

# MEETING THE CHALLENGE OF CLIMATE CHANGE

*1996 update*  
*on*  
*initiatives in Ontario to reduce greenhouse gas emissions*

*December 12, 1996*



MINISTRY OF ENVIRONMENT AND ENERGY

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December 12, 1996

Dear friends and colleagues:

It is my pleasure to present the 1996 update on initiatives in Ontario to reduce greenhouse gas emissions. Ontario remains committed to assisting Canada in meeting the national climate change objective of stabilizing greenhouse gas emissions at 1990 levels by the year 2000.

The initiatives listed in this report include actions by all levels of government and all sectors of the economy, including the agricultural, forestry, industrial, residential, transportation, commercial, institutional and energy supply sectors.

The provincial government is continuing its commitment and is supporting the expansion of municipal public transit systems, developing options for a vehicle inspection and maintenance program, reviewing air standards, co-ordinating development of a smog plan to reduce emissions of toxic pollutants and greenhouse gases and preparing guidelines for the control of methane emissions from landfills.

Recognizing that government has an important leadership role to play, the Ontario government has established a target to reduce emissions of greenhouse gases from government operations (buildings and vehicles) by 40 per cent by the year 2000.

The initiatives outlined in this report have contributed to the gains experienced in Ontario to date and will continue to provide benefits for many years to come. Forecasts of emissions in Ontario in the year 2000 have shown a reduction from nine per cent above the 1990 level in previous forecasts to about one per cent above the 1990 level in the most recent forecast.

We believe that climate change is too serious an issue to adopt a "wait and see" approach. The costs of inaction are too high. The Ontario government is therefore involving other governments and the private sector in pursuing sustainable measures and actions that meet multiple environmental or economic objectives. We encourage all Ontarians to participate in this important endeavour.

Sincerely,

A handwritten signature in black ink that reads "Norm. Sterling".

Norman W. Sterling  
Minister



# MEETING THE CHALLENGE OF CLIMATE CHANGE

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## **MEETING THE CHALLENGE OF CLIMATE CHANGE**

### **1996 update on initiatives in Ontario to reduce greenhouse gas emissions**

#### **HIGHLIGHTS**

- ▶ Work has continued on the initiatives described in last year's report on climate change measures in Ontario (Meeting the Challenge of Climate Change: A Status Report on Initiatives in Ontario To Reduce Greenhouse Gas Emissions). This report provides an update on those measures, and lists some new measures that have been identified that help reduce emissions of greenhouse gases.
- ▶ The Ontario government has continued to build on the province's past leadership in energy efficiency and pollution prevention to support climate change objectives. Projections of emissions in Ontario in the year 2000 have shown a reduction from nine per cent above the 1990 level to about one per cent above the 1990 level in the most recent forecast. The government has reaffirmed its commitment to environmental protection, and climate change continues to be a top priority.
- ▶ The Voluntary Challenge and Registry Program is an important component of the National Action Program, and continues to receive strong support from all sectors of the provincial economy. Over 240 Ontario companies and institutions from the government, industrial, commercial, residential, institutional, and energy sectors have registered their commitment to reduce greenhouse gas emissions voluntarily with the program.
- ▶ The Ontario Ministry of Environment and Energy has submitted an Action Plan to the Registry which includes a target to reduce greenhouse gas emissions from government buildings and government vehicles by 40 per cent by the year 2000 compared with 1990 levels.
- ▶ The government has adopted a prudent approach to managing greenhouse gas emissions by encouraging cost-effective measures that can be initiated today because they are justified for other environmental or economic reasons. Examples of this approach include the development of options for a vehicle inspection and maintenance program, the development of a smog plan to reduce emissions of toxic pollutants and greenhouse gases, and preparation of guidelines for the control of methane emissions from landfills.

## Highlights Continued

- ▶ Long-term solutions are required to address this long term problem. The province is looking for sustainable solutions that will result in improvements in emission levels for many years to come, avoiding costly "quick fixes". Some actions will be possible over the short-term. Others will require a gradual modification of behaviour and consumption patterns over time.
- ▶ Climate change is a shared responsibility. There are roles for both public and private sector actions to reduce emissions. Ontario looks forward to working in partnership with other jurisdictions as well as federal, provincial and territorial governments.
- ▶ Managing climate change will involve an evolutionary process, reassessing progress and introducing new approaches as required. Existing initiatives provide a solid basis upon which further actions may be expanded or developed.



## I. INTRODUCTION

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Canada has made a commitment to address the environmental threat posed by climate change. Meeting this difficult challenge will require a wide range of initiatives by all levels of government, the private sector and individual Canadians to help control and reduce emissions of greenhouse gases.

Ontario is committed to assisting Canada meet the national climate change objectives. This status report outlines activities in Ontario that will help manage greenhouse gas emissions. The policies and programs in place today, the actions planned, and the studies in progress together provide a framework upon which further actions will be introduced, as all sectors of the province continue to work toward the national target for climate change.

### **The Global Challenge**

Following the 1992 Earth Summit meetings in Rio de Janeiro, Canada and over 150 other countries signed the United Nations *Framework Convention on Climate Change*, which commits signatories from industrial countries to aim to return greenhouse gas emissions to 1990 levels by the year 2000.

In the past 200 years, atmospheric concentrations of carbon dioxide -- the principal greenhouse gas -- climbed by some 25 per cent, and the rate of increase is accelerating. If this trend is not reversed, atmospheric carbon dioxide is expected to double within the next century.

The Intergovernmental Panel on Climate Change (IPCC), an expert panel of some 2,500 scientists from around the world, is attempting to model changes in the global temperatures, precipitation and wind patterns that will result as greenhouse gases accumulate in the atmosphere. The IPCC models suggest that we may experience an increase of 0.8°C to 3.5°C in global temperatures by the year 2100.

If climate change occurs to the extent predicted by the scientific models, it will pose significant risks to the environment. This could result in the shrinking of the polar ice caps, severe storms, and serious disruptions in world climate patterns. Sea levels may rise, causing flooding problems for coastal communities. The ecosystems that support our forests and farmlands would be fundamentally and irreversibly altered.

Scientific models cannot, however, predict with certainty the magnitude, the timing, the regional impacts, the risks or the economic impacts associated with climate change. This remaining uncertainty supports a degree of flexibility in developing mitigative responses.

In Ontario the potential impacts of climate change over the long term could include a decline in Great Lakes water levels hampering commercial shipping, increasing dredging, reducing water supply and hydroelectric power generation, impairing water-based recreation activities and tourism; impaired water quality which could lessen fish health, survival and productivity; and a northward shift of boreal forest with impacts on forest-based industries and resource towns.

## **Canada's Response**

Federal, provincial and territorial energy and environment ministers have agreed to work together to help meet the national objective of stabilizing greenhouse gas emissions at 1990 levels by the year 2000. Options are also being considered to address emissions beyond the year 2000.

Without further actions taken, the most recent federal forecast predicts that Canada's greenhouse gas emissions will be approximately 8 per cent higher in the year 2000 than they were in 1990.

The National Action Program sets out a framework of opportunities that jurisdictions across Canada might pursue to reduce greenhouse gas emissions. Canada's National Action Program was tabled in Berlin in April 1995 at the first Conference of the Parties to the United Nations *Framework Convention on Climate Change*. The National Action Program is undergoing a formal review process with a report provided to the Conference of the Parties in Spring 1997.

The National Action Program is founded on a number of principles. The plan advocates a precautionary approach for taking action, recognizing remaining uncertainties in the scientific projections for climate change. It emphasizes shared responsibility by all sectors. Canada's plan is presented as a "living program", which is in the early stages of development and which will be further expanded over time as experience is gained, and scientific and economic understanding enhanced.

## Climate Change in Ontario

While the period of analysis is too short and the science of climate modelling is still too immature to indicate a causal relationship between changes in atmospheric concentrations of greenhouse gases and the observed effects on a region the size of Ontario, research by the Ministry of Environment and Energy has helped determine the following actual changes which have occurred in the past 20 years. The research indicates that:

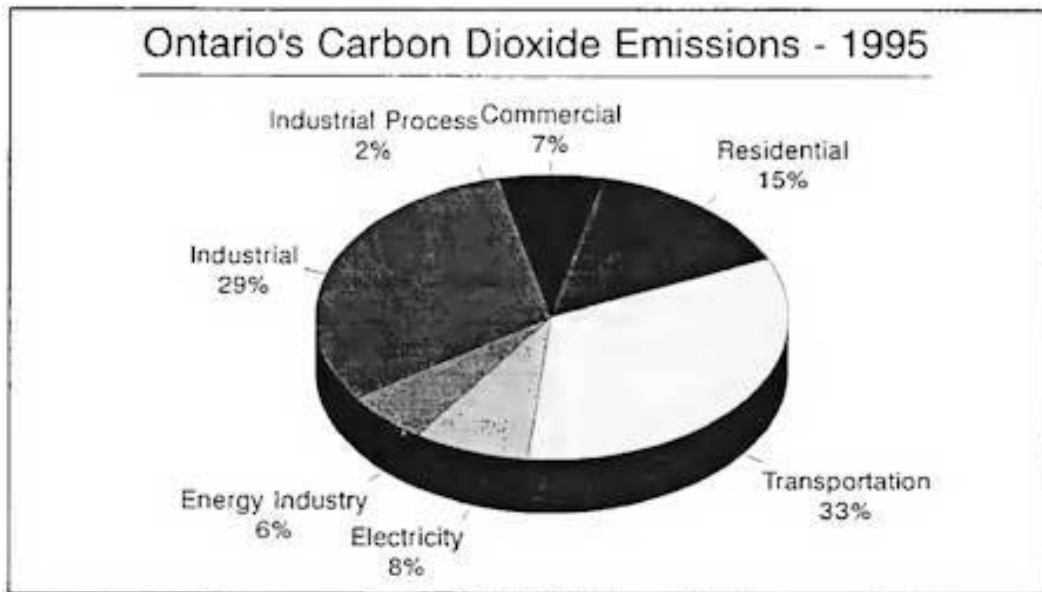
- ▶ Air and water temperature have increased by two degrees Celsius in northwestern Ontario, over the past two decades. The length of time that the lakes are ice-covered each year has decreased by three weeks.
- ▶ The depth of the upper warm mixing zone of lakes has increased, reducing the habitat for species such as lake trout that require cold water to survive.
- ▶ Higher than normal evaporation and lower than average precipitation have decreased the rate of water renewal in lakes, leading to higher concentrations of chemicals.
- ▶ Length and frequency of droughts in areas around Ontario has increased, leading to a number of effects linked to other environmental problems. Decreases in organic carbon levels allows harmful solar radiation to penetrate deeper in the water, damaging aquatic life. This problem is exacerbated by the thinning of the ozone layer. The droughts have also led to releases of sulphur which has accumulated in wetlands as a result of acid rain. This is inhibiting the recovery of ecosystems affected by acid rain.

