integrated pulp and paper plants that reuse water, resulting in energy savings and near-zero effluent emissions.

- NRCan works in several areas of green building technology. Cost-sharing arrangements have accelerated the development and commercialization of a new generation of energy-efficient and passive solar technologies, greening the Canadian residential and commercial building industry and producing some of the most advanced buildings in the world. An example of note is NRCan's C-2000 Program for Advanced Commercial Buildings, which plays a significant role in establishing goals for energy efficiency in commercial buildings.

- NRCan has led the development of community energy systems in Canada for the past 12 years. This work includes technology transfer, systems development, modelling, information dissemination, and a complete system assessment that includes costs, financing, applicable incentive programs, and commercial viability. Ongoing research and development is providing this industry with important design options and criteria that apply to both large and small communities in populated and remote areas of Canada. One project makes use of waste wood from a local sawmill to provide green electricity and heat to both the mill and the City of Revelstoke, British Columbia.

NRCan's Energy Policy Branch (EPB) takes the lead on federal energy policy and international energy issues, environmental issues pertaining to energy, sustainable development and other long-term strategies, fiscal analysis, forecasting and other cross-cutting energy issues. EPB provides the linkages between the efficiency, resources and technology branches within the Energy Sector when issues are of a general nature or require central coordination.

- The main responsibility of the Analysis and Modelling Division (AMD) is the development of Canada's long-term energy and energy-related emissions projections. These projections are published under the title *Canada's Energy Outlook* and, more recently as *Canada's Emissions Outlook: An Update.* AMD's modelling framework is also used in the quantitative assessment of energy and environmental policy options and proposed measures. AMD took a lead role in the Analysis and Modelling Group (AMG), a federal-provincial body established under the National Climate Change Process (NCCP) to examine the impacts of various policy options to meet Canada's climate change commitments. The AMG released its report on the first phase of the analysis, *An Assessment of the Economic and Environmental Implication for Canada of the Kyoto Protocol*, in November 2000. Recent analytical work has been done in support of the federal *Discussion Paper on Canada's*

Contribution to Addressing Climate Change (May 2002), where the economic impacts of several policy scenarios were examined, as well as for the *Climate Change Plan for Canada* (November 2002), where a "reference case" broadly reflective of the policy approach set out in the *Plan* was assessed. Currently, AMD is engaged in a major project to develop a new integrated energy-technology-economy modelling structure for Canada. The new modelling structure will significantly enhance NRCan's capacities to undertake policy analysis.

- The Domestic Environment Policy Division (DEPD) has the lead responsibility on domestic policy development, coordination and analysis related to climate change and other environmental issues. The Division is called upon to provide domestic policy analysis, advice and recommendations to senior departmental officials and the Minister of NRCan. Under the NCCP, DEPD took a lead role in the Targeted Measures Coordination Group (TMCG), formed in fall 2001 to define, for analytic purposes, possible packages of targeted measures as a complement or alternative to Domestic Emissions Trading (DET). Working closely with the AMG, the TMCG played a lead role in developing various packages of targeted measures which were simulated in national analytical work in the lead-up to the release of the *Climate Change Plan for Canada* and ratification. Effort now is focused on the implementation of the various identified measures. Federal-provincial relations are currently a primary focus, particularly as emphasis shifts to implementation.

- The International Environment Policy Division (IEPD) has the lead responsibility for developing and advancing NRCan's positions both within the Canadian delegation and at international climate change negotiations. It works closely with the Department of Foreign Affairs and International Trade and Environment Canada to develop agreed upon Canadian positions that will be put forward during international negotiating sessions. IEDP is often called upon to provide policy analysis, advice and recommendations to senior departmental officials and the Minister of NRCan. Key areas of work are defined, in part, by the provisions of the Kyoto Protocol and include: forestry and agricultural sinks; Kyoto mechanisms; compliance; and the engagement of developing countries. The IEPD played an integral role in negotiations at Bonn and Marrakesh where final agreement on the rules for implementing the Kyoto Protocol were reached. Current activities have centered on positioning Canada for the negotiation of our second commitment period targets, and encouraging collaboration with the United States on climate change-related activities.

Canadian Forest Service

Forests are a dominant feature of the Canadian landscape and play a vital role in the economic, social and environmental well being of this country and globally. Climate change is expected to have a significant impact on Canada's forests and on the social and economic structures that depend upon them. The potential role of forests in mitigating the effects of climate change has also become an important issue as a result of the Kyoto Protocol. Critical for Canada is our ability both to account for the role and response of our forests in relation to climate change and to meet our present and future national and international reporting requirements under the *Kyoto Protocol.* The Canadian Forest Service (CFS) continues to be actively involved in international climate change negotiations, the development of domestic mitigation options, and climate change-related policy analysis.