## II. SOURCES OF GREENHOUSE GASES

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While Canada is responsible for only two per cent of net global greenhouse gas emissions, it is the eleventh largest net emitter of greenhouse gases.<sup>1</sup> On a per capita basis, Canada's greenhouse gas emissions are four times greater than the global average.<sup>2</sup>

Ontario, as the manufacturing centre of the country and the base for one-third of the country's population, produces about one-third of Canada's energy-related carbon dioxide emissions.<sup>3</sup> Ontario is one of the largest sources of greenhouse gases in the country. In per capita terms, Ontario ranked seventh among the provinces in terms of energy-related carbon dioxide emissions in 1990, 14.5% below the national average.<sup>4</sup>



Cold Ontario winters and hot summers translate into substantial requirements for heating and cooling, and reliance during peak periods on fossil-fuelled powerplants, furnaces and boilers, which emit greenhouse gases. Transportation needs are great in Ontario, where a commuter culture and the distances between regional centres translate into millions of cars, trucks, trains

<sup>1</sup> Natural Resources Canada, Voluntary Challenge and Registry Program—November 1995 Progress Report, p.4

<sup>2</sup> On a per-capita basis, the global emission of carbon averages about 1.15 tonnes per person per year. However, industrialized countries of northern latitudes are the most intense emitters of fossil-fuel CO<sub>2</sub>. The rate of emission in Canada is 4.7 tonnes/person-year, compared With 5.4 in the United States. Source: World Resources Institute, World Resources 1992-1993, (New York: Oxford University Press; 1992), p. 210.

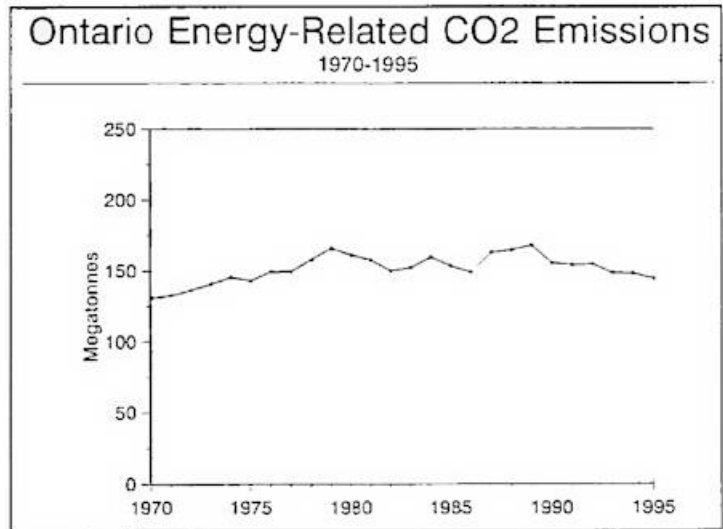
<sup>3</sup> Environment Canada, Canada's National Report on Climate Change - 1994, pp. 94, 95.

<sup>4</sup> Source: Population from Statistics Canada 91-213. CO<sub>2</sub> emissions from Environment Canada.

and airplanes, all generating greenhouse gases. And an economy made strong by resource extraction and processing requires smelters, paper mills, steel plants -- all of which use energy and emit greenhouse gases.

After peaking in 1989, Ontario's greenhouse gas emissions declined for several years as conservation efforts reduced energy use, economic conditions slowed development and the province made greater use of nuclear-generated electricity.

In 1990, Ontario consumed (approximately 3,686 petajoules (PJ) of primary energy, releasing 155 million tonnes of carbon dioxide. In 1995, when primary energy consumption rose to 3,785 PJ, up 2.7% from 1990 carbon dioxide emissions were 147 million tonnes, 5% below the 1990 level.



The last federal forecast for Ontario's emissions in the year 2000 suggested that, while Ontario's economic output and population will continue to grow, the actions outlined in this report will almost completely offset the increase in emissions that would have occurred as a result of that growth.

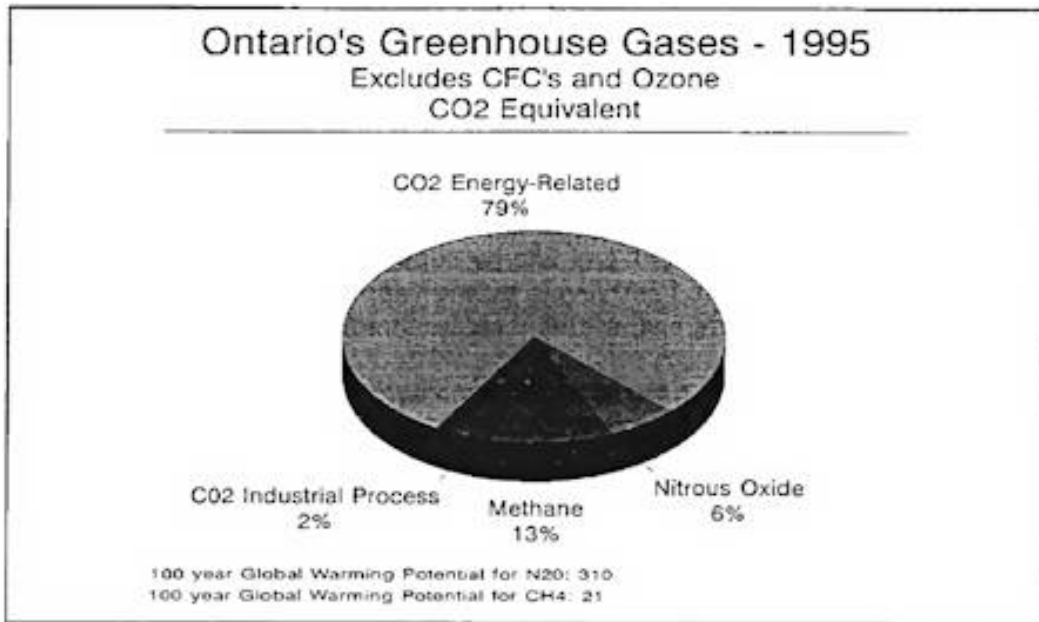
## The Greenhouse Gases

### Carbon Dioxide (CO<sub>2</sub>)

Carbon dioxide accounts for some 81 % of Ontario's greenhouse gases. This gas is produced primarily through the combustion of organic fuels, such as wood, coal, oil and natural gas, and is also released as an inherent part of some industrial processes.

### Methane (CH<sub>4</sub>)

Until recently, the global warming potential of methane had been underestimated by the international scientific community. While accounting for a smaller share of global greenhouse gases, methane has a global warming potential 21 times that of carbon dioxide over a 100 year period, making it a very serious greenhouse gas. Methane is produced by the digestion or decay of organic matter in the absence of oxygen. Landfills, marshes and swamps, and the stomachs of cows, generate methane gas. Methane also escapes during the processing and shipment of natural gas. In Ontario, anthropogenic methane accounts for an estimated 13% of the province's greenhouse gas emissions, on a carbon dioxide equivalent basis.



### Nitrous Oxide (N<sub>2</sub>O)

Nitrous oxide is produced by the burning of fuel and the extensive use of fertilizers. Nitrous oxide is a potent greenhouse gas, with a global warming potential 310 times that of carbon dioxide over a 100 year period. It accounts for six per cent of Ontario's greenhouse gas emissions on a carbon dioxide equivalent basis.

### Other Greenhouse Gases

Other greenhouse gases include chlorofluorocarbons (CFCs) and ozone. CFCs are synthetic compounds once commonly used as refrigerants, cleaning solvents, aerosol propellants and in the manufacture of plastic foam. Use of CFCs is being phased out under the Montreal Protocol, introduced to safeguard the planet's ozone layer.

Ground-level ozone, a prime component of smog, is formed when sunlight acts upon the volatile organic compounds (VOCs) and nitrogen oxides (NO<sub>x</sub>) emitted primarily by cars and industry. As well as being a serious pollutant, ozone is a greenhouse gas.

### **III. MANAGING GREENHOUSE GAS EMISSIONS IN ONTARIO**

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#### **Ontario's Commitment**

Ontario's Ministry of Environment and Energy supports the national objective of stabilizing greenhouse gas emissions at 1990 levels by the year 2000. Ontario will continue to work with other public and private sector stakeholders in addressing climate change.

While uncertainty remains as to the extent and momentum of projected global climate change, the risks of inaction are too high to adopt a "wait and see" approach. Reducing the emissions of greenhouse gases will reduce the risk of climate change and soften the environmental repercussions. The Ontario government supports a precautionary approach to managing greenhouse gas emissions through sustainable measures and actions that support other broad environmental objectives, such as energy efficiency and resource conservation.

Many of the directions set out in the National Action Program have already been initiated in Ontario. For example, Ontario has long been a leader in developing energy efficiency initiatives, many of which are outlined in this report, which will help reduce greenhouse gas emissions and counter the effects of climate change. Ontario encourages other jurisdictions in Canada to follow these directions. By building on these initiatives, the province will seek to assist Canada in meeting its international commitment.

Like other jurisdictions in Canada, the Ontario government is studying, developing and implementing actions which will help meet the national emission goals. The province will continue to study the options to identify further opportunities, as guided by the principles outlined below.

#### **Guiding Principles**

##### ***A Comprehensive Approach***

In the spirit of the National Action Program, Ontario is adopting a comprehensive approach to climate change. To meet the province's environmental responsibilities relating to climate change, the province will seek opportunities to address all types of greenhouse gases. Similarly, we will look for ways of managing emissions across all sectors where greenhouse gas emissions originate. All players in the economy have a role to play in shouldering some of the responsibility for addressing emissions. By positioning all to make sensible choices in the production and consumption of energy in years to come, the costs will be shared and maximum effectiveness guaranteed.

### ***Cost-Effective Responses***

The Ontario government believes that actions should focus on sustainable solutions. Priority will be given to cost-effective approaches that provide multiple environmental benefits relating to climate change, smog and air toxics. In addition to the environmental benefits, many measures conserve non-renewable resources or improve energy efficiency.

### ***Partnerships***

The Ontario government will show leadership where government intervention makes sense. But clearly participation in all sectors must continue if progress is to be ensured. There are roles for both the public and private sectors in reducing emissions.

The Ontario Ministry of Environment and Energy is a strong supporter of the national Voluntary Challenge Program -- an important component of the National Action Program on Climate Change. Organizations are encouraged to register voluntary action plans for emission reduction through this national registry. Many programs and activities are in place in the private sector, and new action plans are being developed as Ontario industries embrace the Voluntary Challenge. Environmental leadership is continuing within Ontario's municipal governments, where commitments have been made and plans are being developed to reduce greenhouse gas emissions.

### ***Sustainable Solutions for the Long-Term***

Long-term solutions are needed to address a long-term problem such as climate change. Some responses will be relatively easy to introduce over the short term. Others will involve the gradual modification of behaviour and consumption patterns over time by all members of society. Ontario places a priority on solutions that will result in emissions reductions that last for many years to come.

### ***Evolving Responses***

Just as Canada's National Action Program is a "living plan", developing over time, Ontario's climate change responses will follow an evolutionary process, as progress is assessed and new initiatives introduced as required.

The actions reported in Section IV signal the groundwork laid and some new actions planned across Ontario.



## **IV. INVENTORY OF ONTARIO ACTIONS WHICH REDUCE GREENHOUSE GAS EMISSIONS**

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### **Broad-Based Activities**

#### **Communicating Climate Change**

To better acquaint the general public with the issue of climate change, the Ontario government will be developing new materials that will broaden understanding of the issues involved and the challenges we face. The Ministry of Environment and Energy has prepared a series of brochures on environmental issues, including one on the impact of climate change on Ontario.

The Ministry will make greater use of its Internet Web site to distribute information about the Ontario government's approach to the climate change issue and to provide links to other important sites in Ontario and outside the province.

#### **Voluntary Challenge Program and Registry**

The Ontario government has been assisting in the development of the national Voluntary Challenge Program and Registry with the federal government and other provinces.

The Voluntary Challenge Program will provide a vehicle through which Ontario's organizations may signal their voluntary commitment to reducing greenhouse gas emissions from their operations or indirectly. The program will ensure flexibility to organizations, who can tailor action plans as most appropriate for their respective lines of business and circumstances. These commitments and the planned industry actions will be recorded in the national Registry.

To date, over 240 Ontario-based companies have indicated their commitment to voluntarily undertake actions to reduce greenhouse gas emissions. The participating companies collectively generate a significant portion of the greenhouse gas emissions in Ontario. Of these companies, 144 have prepared comprehensive Action Plans outlining their activities and targets.

The Ontario government works with all sectors and encourages them to come forward to demonstrate that significant progress will be made voluntarily in support of Canada's climate change objectives.

## Broad-Based Activities

### **Pilot Emissions Reduction Trading Program**

Emissions Reduction Trading is an innovative tool which supplements traditional "command and control" regulation to reduce total emissions of a given pollutant. The purpose of the pilot program is to demonstrate how to reduce emissions of NO<sub>x</sub> and VOCs in and into Ontario. Industry believes that emissions reduction trading allows flexibility in meeting air quality objectives at a lower cost. The concept is also applicable to other emissions, eg. greenhouse gases.

Trades are based on real reductions in NO<sub>x</sub> and VOC emissions. Trading involves creating a market whereby emission credits which are above and beyond legal emission limits, can be traded to those facilities who would otherwise face higher costs to reduce their emissions. Overall emissions are reduced below regulated levels since a portion of the credit is retired upon creation.

In August 1996, a Pilot Emissions Reduction Trading program (PERT) was officially launched by a consortium of companies with an announcement about four demonstration projects. The projects are:

- (1) Ontario Hydro purchased 400 short tons of NO<sub>x</sub> credits, created in Michigan, from Detroit Edison;
- (2) ProtectAir, the company that operates the pilot Vehicle Inspection Centre in Mississauga, proposes to purchase 140 high emission vehicles in the Greater Toronto Area, with the NO<sub>x</sub> and VOC credits created by the retirement of vehicles to be purchased by Ontario Hydro;
- (3) the creation of credits by a group called Environmental Interface through incremental energy efficiency gains in hospitals and universities with sale of those credits to Ontario Hydro; and,
- (4) Ontario Hydro created NO<sub>x</sub> credits through early installation of low-NO<sub>x</sub> burners at the Nanticoke and Lambton generating stations.

No environmental protection regulation has been by-passed in any of these actions.

While the emissions reduction achieved by the trades in this demonstration phase is small, the Ontario government supports the concept of emissions trading in general and is committed to exploring the feasibility and benefits of such a system.

## Broad-Based Activities

### **International Cooperation**

Technology is expected to play a major role in reducing greenhouse gas emissions. The United Nations *Framework Convention on Climate Change*, which Canada signed, focused on the need to transfer technologies that control, reduce or prevent emissions of greenhouse gases to developing countries to ensure that rapidly growing economies adopt the most efficient processes currently available.

A section of the FCCC stipulates that developed countries should "promote, facilitate, and finance improved access to these technologies" by developing countries. The Ontario Centre for Environmental Technology Advancement (OCETA), with funding from the Green Industries Office of the Ontario Ministry of Environment and Energy, is participating in the development of an electronic database with the International Environmental Business and Technology Institute in the U.S. and the Environmental Quality Centre at the Monterrey Technology Institute in Mexico to promote the sale of North American "green technology".

OCETA and the Green Industries Office collaborate with many environmental companies in Ontario to arrange trade missions, gather information about opportunities in foreign countries, and promote Ontario technologies and expertise to visiting delegations. These contacts have resulted in a range of relationships including strategic alliances, joint ventures, licensing agreements, R&D collaboration, technology transfer and cross-trade agreements, all of which accelerate emission reductions globally.

### **Research**

The government of Ontario carries out research and conducts studies related to climate change through both internal and commissioned work. This work, as shown in the following examples, helps us in understanding the implications of climate change for Ontario and the different ways in which we may address climate change.

#### **Canadian Institute for Environmental Law and Policy**

The Ministry of Environment and Energy co-sponsored a multiple stage process by the Canadian Institute for Environmental Law and Policy (CIELAP) that focused on a strategy for CO<sub>2</sub> reduction in Ontario and culminated in the production of the report [A CO<sub>2</sub> Reduction Strategy for Ontario: A Discussion Paper](#).

The report was prepared with the assistance of a multi-stakeholder Advisory Committee and the Energy Research Group at Simon Fraser University. The report outlines the costs and benefits of one possible strategy to stabilize Ontario's CO<sub>2</sub> emissions at the 1990 level by the year 2000 and to reduce them by 20%, relative to the 1988 level, by 2005. The purpose of the report is to help foster an informed public debate about appropriate CO<sub>2</sub> targets for Ontario and the best means to achieve Ontario's targets.

## Broad-Based Activities

### **Aquatic Ecosystems Research**

Staff of the Aquatic Sciences Section of the Ministry of Environment and Energy have been carrying out research on climate change effects on aquatic ecosystems. The work done by the Ministry includes long-term meteorologic measurements at a network of sites, and detailed hydrologic, physical, chemical and biological measurements made over twenty years on eight lakes, thirty streams and all of the associated watersheds.

The Aquatic Sciences Section (which is based at the Dorset Environmental Science Centre in the District of Muskoka) carries out a number of activities associated with evaluating the effects and potential effects of climate change on the Ontario environment.

The principal objectives of these studies are to evaluate the current measurable effects of changing climate on the Ontario environment, particularly on aquatic ecosystems; to develop models for prediction of future environmental effects based on realistic climate change scenarios; and to assess how climate change is altering ecosystem's responses to other environmental stresses such as changing acid rain levels.

### **Agricultural Emissions Research**

The Ontario Ministry of Agriculture, Food and Rural Affairs funds a portion of the research conducted by the University of Guelph's Environment and Natural Resources program area. This research focuses on air quality and trace gases management. The program seeks to develop sound management practices to minimize emissions that arise from agricultural sources. It also assesses the impact of nitrogen fertilization and water management strategies on the trace gas emissions from animal manure systems.

### **Forest Adaptability Research**

The Ontario Forest Research Institute has undertaken research and development to provide us with a better understanding of the adaptability of our forests so that forecasting of potential global warming impacts to Ontario's forests can lead to effective preventative measures. The research will a) improve our understanding of forest ecosystem composition, structure and function at multiple scales, from site specific to landscape, b) assess the health and productivity of all forest system classifications, particularly as it relates to disturbance and resilience, c) evaluate current and predict future forest ecosystem status concerning both genetic and ecological diversity, and d) provide modelling support systems that help ensure science principles are grounded in sound policy decisions and operational practice.

## Sector-Specific Activities

### Measures to Address Climate Change in Ontario Government Operations

Greenhouse gas emissions from Ontario government operations result from a range of tasks and activities. The principal sources are from energy use in government buildings, which account for approximately 90% of emissions, and vehicles, which account for almost 10% of emissions. In total, Ontario government operations accounted for 1073 kilotonnes of greenhouse gas emissions in 1990 - about 0.7% of Ontario's total emissions.

The Ontario government owns or leases a total of about 10,000 buildings and facilities across Ontario. Approximately 75,000 Ontario government employees work in over 750 major workplaces across Ontario. The government operates a fleet that consists of over 13,000 vehicles, including about 10,000 passenger cars and light trucks, 2,000 heavy duty vehicles, and 1,000 specialized vehicles.

In May, 1996, the Ministry of Environment and Energy submitted an Action Plan to the Voluntary Challenge and Registry Program which outlines the measures underway to retrofit buildings and improve fleet efficiency, thus reducing emissions of greenhouse gases.

Substantial reductions in emissions have already been achieved. Measures such as energy conservation and waste reduction have been actively pursued in government buildings. The Ontario government will continue to build on this base of initiatives. Greenhouse gas emissions from government operations are targeted to be reduced by 40 per cent from 1990 levels by the year 2000.

#### **Renewable Energy**

Demonstrating the multiple benefits of renewable energy technology in a real-world application, the Ministries of Health, Transportation and Environment and Energy collaborated on a project to radically improve the service provided by a provincially-owned radio transmitter in Northern Ontario.

Situated 200 kilometres NW of Thunder Bay, the air-ambulance radio transmitter at Gray Trout Lake, owned by the MOH, and diesel-powered repeater station owned by MTO, used to cost \$25,000 a year to operate and maintain. The service was also out of commission nearly 700 hours a year.