From a science and technology perspective, the CFS is Canada's largest research organization investigating the relationship between forests and climate change. The CFS plays a key role in defining strategic research gaps and priorities; developing research partnerships; advising on climate change-related policies; increasing public awareness of climate change; and coordinating activities with industry, academia, non-governmental organizations, and other governmental departments and agencies in the forest sector. Climate change research related to the forest sector is conducted at CFS laboratories in Victoria, Edmonton, Sault Ste. Marie, Sainte-Foy, Fredericton, and Corner Brook and is integrated through the Climate Change Network.

Through the science and technology programs, CFS has developed knowledge, tools, and techniques to support policies and practices that facilitate sustainable forest management and global stewardship under a changing climate. The CFS climate change research program receives approximately $550 000 per year of departmental funding and leverages up to five times that amount from other government and external funding sources. The program entails a suite of projects that includes:

- carbon budgeting and accounting activities that build on the Canadian Forest Service Carbon Budget Model in a national effort to generate a carbon accounting framework that will enable Canada to meet its international reporting requirements;
- research activities that examine impacts of and adaptive responses to climate change effects on Canada's forest, forest ecosystems carbon cycle/budget, biodiversity, productivity and growth, and natural disturbance regimes;
- an impacts detection program that examines existing databases to assess their use in detecting change, and uses remote sensing and related techniques to investigate tree line responses to climate change; and
- social and economic studies to develop methods for assessing social and economic effects of climate change on Canada's forest sector and forest dependent communities.

Further details can be found at:
http://www.nrcan-rncan.gc.ca/cfs-scf/science/resrch/climatechange_e.html.

Earth Sciences Sector

The Earth Sciences Sector undertakes a range of climate change-related activities. As well as hosting the national Climate Change Impacts and Adaptation Program, its scientists undertake monitoring and research to improve the understanding of climate changes both past and present and to examine the vulnerability of Canadians to climate change. Working with federal, provincial, and territorial colleagues, the sector is also leading the development of a national framework for adaptation policy.

Using information from lake- and ocean-bottom sediments, tree rings, glaciers, and other sources, researchers in the sector have developed paleoenvironmental reconstructions of past periods in Earth's history that help to build a better understanding of the dynamics of the climate system and past environmental responses to climate changes.

The sector has also contributed to the understanding of carbon storage and greenhouse gas cycles through studies on the extent of changes in peatlands, forest productivity, and natural gas hydrates.

Reducing Canada's Vulnerability to Climate Change is a core program of the Earth Sciences Sector's Science and Technology Strategy. Working with research partners and stakeholders, sector scientists provide geoscientific knowledge that helps to define the future risks to infrastructure and communities from permafrost degradation, changes in slope stability, glacial loss, and coastal erosion. They are also involved in the analysis of past and future droughts, groundwater availability, and hazards such as floods.

Further details can be found at: http://climatechange.nrcan.gc.ca/english/index.asp; http://nrcan.gc.ca/ess/themes/env_e.php; http://adaptation.nrcan.gc.ca/home_e.asp .

Table 1: NRCan's Energy Efficiency and Alternative Energy Initiatives (2001-02)[7]

General Programs
Outreach
Community Energy Systems Program
National Energy Use Database
Program of Energy Research and Development

Housing
New houses
R-2000 Standard
Super E™ Program
Existing houses
EnerGuide for Houses
Residential equipment
Energy Efficiency Standards and Regulations
Labelling and Promotion

Buildings
New buildings
Commercial Building Incentive Program
Industrial Building Incentive Program
Green Buildings
Existing buildings
Energy Innovators Initiative
Equipment
Energy Efficiency Standards and Regulations
Buildings Program Simulation
Bringing Energy-Efficient Technologies To Market

Industry
Industrial Energy Efficiency (Canadian Industry for Energy Conservation and Industrial Energy Innovators)
Advanced Combustion Technologies
Processing and Environmental Catalysis Program
Industrial Process Engineering Program
Industrial Process Integration Program
Industry Energy Research and Development Program
Emerging Technologies Program
Energy Technologies for High-Temperature Processes
International Centre for Sustainable Development of Cement and Concrete
Equipment
Energy Efficiency Standards and Regulations
EnerGuide for Industry
Mine Ventilation
Water-Powered Hydraulic Drill