After looking at possible solutions to the problem, it was determined that a hybrid renewable energy system, consisting in this case of a 2.8 kWh photovoltaic system and 440-watt propane-powered thermoelectric generator (TEG), would both improve reliability and reduce operating costs.

The system became operational in mid-1996. The most important outcome is a reduction in downtime to less than 1 minute per year. Lower annual operating costs (in the 512,000 range) are a bonus, providing a simple payback of about six years.

## Sector-Specific Activities

### **Municipal Government Activities**

The two largest municipal governments in Ontario --Toronto and Ottawa-- and the largest regional government --Metro Toronto-- have made commitments to reduce emissions by 20% from 1988 baseline levels by the year 2005. The leadership shown by these local governments will make important contributions to addressing greenhouse gas emissions in Ontario.

These urban centres are significant sources of greenhouse gases. Together, these centres account for about one-third of Ontario's population of 11 million people, and a corresponding share of greenhouse gas emissions. Actions taken by these governments can have considerable impacts on emission levels.

### **Climate Change Plans**

#### City of Toronto

The City of Toronto has declared an official commitment to reduce carbon dioxide emissions within the City of Toronto by 20% of the 1988 levels by the year 2005. An Energy Efficiency Office was established, and works towards the following major objectives:

1. to promote and pursue energy efficiency and conservation practices in all City-owned buildings;
2. to promote and pursue energy efficiency and conservation practices in new construction by the City or by others; and
3. to promote the use of energy efficient methods and practices in existing buildings, by facilitating the implementation of energy efficient retrofits by the public and private sectors.

Some of the programs and initiatives that have been undertaken to date to assist the City of Toronto in meeting its official carbon dioxide emissions reduction target include:

- ▶ The City-Owned Building Retrofit Program;
- ▶ The Better Buildings Partnership;
- ▶ A Street and Lane Lighting Conversion Program;
- ▶ Energy Efficiency and Conservation Standards for New and Existing Buildings;
- ▶ Expansion of the Toronto District Heating and Cooling System (TDHC);
- ▶ Development of a City-wide database to track emissions reductions;
- ▶ Land Use and Transportation Initiatives;
- ▶ Approval of an anti-idling by-law;
- ▶ Studies and planning exercises; and
- ▶ development and dissemination of information on energy efficiency.

## Sector-Specific Activities

Another major initiative currently underway is the **Energy and Water Efficiency Pilot Programme**. This \$30 million Pilot Program will involve retrofitting small, medium and large buildings in both the public and private sectors, focussing on multi-unit residential, commercial, institutional and industrial buildings.

### City of Ottawa

In the past year, the City of Ottawa has worked with the community to implement the Task Force on the Atmosphere's Action Plan. A cornerstone initiative of the Action Plan is a *Corporate Challenge*, which is helping participating organizations to reduce greenhouse gas emissions from their own facilities and operations. Nine local organizations in both the public and the private sector have taken up the Challenge, including the Corporation of the City of Ottawa.

Other Action Plan initiatives include the *Information and Referral Service*, *Employer based Transportation Demand Management* and the *Transportation Awareness Campaign*. The City of Ottawa's new greenhouse gas monitoring tool, developed in conjunction with Environment Canada, will be used to monitor how well the Action Plan is achieving the 20% CO<sub>2</sub> reduction target. The monitoring tool will be standardized to allow its use by any Canadian municipality wishing to track and reduce greenhouse gas emissions.

The Task Force on the Atmosphere's Action Plan has demonstrated that through shared use of resources, understanding of the barriers standing in the way of increased energy efficiency, and extensive community involvement, a comprehensive greenhouse gas reduction plan can thrive at the municipal level.

### Metro Toronto

In May 1991, Metro Toronto adopted a Strategic Plan that guides Metro initiatives to achieve environmentally sustainable development, social equity and economic vitality. Arising out of the Strategic Plan, Metro Toronto adopted the Metro Urban Carbon Dioxide Reduction Strategy in 1993, with the target to reduce carbon dioxide emissions associated with energy use within the Metropolitan Toronto area by 20% below 1988 levels by the year 2005. This target is confirmed in resolutions of Council and in the new Metro Official Plan. Some of the actions taken in Metro which help reduce greenhouse gas emissions are outlined below.

- ▶ Methane recovery at landfills and sewage treatment plants;
- ▶ Measures to support land use intensification;
- ▶ Evaluation of 50 Metro vehicles in the Ontario government's pilot vehicle emissions inspection and maintenance program;
- ▶ Energy Efficiency Retrofits;
- ▶ Support for less carbon-intensive transportation modes;
- ▶ Optimization of the water distribution system to improve energy efficiency;
- ▶ Distribution of water efficiency retrofit kits under the Metro water efficiency program;

### Sector-Specific Activities

- ▶ Operation of an extensive recycling system that helps conserve the energy in manufactured products.
- ▶ Investigation of district energy and cogeneration system opportunities and participation in future energy demand and supply planning.
- ▶ sponsorship of a "Clean Air Summit" focussing on the health effects of air pollution from human activities.

### **Ontario Municipal Improvement Facility**

Launched in 1994, seven Ontario municipalities have initiated strategic planning to pinpoint potential areas for retrofit of their municipal buildings. Participants include: the Region of Sudbury, the City of Ottawa, the City of Hamilton, the Region of Hamilton Wentworth, the Town of Port Hope, the City of Burlington and the Town of Port Elgin.

The International Council for Local Environmental Initiatives (ICLEI) is agent for the project. ICLEI, a United Nations affiliate with strong environmental roots, provides brokerage and consultation services for the municipalities planning to retrofit their buildings to conserve energy and water. The provincial government has provided \$700,000 seed money while Ontario Hydro has provided \$50,000 and Consumers Gas has provided in-kind support.

Some tangible results include: the City of Sudbury which has examined energy and water efficiency and conservation opportunities in 120 of its municipal buildings. With implementation of recommended retrofits the City is expected to save in the order of \$1,000,000 annually.

The City of Ottawa is undertaking improvements that will see 28,000 tonnes of CO<sub>2</sub>, saved annually.

The Town of Port Elgin is looking at its 17 facilities with a view to making them more energy efficient, thereby saving greenhouse gas emissions and saving on energy bills.



## Sector-Specific Activities

### **Commercial and Residential Energy Efficiency**

There are a broad range of initiatives being undertaken individually by consumers, home builders, manufacturers, landlords, tenants and home owners in Ontario to reduce energy use associated with buildings and appliances in Ontario. Individuals and corporations have recognized the economic and environmental value of reducing energy use. To support these individual initiatives, the Ontario government has established standards on energy efficiency and programs to assist "green" initiatives.

#### **Energy Efficiency Act (EEA) Standards**

Under the Ontario **Energy Efficiency Act**, minimum performance standards are set for electrical and gas-fired equipment which are sold or leased in the province. This ensures that consumers are protected since minimum acceptable energy inefficiencies are defined, reduces energy costs, and reduces environmental impacts through decreased pollution and carbon dioxide emissions. By the year 2000, existing and recently developed energy efficiency standards are estimated to result in energy savings of 4,300 TJ (equivalent value \$76 million) and a reduction of 260,000 tonnes of carbon dioxide emissions.

Electrical equipment standards developed this past fiscal year include electric ranges, refrigerated display cabinets, fluorescent lamps, incandescent reflector lamps and heat pump water heaters. Gas-fired equipment standards developed during the same time period include those for clothes dryers, domestic water heaters, swimming pool heaters, wall furnaces and room heaters.

#### **Green Communities**

The success of Green Communities is a result of local grass-roots support and a focus on provision of self-funding "environment enhancing" services. Green Communities initiatives provide opportunities for individuals and business to reduce energy and water costs, with the additional advantage of creating local jobs and benefitting the environment.

The **Green Communities Initiative** evolved from a Ministry of Energy program initiated in 1991 in three Ontario towns. In 1995, when seed funding by the Ministry of Environment and Energy ended, the program had 19 participating "Green Community" organizations from across Ontario. One year later all but three of those Green Communities organizations are still in operation, having achieved self-sufficiency through cost-recouping programs and broad community support. In addition, two new communities are planning "green" programs.

The Green Communities Initiative was designed to promote the greening of Ontario by encouraging communities to increase energy and water efficiency, reduce waste and prevent pollution. A distinctive feature of the Initiative was reliance on communities setting their own goals and developing their own methods for achieving them, which leads to self-sustaining

## Sector-Specific Activities

activities. Each community developed its own unique set of partners, such as: the local municipality, electric utility, gas utility, newspapers and radio stations, local institutions such as local community colleges and universities, public service groups, branches of financial institutions, retailers and major corporations.

In April 1995, the Green Communities established the Green Communities Network to enhance communication between communities and provide research capability, allowing communities to share their successes with one another.

Support provided by the Green Communities Network has been instrumental in improving the cost-effectiveness and revenue generation opportunities of the green communities programs by working together and pooling resources. Communities realizing the need for a more tightly structured provincial organization to serve the needs of member communities recently formed the Green Communities Association. The objectives of the Association are to build sustainable communities through resource conservation, pollution prevention and the adoption of ecologically sustainable practices by establishing and operating an environmental action network for the benefit of its membership and to carry out research and disseminate the results of such research to its membership.

### **Plumbing Code Amendments**

Water conservation programs can lower consumption by 40 per cent, cut the amount of energy needed to heat water, and extend the use of the existing water and sewage treatment infrastructure without expanding the capacity. Amendments made to the Plumbing Code, now part of the Ontario Building Code, will help reduce the demand for hot and cold water in commercial and residential buildings by setting maximum flow rates for showerheads, toilets and faucets. The changes also mandate the use of water efficient fixtures, such as 6 litre toilets, which will be required as of 1996.

### **The Tenant Protection Act**

The Ministry of Municipal Affairs and Housing has undertaken public consultations on proposed changes to Ontario's Rent Control Act, with a Bill entitled 'The Tenant Protection Act'. Some of the proposed changes provide increased incentives for landlords of rent controlled buildings to make energy efficiency improvements to their facilities. The changes could lead to lower energy consumption in rental buildings and reduce related greenhouse gas emissions.

### **Healthy Houses**

Growing awareness about people's sensitivity to off-gases from materials used in conventional construction, concern about the environmental impact of the production of those materials and a desire for improved energy efficiency in homes has led to the development of a new

## Sector-Specific Activities

standard called "EnviroHome" that goes beyond even the R2000 home standard. An R2000 home typically requires builders to incorporate any two indoor air-quality features from a list of eight. An EnviroHome must use all eight, including such things as low toxic paint, air filtering and cabinetry that emits no gases. And while both kinds of home must use water-saver toilets, the EnviroHome standard is much tougher: six litres of water per flush, compared with 13.25 litres in an R2000 home. EnviroHomes also use more recycled materials, from insulation to roofing.

About 8,000 R2000 homes have been sold in the past decade across Canada; of them, about 50 have been built more recently to the tougher EnviroHome standard, according to the Canadian Home Builders Association. The EnviroHomes are located in seven projects scattered across the country, in Edmonton, Saint John, Halifax, St. Catharines, London and Thunder Bay. Four more projects are coming in Moncton, Montreal, Ottawa, and Vancouver.

## Sector-Specific Activities

### **Institutional Sector**

The institutional sector is an important partner in the effort to reduce emissions of greenhouse gases not only through energy efficiency improvements to facilities, but also because of the great potential to educate the users of those facilities about the steps individuals can take to reduce the environmental impact of their lifestyle (see **Sidebar: Kortright Centre**). In times of shrinking operating budgets, schools, hospitals, universities, and community-based institutions have the same urgency to reduce energy bills as owners of buildings in other sectors. However, in the institutional sector, energy efficiency projects are much more visible to a larger number of children and adults, compared with other sectors. Many teachers are acutely aware of the educational benefit of demonstration projects and actively seek them out to give their students a sense of environmental stewardship that hopefully will stay with them for the rest of their lives.

#### **Schools**

In 1993, the Metro Toronto School Board began a major multi-year project to upgrade the energy systems in 525 public schools across the region.

In August, 1996 a consultant was chosen to implement the fourth phase of the upgrading plan, which includes an extensive \$95 million capital project, and implementation of energy and water reduction measures in approximately 320 public school buildings.

Upgrades or modifications will be made to lighting, heating, ventilation, water reduction and mechanical systems. As well, automated building control systems will be installed and there will be a comprehensive staff training initiative.

Energy savings of approximately \$10 million per year will be used to pay for the improvements over a period of 15 years. This is in addition to the approximately \$10 million in energy savings that has been already been achieved from the implementation of similar measures in 205 buildings to date.

#### **Kortright Centre**

The Kortright Centre is located in the Humber River valley in the City of Vaughan, north of Metro Toronto. The Centre is operated by the Metro Toronto and Region Conservation Authority (MTRCA). Kortright is MTRCA's premier nature and conservation centre, promoting environmental awareness to the public, the media and student visitors, and demonstrating sound resource management and conservation practices.

The Kortright Centre offers most of its programs within three theme areas: the Environment Theme, the Water Theme, and the Fish and Wildlife Theme.

The goals of the Environment Theme are:

- (1) to provide unique and appealing educational programming on both the environmental and monetary benefits of energy-efficiency and of renewable energy technologies and lifestyles, and
- (2) to create community awareness capable of making informed decisions concerning energy and environment, through an effective change in lifestyle.

Kortright provides over 60 year round environmental education programs for school students, as well as brownies, guides, cubs, scouts and summer camp groups. An additional 60 programs are offered to the public throughout the year.

## Sector-Specific Activities

### **Hospitals**

**The Penetanguishene Mental Health Centre** is an example of an health-sector institution that has taken steps to reduce its operating costs by implementing energy efficiency measures. They have recently completed conversion from a central gas-fired steam heating system to a new, decentralized, high-efficiency gas boiler system. The facilities are also gradually being updated to more energy-efficient lighting. An automated building control system is planned, after Johnson Controls completes an energy audit of the facilities to obtain a baseline and future energy and water use/savings data.

The new, state-of-the-art, \$90 million **Whitby Mental Health Centre** is the first public psychiatric hospital to be built in North America in 25 years. This award-winning, 325-bed facility replaces the 80 year-old Whitby Psychiatric Hospital.

Designing the project presented many challenges in terms of patient well-being as well as physical plant and cost criteria. All materials used were the least toxic possible to minimize exposure to chemicals. The facility required higher ventilation rates for medical and functional reasons, but met ASHRAE ventilation standards. Heating, cooling, ventilation, lighting and security are managed by an automated system. High efficiency ASHRAE standards were fulfilled through features such as energy-efficient lighting, a "Harvester" ice storage system and careful attention to water pipe insulation. Electronic ballasts and T8 lamps were used throughout and "light valves" naturally illuminate lower levels.

These two Centres are good examples of the potential to integrate a range of sometimes competing design and operational considerations while achieving high environmental standards.

### **Partnerships for Sustainable Development**

The term sustainable development does not have an "official" definition, but one which is commonly used is the idea that society should meet the requirements of today without compromising the ability of future generations to meet their own needs. The concept is now a world-wide focus for efforts to integrate economic, social and environmental values, and thus includes issues such as climate change.

**York University's Centre for Applied Sustainability** fosters actions that will have an impact on greenhouse gas emissions in the long term by working with different sectors of society in the transition to sustainable development. Staff at the centre work with domestic and international organizations and community groups to help them develop their own policy and programs for sustainability.

Some key areas of work are:

- ▶ Continuing the work of the **Ontario Round Table on Environment and Economy**, including the Transportation and Climate Change Collaborative;

## Sector-Specific Activities

- ▶ Working with the **Sustainable Communities Ad Hoc Working Group** to help communities achieve an economic base that provides for social and environmental sustainability, including the use of full-cost accounting;
- ▶ Collaborating with the Ontario Learning for Sustainability Partnership on sustainability curriculum and other resources development.

**The Ontario Learning for Sustainability Partnership** is an innovative, non-profit educational partnership established to make sustainability a major component of school-based learning. Members include Ontario youth, educators, teachers' federations, universities, businesses, labour, government ministries, non-governmental organizations, First Nations' organizations, and community groups. The Partnership is formally endorsed by the Ontario Ministry of Education and Training and the Ontario Teachers' Federation and its affiliates.

Among its various activities, the Partnership promotes the development of appropriate and responsive sustainability curriculum, standards and professional development programs; provides access to quality information and resources for teachers and students; and is developing and promoting a provincial strategy for sustainability education initiatives. The curriculum resource development includes work on climate change, energy use and energy conservation/efficiency units.

## **Public Information and Education Activities**

**The Environment and Energy Conference of Ontario (EECO)**, co-sponsored by the Ministry of Environment and Energy, is the premier annual event in Ontario focussing on developments related to environmental and energy issues. This year's conference included sessions on climate change. The mission of the conference is to promote opportunities for industries and other stakeholders to network and build business-to-business arrangements and to learn of new direction and technologies relating to resource conservation and pollution prevention.

**Green Brick Road** is a central reference library and clearing house for environment and energy education information to Ontario teachers and students, and the general public. In cooperation with the **Evergreen Foundation, Green Teacher Magazine, and York University's Centre for Applied Sustainability**, Green Brick Road operates a 1-800 "EcoNet" phone line to answer public inquiries.

## Sector-Specific Activities

### **Industrial Sector**

Ontario is home to thousands of industrial companies that together account for approximately 40 per cent of Canada's industrial output. Ontario's industries have been making important contributions to the nation's environmental objectives. The **Canadian Industry Program for Energy Conservation (CIPEC)** notes that while overall greenhouse gas emissions rose in Canada between 1990 and 1994, emissions in the industrial sector fell by 1.5%, due to improvements in energy efficiency. Further commitments are being made through the Voluntary Challenge Program noted earlier.

### **Activities in Support of Ontario Industry**

The Ministry of Environment and Energy works with Ontario industry to encourage voluntary action to go beyond regulations by reducing greenhouse gas emissions and improving energy efficiency.

The Ministry provides a variety of services to support the reduction of greenhouse gas emissions, including:

- ▶ **Utility Bill Analyses:** Analyses of industrial utility bills help facilities reduce power factor penalties, and consumption of gas, electricity, oil and propane;
- ▶ **Walk-Through Audits:** Preliminary on-site evaluations of plant processes and equipment to identify potential savings in energy, water and resource use in the facilities;
- ▶ **Resource Conservation Sector Guides** that focus on generic manufacturing processes and define step-by-step process improvements to save resources such as electrical energy, natural gas and water. Benchmarking performance indicators are included, as well as relevant technologies which can improve manufacturing processes. The Ministry works with industrial sectors to encourage implementation of the measures resulting in significant reductions in greenhouse gases;
- ▶ Preparation of **Conservation Case Studies** of industrial energy, water and resource conservation projects to share cost information and resource benefits among a broader client base to encourage further industrial process improvements;
- ▶ Working with industry on **Environmental Technology Development and Application** projects to introduce to Ontario new leading-edge technologies that prevent pollution, clean the environment and achieve substantial reductions in emissions, waste and energy use. The new products and technologies also provide excellent export opportunities and are helping to create new, permanent, highly skilled jobs in Ontario. More than 40 new technology development projects were completed during the past fiscal year.
- ▶ **Partnering in Energy Efficiency:** the Ministry works with organizations such as the Canadian Industry Program for Energy Conservation (CIPEC) to identify opportunities for industry to reduce energy use.

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### **Ontario's Green Industry Strategy**

Ontario's green industry sector plays a key role in maintaining and improving environmental quality. It has become a world leader in finding solutions to environmental challenges with innovative technologies and processes.

Ontario's green industry strategy, through the Green Industry Office of the Ministry of Environment and Energy, is helping companies in this sector work together to build domestic markets and increase exports.

The Green Industry Office assists these firms in three main areas: technology development, business development and trade promotion.

Working closely with the **Canadian Environmental Industry Association (CEIA)** and the **Ontario Centre for Environmental Technology Advancement (OCETA)**, two of its key private sector partners, the Green Industry Office concentrates on activities which help firms gain competitive advantage domestically and abroad. Current objectives of the Green Industry Office include promoting strategic green procurement, expanding supplier development, monitoring local venture capital pools, facilitating links for Ontario firms with international funds for projects outside Canada, co-sponsoring workshops on accessing key markets and organizing trade missions of Ontario firms to international target markets.



## Sector-Specific Activities

### **Energy Production and Supply**

Ontario's energy sector, including electric and natural gas utilities and pipeline companies accounted for 6 per cent of the province's total greenhouse gas emissions. The downstream use of the energy sector's products by all sectors of the economy accounts for the largest portion (79 per cent) of Ontario's total greenhouse gas emissions. The energy sector in Ontario has both a direct and indirect role in addressing climate change.