Transportation
Personal vehicles
Vehicle Efficiency Targets
Personal Vehicle Program
Commercial fleets
Fleet Vehicle Program
Transportation research and development
Canadian Lightweight Materials Research Initiative
Fuel Cell-Powered Mining Vehicles
Alternative transportation fuels
Vehicle Fuels
Transportation Energy Technologies Program

Renewable Energy Programs
Energy from the Forest
Green Power Initiative
Photovoltaic and Hybrid Systems Program
Renewable Energy Capacity-Building Program
Renewable Energy Deployment Initiative
Renewable Energy Information and Awareness Program
Renewable Energy Market Assessment Initiative
Renewable Energy Technologies Program

Federal House In Order
Federal Buildings Initiative
Federal Industrial Boiler Program
Federal Vehicles Initiative

[7] This comprehensive list comprises NRCan's EAE initiatives, regardless of funding source.

Transport Canada

Transport Canada was the co-chair of the multi-jurisdictional Transportation Climate Change Table created by federal, provincial, and territorial ministers of transportation in 1998 to identify and evaluate opportunities to reduce greenhouse gas emissions in the transportation sector. This sector is the primary source of greenhouse gases in Canada, with emissions forecast to reach 32 per cent above 1990 levels by 2010.

In November 1999, the Table submitted an options paper to the transport ministers and the National Climate Change Secretariat detailing the costs, benefits, and impacts of over 100 measures. The paper, *Transportation and Climate Change: Options for Action*, was the basis for eight stakeholder sessions that were then held across Canada to discuss sectoral and regional issues and the impacts of various measures. The results of these sessions were summarized in a companion report, which, along with the options paper and final research reports, served as input to the development of Canada's climate change strategy.

Since that time, Transport Canada has undertaken a number of sustainable transportation research initiatives to help meet commitments under its 2001-03 sustainable development strategy, fulfil the analytical needs identified by the Table, and contribute to a national perspective on sustainable transportation solutions. Some of these initiatives focus on freight transportation, while others address aspects of urban transportation—including the measurement and costs of congestion, the costs and impacts of improvements to urban transit, and the development of sustainable transportation indicators. Key goals of this research are to provide opportunities for cross-jurisdictional participation and partnerships, and to stimulate ongoing dialogue with provinces, municipalities, and other interested parties on key sustainable-development challenges.

Transport Canada is responsible for the implementation of two transportation sector programs under *Action Plan 2000*. As noted earlier in this report, the Urban Transportation Showcase Program provides a total of $35 million to help four or more cities demonstrate, evaluate and promote integrated approaches to reduce greenhouse gas emissions and increase urban transportation efficiency. The Program also incorporates an Information Network that aims to facilitate the replication of successful sustainable urban transportation strategies. As for the Freight Efficiency and Technology Initiative, it is a $14 million program, being led by Transport Canada in cooperation with Natural Resources Canada's FleetSmart program. The Initiative is designed to reduce the growth of greenhouse gas emissions in the freight transportation sector through technology demonstrations, voluntary agreements with associations, and training and awareness.

As part of the Government of Canada's Strategic Highway Infrastructure Program, Transport Canada has dedicated $29 million over five years to continue delivering on Intelligent Transportation Systems. These systems serve as valuable tools for enhancing security and safety, improving the efficiency and effectiveness of transport operations, and addressing current transportation challenges such as congestion and climate change.

Administered by Transport Canada in partnership with Natural Resources Canada, the Government's voluntary fuel consumption program has more than doubled the fuel efficiency of

the new-vehicle fleet since it was implemented in the 1970s. Through the program, motor-vehicle manufacturers voluntarily agree to meet annual Corporate Average Fuel Consumption targets for new vehicles sold in Canada. The targets, which match mandatory standards in the United States, were 8.6 L/100 km for passenger vehicles and 11.4 L/100 km for light trucks in 2002, while the average fuel consumption of new model-year vehicles sold was 7.9 L/100km and 11.1 L/100km, respectively.

The *Climate Change Plan for Canada*, released in November 2002, renews the Government's commitment to work with manufacturers to improve light-duty-vehicle fuel efficiency by 25 per cent by 2010. To assist consumers, the government will introduce a new vehicle ranking system—similar to the ENERGY STAR® system for consumer appliances—that may include information on each vehicle's life-cycle carbon emissions. Targeted campaigns to reduce fuel use through improved vehicle maintenance and driving practices are also being considered.

Further details can be found at: http://www.tc.gc.ca/programs/environment/climatechange/menu.htm.