Ontario's energy sector has responded to the Climate Change Challenge. The natural gas utilities, Ontario Hydro and the major oil companies have been active participants in the development of the National Action Program and have registered Action Plans with the Voluntary Challenge and Registry Program. Independent power producers have been leading the way with new renewable energy sources and high efficiency cogeneration. The municipal electric utilities have been working with Ontario Hydro on increased energy efficiency and demand-side management.

Examples of initiatives underway in the energy sector are outlined below:

#### **Ontario Hydro's Sustainable Energy Development Strategy**

Ontario Hydro continues to implement its **Sustainable Energy Development (SED) Strategy** and is encouraged by its success in meeting or exceeding its short-term financial and environmental performance targets.

An important component of Hydro's SED Strategy is the **Strategy to Manage Greenhouse Gas Emissions**. The Strategy sets two targets:

- ▶ Reduce the amount of greenhouse gases emitted per unit of energy which Ontario Hydro supplies to its customers (the carbon intensity) by 5 per cent by the year 2000 compared to the 1990 rate.<sup>5</sup>
- ▶ Stabilize Corporate greenhouse gas emissions at the 1990 baseline level of 26,000 kilotonnes CO<sub>2</sub>/year by the year 2000, and further reduce emissions by 10 per cent by 2005.<sup>6</sup>

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<sup>5</sup> The target is for carbon intensity to be reduced from 280 kilotonnes CO<sub>2</sub> per Terawatt-hour in 1990 to 260 kT CO<sub>2</sub>/TWh in 2000. The greenhouse gas emissions target has been established as a measure in Ontario Hydro's Executive Performance Achievement Plan. In 1995, the actual annual rate of emissions was 130 kT CO<sub>2</sub>/TWh. The 1996 business plan estimate is 140 kT CO<sub>2</sub>/TWh.

<sup>6</sup> Actual corporate emissions were 15.5 MT CO<sub>2</sub> in 1995; they are forecast to be 21.0 MT CO<sub>2</sub> in 1996.

## Sector-Specific Activities

The Strategy is based on programs in five areas:

- ▶ End-Use Energy Efficiency.
- ▶ Supply-Side Energy Efficiency.
- ▶ Renewable Energy.
- ▶ Greenhouse Gas Offsets and Other Market Mechanisms.
- ▶ Ontario Hydro International

The 1996 Action Plan to Manage Greenhouse Gas Emissions shows that Ontario Hydro is on track to achieve its targets. By the year 2000 it is expected that programs in these five areas will result in savings of about 8,000 kT CO<sub>2</sub> equivalent per year.

A highlight of Ontario Hydro's activities in 1995 was its **In-House Energy Efficiency Program** under the Supply-Side Energy Efficiency element of the Action Plan, which to-date has achieved energy savings and greenhouse gas emissions reductions well beyond its annual targets. This trend continued in 1996 (see Sidebar).

Under renewable energy, there were a number of key developments to report:

- ▶ Final bids were submitted to Hydro under Round 1 of the **Renewable Energy Technologies (RETs)** Request for Proposals (RFP) for up to 60 Megawatts (MW) of grid-connected renewable energy. The projects are awaiting final approval from Hydro's Board of Directors. In 1997, a second RFP is expected to be issued for an additional 65 MW of RETs supply, and will likely be open to the private sector, Ontario Hydro Business Units and municipal utilities.
- ▶ As part of Round 1, Hydro is also pursuing "green power" sales to industrial, commercial and institutional customers in order to offset costs of the Power Purchase Agreements and begin the establishment of a green power market.

### **Ontario Hydro's In-House Energy Efficiency Program**

Ontario Hydro's internal energy use represents approximately 10% of the utility's overall energy production. The In-House Energy Efficiency program aims to achieve over 1,700 Gigawatt-hours (GWh) per year of in-house energy savings by the year 2000. Internal energy savings have been established as a measure in the Executive Performance Achievement Plan.

To the end of 1995, the program resulted in energy savings of 803 GWh compared to the target of 600 GWh. This represented annual savings for Ontario Hydro of approximately \$30 million, and greenhouse gas emission reductions of 462,800 tonnes of CO<sub>2</sub> equivalents, with no loss of revenue and excellent pay-back. These savings came from improvements to electricity efficiency and to generation conversion processes.

Electricity efficiency savings of about 590 GWh exceeded the minimum target of 375 GWh, from a variety of measures, including:

- ▶ reduced transmission and distribution losses;
- ▶ process and technology changes;
- ▶ more energy-efficient lighting;
- ▶ occupancy sensors at Head Office; and
- ▶ avoiding excessive heating and cooling.

By the end of 1996, the program is projected to achieve annual energy savings of over 1 100GWh with long term annual cost savings to Ontario Hydro of over \$44 million. Over the next ten years, the forecast accumulated cost savings to the Corporation are half a billion dollars, with considerable emissions reductions.

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- ▶ The RETs program is also taking advantage of existing opportunities to cost-effectively deploy RETs for in-house and customer niche applications, such as utilizing RETs for electricity supply in remote communities to replace high-cost diesel generation.
- ▶ A series of "Green Pricing" pilot projects are being developed to solicit customers' voluntary support for RETs projects. The first pilot involves installation of a large (600 kw) wind turbine at Ontario Place.
- ▶ A successful 600 kilowatt wind turbine installation by Tacke Windpower, adjacent to the Bruce Nuclear Power Development, helped contribute to Tacke's establishment of a global blade manufacturing facility near London, Ontario. The plant has created 70 permanent jobs, and will ultimately produce about one-third of Tacke's annual global blade production, estimated at about \$9 million in annual sales.
- ▶ In 1995, Ontario Hydro Technologies invested more than \$10 million in SED-related technology development. Renewable energy research and development efforts focused on solar, wind, biomass and microhydro.

The Renewable Energy Technologies Program is a five-year, \$110 million program that, by the year 2000, could see up to 125 mega-watts of generation capacity added to the utility's system through such renewable sources as wind, solar, and biomass. It is intended to give Ontario Hydro experience in using renewable energy in its own operations, and to set the stage for a cleaner, more sustainable future.

## **Natural Gas Utilities**

Natural gas utilities, in conjunction with other energy supply and service companies, are central players in promoting and achieving energy efficiency in the province. Demand for natural gas is expected to grow significantly to the year 2000 from the addition of new customers and from fuel switching to natural gas. Ontario's three major gas utilities - Consumers Gas, Centra Gas and Union Gas - have introduced education, energy efficiency, and energy conservation programs to mitigate the potential impact on emissions from the increase in demand. Demand-side management programs improve the efficiency of customers' gas use in a cost-effective manner, as well as reduce greenhouse gas emissions and nitrogen oxides emissions, and assist in addressing ground-level ozone.

Consumer's Gas and Centra and Union Gas have all shown strong support for the national Voluntary Challenge Program, and have filed Action Plans on climate change with the Voluntary Challenge.

The Action Plans describe initiatives that will:

- ▶ reduce fugitive methane emissions from operations through measures such as installation of low or no-bleed instruments, improved pipeline purging procedures, and reduction of third-party damage;

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- ▶ reduce underground pipeline losses, eliminate gas emissions from existing storage wells;
- ▶ reduce energy used in system operations;
- ▶ reduce energy used in leased and owned facilities through energy audits and equipment retrofits;
- ▶ reduce carbon dioxide emissions from company vehicles through conversion of vehicles to natural gas and employee programs;
- ▶ establish partnerships with community groups, other utilities and governments to promote awareness of climate change;
- ▶ provide programs which may improve energy conservation and efficiency for customers, through promotion, provision of efficient equipment and expertise, supportive financing and billing, support for cogeneration projects and research and development;
- ▶ offset emissions with treeplanting and support of research programs through agencies such as Gas Technology Canada and the Gas Research Institute.

## **Renewable energy**

A renewable energy industry exists in Ontario that already contributes to the reduction of greenhouse gas emissions from electricity generation. Wood and hydraulic energy sources used for electricity generation accounted for almost 11 per cent of Ontario's primary energy demand in 1994.<sup>7</sup> Wood was also used in the residential and industrial sectors for heating purposes, accounting for about 2.4 per cent of primary energy demand.

Photovoltaic technologies, wind turbines, and ground-source heat pumps provided a small contribution to overall energy demand, but interest in renewables is growing as the benefits and economics are better understood, particularly in remote applications.

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<sup>7</sup> Primary energy includes all the natural gas, coal, and oil, and other sources used to supply energy to end-users, including transmission losses and waste heat.

## Sector-Specific Activities

### **Transportation Sector**

The transportation sector accounts for approximately one-third of the province's greenhouse gas emissions. Ontario is pursuing several initiatives that address emissions originating in the transportation sector, such as **supply-side initiatives** that affect the maintenance of vehicles on the road, the types of vehicles and fuels sold and the availability of transportation options, as well as demand-side initiatives that can influence the demand for vehicle travel and fuel usage.

#### **Vehicle Inspection and Maintenance Programs**

A vehicle inspection program, involving a pilot test centre in Mississauga, operated for one and a half years to raise driver awareness, evaluate test procedures, and compile information on the condition of Ontario vehicles. Testing was provided at no cost to owners who brought their vehicles in voluntarily.

The Ministry of Environment and Energy is developing options for the introduction of vehicle emissions testing in southern Ontario. The program will be aimed at identifying and reducing the emissions of toxic pollutants, smog-related gases, and greenhouse gases from the estimated 20 per cent of the vehicle fleet which, at any given time, is in need of repair. Studies have shown that such repairs result in an approximate average fuel efficiency improvement and carbon emission reduction of 10 per cent for the repaired vehicles. Analysis has indicated that a program for the Greater Toronto Area alone would improve fuel efficiency enough to reduce carbon dioxide emissions by nearly 400 kilotonnes a year, or almost 1 per cent of total greenhouse gas emissions from Ontario's transportation sector.

The **Canadian Automobile Association** also conducts voluntary vehicle emissions tests to raise awareness of the importance of properly maintaining vehicles. The free tests are an annual event at a number of locations. In 1996, the CAA ran clinics in Oakville, Burlington, Hamilton, Brantford and Caledonia. The five-minute test checks for the amount and type of unburnt gases coming from a car's exhaust system.

In **Windsor**, the City's air quality control committee has offered free testing clinics the last two summers. Certified mechanics conducted the five minute tests on vehicles' exhaust systems and advised owners about the things they could do to make their vehicles run cleaner.

#### **Public Transit**

Ontario has an extensive transit network in place. To encourage public transit, the government of Ontario makes a significant contribution each year to the operation of subways, buses and specialized services by municipalities and to the GO Transit Commuter rail and bus system. The government's transit program supports both capital and operating expenses.

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Recognizing the benefits of transit in promoting growth, protecting the environment and conserving energy, Ontario recently pledged \$511 million to an expansion of Toronto's subway system. Metro Toronto regional government subsequently voted to complete construction of the \$875 million Sheppard Avenue line in North York (north of the City of Toronto) to serve the future growth of the City and to improve the efficiency of the existing lines. The new 6.4 kilometre line is scheduled to open in 2002.

The expansion of the rapid transit network is one element in a comprehensive transportation strategy for accommodating the expected population growth in the Greater Toronto Area. Rapid transit (and an increasing proportion of trips by transit) can accommodate this expected growth in an environmental, social and fiscally responsible manner.

In 1995, the government reaffirmed its commitment to a sound transportation system in the Greater Toronto Area by ensuring that rapid transit will be economically sustainable in the long term. To this end, Ontario will proceed with transit projects in a phased approach. In addition, the province is developing strategies for increased private/public partnership opportunities and benefit sharing to ensure that potential future projects are delivered in a fiscally responsible manner.

Ontario **is** working on a transit integration initiative in the Greater Toronto Area to improve service for commuters who cross municipal boundaries. This initiative is aimed at building transit's modal share in a market segment dominated by the automobile.

Shifting commuters out of their cars and into transit will reduce energy consumption, the production of greenhouse gases and vehicle emissions.

### **Greater Toronto Area (GTA) Transportation Plan**

The Ministry of Transportation has initiated the development of a Greater Toronto Area Transportation Plan. The plan is to ensure that appropriate choices are made in transportation investments to yield optimum benefits for the community, the environment and the economy. The plan will address the requirements associated with preservation and rehabilitation of existing infrastructure, as well as opportunities for optimizing the use of existing facilities. Opportunities for selective expansion of the transportation network will also be assessed.

### **Biking**

Ontario policy officially recognizes the bicycle as a mode of transportation. Bicycles are to be considered in land use and transportation activities. Municipalities receive provincial funding for bicycle infrastructure on a similar basis as funding for roads and transit.

For example, Ottawa's Comprehensive Cycling Plan is a commitment by the City to encourage and support the bicycle as a means of transportation. The plan includes a number of policies encouraging the use of bicycles as an alternative to the automobile.

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The City of Toronto has seen a tremendous growth in bicycle use over the past decade as increasing numbers of people ride to work and for recreation. It is worthwhile noting that Bicycling Magazine of the U.S. rated Toronto as the best city for cycling in North America in 1995. The Toronto City Cycling Committee is an official citizen's advisory committee to City Council. It promotes greater and safer use of bicycles by planning, educating and advocating for cyclists in the City of Toronto. Promotional programs and activities include riding courses, user groups, Bike-to-Work Week, and advocating for bike paths, bike parking, on-street bike lanes, wider curb lanes, and a network of safe biking routes throughout the City.

### **Alternative Transportation Fuels (ATF)**

In Ontario, the commercially available alternative fuels are natural gas and propane. Ethanol is also added to some gasolines to produce ethanol blended gasolines. Ontario supports the use of alternative transportation fuels in light and heavy duty vehicles through fiscal incentives, research, development and demonstration. To encourage the purchase of alternative fuelled vehicles, Ontario offers several incentives:

- ▶ A **retail sales tax refund** on vehicles which operate on natural gas, propane or electricity, including vehicles which are converted to operate on these fuels within 180 days of purchase. The rebate is capped at \$750 for propane vehicles and \$1,000 for other types of fuels, except for buses, which are not capped, to encourage the use of alternative transportation fuels by transit authorities;
- ▶ **Full rebate of the Tax for Fuel Conservation** on new vehicles which are converted within 180 days of purchase to use an alternative fuel exclusively;
- ▶ **Exemption of all ATFs (except propane) from fuel taxes**, including the ethanol portion of ethanol-blended gasoline. The tax rate of 4.3 cents per litre for propane is well below the tax rate of gasoline on an energy equivalent basis;
- ▶ Producers of **ethanol from renewable** feedstocks in Ontario have been granted an agreement until the year 2010 that if a tax is imposed on ethanol reducing the current 14.7 cents per litre differential with gasoline taxes, they will receive offsetting payments not to exceed the amount of the reduced tax differential.
- ▶ In the fall of **1996** the province authorized a **\$5 million payment** to Commercial Alcohols **Inc., toward the** construction near Chatham, Ontario, of a 150 million litres-per-year ethanol manufacturing facility worth \$153 million.

Ontario also supports the research and development of alternative fuels. Working with partners, a renewable biodiesel fuel made from biomass is being evaluated. This project will assess the technical feasibility and environmental impacts of soybean-derived biodiesel in heavy duty diesel engines. A pilot project to develop, test, and evaluate the use of liquified natural gas-powered buses in a commuter application has been initiated. The first prototype bus is in regular daily use.

## Sector-Specific Activities

### **The Tax for Fuel Conservation**

The graduated Tax for Fuel Conservation is based on the fuel economy of new vehicles. Buyers of less fuel efficient vehicles must pay an added tax that, depending on the model, ranges from \$75 to \$7,000 for passenger cars and \$75 to \$3,200 for sport-utility vehicles. Rebates of \$100 are offered to those who purchase the most fuel efficient cars -- those with fuel economy ratings of less than 6 litres per 100 kilometres.

Together, the tax incentives/disincentives and the prevailing economic conditions appear to be changing consumer buying habits. Between 1990 and 1992, the sales of the most fuel efficient cars tripled, while sales of the worst gas guzzlers fell from 21,200 to just 7,700. By the year 2000, the Tax for Fuel Conservation is expected to reduce annual carbon dioxide emissions by 200 kilotonnes.

### **CCME Task Force on Cleaner Vehicles and Fuels**

The Ontario government has been working with the federal government and stakeholders to implement the recommendations of the Task Force on Cleaner Vehicles and Fuels that were adopted by the Canadian Council of Ministers of the Environment (CCME) in November 1994. The recommendations seek improvements in air quality through strengthened standards for vehicle emissions and fuel formulations.

The Task Force recently completed its report, and its recommendations were endorsed by Environment ministers in October 1995. Initiatives include:

- ▶ a comprehensive approach to fuel efficiency improvements through changes in driver behaviour, on-road efficiency performance, purchase decisions and vehicle fuel efficiency technology;
- ▶ co-ordination of government and stakeholder activities to support the availability of advanced technology vehicles and market development of alternative fuels;
- ▶ the adoption in Canada of the low emission vehicle initiative planned for introduction in the continental U.S.;
- ▶ consideration of vehicle inspection and maintenance programs and other measures to help reduce in-use vehicle emissions; and
- ▶ new national standards for diesel and gasoline.

These initiatives will provide cross-cutting environmental benefits in Ontario by helping to reduce smog and ground-level ozone conditions in the province, and reduce greenhouse gas emissions from vehicles.



## Sector-Specific Activities

### **Smog Plan**

As part of the Ontario government's on-going effort to respond to Ontario's smog problem, a Smog Management Plan is being developed to reduce emissions of Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs), both of which lead to the formation of ground-level ozone. The Plan will address Inhalable Particulates and transboundary emissions. Ground-level ozone and inhalable particulates are air pollutants that have been linked to increased human mortality, a wide range of health problems, property, material and vegetation damage.

One of the proposed goals is to attain a 45 per cent reduction of the 1990 emissions of NOx and VOCs by 2015, leading towards the reduction of ground level ozone in Ontario. Another proposed goal is to initiate actions to reduce emissions that contribute to inhalable and respirable particulates by at least 10 per cent by 2015.

The benefit of a Smog Plan from a climate change point of view, is that actions to reduce nitrogen oxides, through a decrease in fossil fuel use, can also reduce emissions of carbon dioxide.

## Sector-Specific Activities

### **Landfill Gas Recovery**

The natural biodegradation of organic material in a landfill produces a gas that is either emitted to atmosphere through the cover of the landfill or migrates off-site through the soil. Landfill gas typically contains 40 to 60 per cent by volume methane and carbon dioxide and a small amount (zero to a few thousand parts per million by volume) of non-methane organic compounds.

Landfill gas collection and control provides a number of environmental benefits, including a reduction in the potential for migration of landfill gas and the potential for explosive hazard; enhanced long-term land-use planning in the vicinity of landfills; reduction in emissions of greenhouse gases (see Sidebar); reducing odour impacts; and reducing toxic air emissions from landfills. There is also a potential for energy recovery from landfill gas management systems because the methane component has a relatively high heating value.

For example, landfill gases are currently being used to generate electricity at three sites in Metro Toronto, which are estimated to recover about 90,000 tonnes of methane annually.

On June 17, 1996 the Minister of Environment and Energy tabled new landfill standards for the province and invited public comment on them. The new standards were mainly designed to make the approvals process for new and expanding landfill sites less costly, less time-consuming and more predictable, but atmospheric emissions of landfill gas were also addressed by the new regulations.

The consultation document proposed a threshold level for collection at sites larger than 2.5 million tonnes. The Ministry of Environment and Energy estimates that this threshold will result in collection of up to **3.2 million tonnes of methane** over the expected 40 year life of the landfills.

Ontario has also committed to a provincial waste diversion target of 50% by the year 2000, which is expected to reduce overall methane emissions from landfills in Ontario.

<b>Landfill Gas Recovery</b>
<b>Landfill GHG Contribution (1995):</b>
<ul style="list-style-type: none"><li>▶ 5% of total Ontario Greenhouse Gases</li><li>▶ 7,798 kilotonnes equivalent CO<sub>2</sub> emissions</li></ul>
<b>Percentage Landfill GHG Reduction with Controls at new landfill sites ≥ 2.5 million tonnes:</b>
2000: 22% Reduction of Landfill GHG
<b>Impact on Ontario GHG Emissions:</b>
2000: 1% Reduction of Ontario GHG

## Sector-Specific Activities

### **Agricultural Sector**

The agriculture sector has opportunities not only to reduce emissions from operations through improved energy efficient technologies and expanded production and use of fuel ethanol, but also to decrease emissions from ruminant farm animals and to increase plant photosynthesis and carbon sequestration.

Measures to reduce greenhouse gas emissions that are currently being implemented by the agriculture industry in Ontario include the following: continued expansion and production and usage of fuel ethanol as a substitute for fossil fuels; reducing methane emissions from ruminant farm animals through improvements in feeding technology and increased use of feed additives which improve rumen efficiency; improving crop yields from improved practices and use of new technology; and shifting to no-till seeding practices from conventional tillage practices reducing the rate of oxidation of soil organic matter, resulting in lower carbon dioxide emissions.

### **Farm Environmental Agenda**

The Ontario Farm Environmental Coalition has developed and is delivering the environmental farm planning initiative with farmers. The Environmental Farm Plan initiative encourages farmers to conduct voluntary environmental farm assessments. As of October 1996, 7751 participants have attended local workshops, and 3353 peer-reviewed plans have been deemed appropriate.

The Ontario Farm Environmental Coalition meets regularly with the Ontario Ministries of Agriculture, Food and Rural Affairs and Environment and Energy to discuss environmental issues and maintain a close working relationship.

For example, OMAFRA and the Essex Region Conservation Authority and several other partners are working with farmers and local businesses to start a 12-hectare demonstration farm in **Holiday Beach Conservation Area**.

Techniques ranging from no-till farming to technology that monitors yields at specific locations so farmers can use pesticides and fertilizers wisely will be demonstrated (**see Sidebar**). The demonstration project is intended to benefit both farmers and city people.

#### **Hi-Tech Farming**

New technology being promoted at the **Holiday Beach Demonstration Farm** (see text) is in use at one Milton area farm.

Greg Kitching has installed equipment, including a Global Positioning System (GPS), in the family's combine that uses satellite signals and monitoring devices to precisely determine the yield and soil conditions from specific sections. In the past, it was only possible to calculate the average yield. However, the actual yields (and the need for expensive herbicides, fertilizer and manure) could vary widely on the 560 hectare (1,400 acre) farm.

As data is collected and analyzed over a period of time, he will be able to determine how each section should be treated for maximum returns, thereby saving money and energy.

## Sector-Specific Activities

Researchers at the University of Guelph and elsewhere have been able to prove that competitive yields can be obtained in no-till situations and achieve energy savings and environmental benefits. One Guelph study estimated that the potential for reduced CO<sub>2</sub> emissions from no-till, through running less farm equipment and causing less carbon to be released into the atmosphere, is equivalent to burning 270 million litres of gasoline!

Improvements in farming practices and information, and technological improvements over the past several decades have led to significant energy efficiency savings. Guelph researchers analyzed data on the Ontario corn and soybean industry from 1975 to 1991 and came up with the following results:

	1975	1991	% change
Grain Corn			
Total crop (million tonnes):	3.3	5.3	+61
Crop area (thousand hectares):	575	766	+33
Energy use (million L diesel equiv):	292	191	-35
Energy efficiency (litres/tonne):	88	36	-59
Soybeans			
Total crop (million tonnes):	0.4	1.4	+250
Crop area (thousand hectares):	158	570	+261
Energy use (million L diesel equiv):	28	51	+ 82
Energy efficiency (litres/tonne):	70	36	- 49

The researchers concluded that if 1975 production methods were used to meet 1991 corn and soybean production levels, Ontario farmers would need 330 million more litres of diesel fuel energy equivalent, and 120,000 more hectares of land (almost twice the area of Toronto). Trends were similar in other food businesses: in 1991 Ontario produced 2.9 per cent more milk using 849,000 fewer animals and 573,400 fewer hectares of land (nine Torontos) than in 1951; to meet the 1991 demand for eggs and chickens using 1951 methods would have required an additional 676,000 hectares of land, almost 11 times the size of Toronto.

## **Decreasing Methane Emissions**

Methane emissions from respiration of livestock can be decreased in two ways, by increasing animal productivity, and by increasing digestion efficiency. Management practices to increase productivity have already been and will continue to be adopted by Ontario producers for economic reasons.

A second source of methane is from animal waste. Manure application methods are under constant review to determine how to maximize nutrient use, and reduce odour. This also reduces methane formation. Currently manure injection methods are being evaluated to determine if this technique could increase nutrient efficiency.

One project that is organized by OMAFRA is the "Custom Manure Applicators" course. The course focuses on environmental safety and nutrient efficiency in the context of manure application.

## Sector-Specific Activities

### **Forest Management**

The Ontario Ministry of Natural Resources is responsible for the management of Crown forests in Ontario. These forests cover most of Ontario and form an important part of the natural carbon cycle.

Research into the adaptability of forests to climate changes was described in the section above on Research. A number of recent initiatives introduced in Ontario to ensure forest sustainability through good forest management will also indirectly support carbon sequestration.

- ▶ Ontario recently proclaimed the Crown Forest Sustainability Act for the purpose of providing for the sustainability (long term health) of Crown forests. Managing forests to ensure their sustainability is the first priority.
- ▶ The Ministry of Natural Resources is entering into new business relationships with the forest industry to ensure the regeneration of Crown forests. A **Forest Renewal Trust Fund** is in place to provide adequate funding for forest renewal.

It has been estimated that about twenty per cent of the approximately one-million hectares that are harvested each year in Canada are subsequently characterized as "not-satisfactorily regenerated" (NSR).<sup>8</sup> Ultimately, silviculture investments will ensure that most of these NSR lands will become restocked with a commercial forest. However, some of these poorly regenerated areas could be utilized for the development of optimally stocked, forest-carbon reserves. For example, the typical cost of rural tree planting initiatives equates to approximately \$1-10 per tonne of carbon sequestered, compared with \$15-30 per tonne for urban trees.

In urban areas, greening initiatives--projects that introduce more plants, and especially trees, into urban areas--have traditionally been thought of as beautification schemes. The benefits of greening initiatives, however, extend far beyond their cosmetic appeal. Trees cool ambient city air through shading and evapotranspiration: a mature tree breathes out up to 375 litres of water a day. By shading and cooling buildings, trees reduce the need for (and expense of) air conditioners in the summer. This cuts down on the amount of fossil fuel burned to generate electricity, which in turn slows the growth of atmospheric carbon dioxide.

Urbanization, having replaced landscapes of soil and vegetation with concrete and asphalt, has caused a decrease in the landscape's ability to lower daytime temperatures through shade and evapotranspiration. In addition, by using dark-coloured materials on roads, buildings, and other surfaces, cities now absorb more heat from the sun and reflect less. This creates an "urban heat island" effect that causes every city around the world to experience a temperature increase of between 1.7 and 4.9°C compared to its surrounding area. Cities need trees to keep cool.

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<sup>8</sup> The State of Canada's Environment (Government of Canada, Ottawa, Ontario: 1991)

## Sector-Specific Activities

Recognizing the benefit of urban greening initiatives, the City of Toronto created the "Greenest Cities" program as part of its Toronto Atmospheric Fund to counteract global warming. In the fall, upon request by any homeowner in Toronto, Greenest Cities will supply a free tree and advice on how and where to plant it in a backyard. For \$20, Greenest Cities will arrange to have it delivered and planted. In some areas, homeowners can get a free tree by booking a free home audit that will identify how they can save energy and improve indoor air quality.

To preserve trees that are already rooted, in 1995 the City of Toronto passed a by-law that requires developers to receive City approval before cutting down trees to make way for new construction. In September, 1996, the Ontario Municipal Board upheld the by-law against its first legal challenge on the basis of the importance of environmental preservation.

Research, forest management and urban greening initiatives can be considered as measures taken in anticipation of future global warming, as well as an effective way to reduce the rate of warming through carbon sequestration. The greatest promise for cooling the urban landscape, however, will be fulfilled in 20-30 years as the new generation of urban trees reach maturity.

## **V. MEETING THE CHALLENGE**

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This document lists a number of initiatives underway in Ontario that will help address climate change. The range of activities is extensive, however, this listing should be considered as illustrative rather than comprehensive.

The Ontario government looks forward to further progress on climate change through continued collaboration with other governments, and with the province's industries, businesses and members of the public.

## Appendix A

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### GLOSSARY OF TERMS

**adaptability**

the degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate; adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of changes in conditions.

**ambient air quality**

quality of circulating air in the surrounding area, usually refers to local conditions

**biofuels**

fuels obtained as a product of biomass conversion (eg. alcohol or gasohol)

**biomass**

1) the total quantity of living matter in a particular habitat; 2) plant and organic waste materials used as fuel and feedstock in place of fossil fuels.

**carbon sequestration**

the biochemical process through which carbon in the atmosphere is absorbed by biomass such as trees, soils and crops.

**carbon sinks**

chemical processes that absorb carbon dioxide

**cogeneration**

production of electricity and heat, as main outputs, from energy sources in an installation such as a thermal plant or heating station.

**demand-side management**

any activity designed to alter the customer's timing or use of electricity, natural gas, or other energy form; such actions are designed to control the demand upon the utility by manipulating the customer's use of energy use during peak periods, to shift usage from demand peaks to demand valleys, build load, conserve overall energy usage, and/or otherwise change the demand placed upon the utility.

**district heat**

thermal energy transmitted through pipelines in the form of heated water or steam to point of consumption.

**evapotranspiration**

loss of water from the soil both by evaporation from the surface and transpiration from the plants growing thereon.



**feedstock**

raw material (eg. oil products or natural gas) used as input into industrial processes for manufacturing of materials or consumer goods (eg. plastics, fertilizer); energy feedstocks are often included in total energy consumption even though they represent so-called non-energy consumption.

**greenhouse gas**

any gas that absorbs infrared radiation in the atmosphere.

**joule**

1) a very small international unit of energy; 2) the energy produced by a power of one watt flowing for one second;

**kilowatt-hour (kWh)**

1) commercial unit of electrical energy; 2) 1000 watts; 3) the total amount of power needed to light ten 100-watt light bulbs for an hour.

**mitigation**

an intervention to reduce the emissions or enhance the sinks of greenhouse gases.

**primary energy**

1) the energy that is embodied in resources as they exist in nature (eg. coal, crude oil, natural gas, uranium, sunlight); 2) the energy that has not undergone any sort of conversion.

**smog**

a mix of photochemical oxidant air pollutants produced by the reaction of primarily hydrocarbonaceous air pollutants (such as NO<sub>x</sub> and VOCs), with sunlight.

**stakeholders**

the entities that will be affected by a particular action or policy

**sustainable**

a term used to characterize human action that can be undertaken in such a manner as to not adversely affect environmental conditions (eg. soil, water quality, climate) that are necessary to support those same activities in the future.

**watt**

1) the scientific unit of electric power; 2) a rate of doing work at the rate of one joule per second. A typical light bulb is rated at 25, 40, 60 or 100 watts, meaning that it consumes that amount of power when illuminated.