

Chapter 9

Climate Change and its Impact on the Lake Superior Basin



Ice caves at Meyers Beach, Bayfield, Wisconsin. Photo credit: Frank Koshere,
Wisconsin Department of Natural Resources.

Lake Superior Lakewide Management Plan 2008

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Chapter 9

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9.0 BACKGROUND

The United Nations recently released the Intergovernmental Panel on Climate Change's (IPCC) *Fourth Assessment Report Climate Change 2007* (or Synthesis Report). This report summarizes the most important findings, which include:

1. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and a rising global average sea level.
2. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.
 - a. In terrestrial ecosystems, earlier timing of spring events and poleward shifts in plant and animal ranges are with *very high confidence* linked to recent warming. In some marine and freshwater systems, shifts in ranges and changes in algal, plankton, and fish abundance are with *high confidence* associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation.
3. Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 70 percent between 1970 and 2004.
 - a. Changes in atmospheric concentrations of GHGs and aerosols, land-cover, and solar radiation have altered the energy balance of the climate system.
 - b. Global atmospheric concentrations of CO₂, methane (CH₄), and nitrous oxide (N₂O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.
4. Most of the observed increase in globally-averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations. It is *likely* that there has been significant warming from anthropogenic sources over the past 50 years averaged over each continent (except Antarctica).

9.1 OBSERVED AND ANTICIPATED EFFECTS ON THE GREAT LAKES BASIN ECOSYSTEM

The effects of a changing climate are now and continuing to be experienced in the Great Lakes and the Lake Superior basin over the next century. In a report prepared for the International Joint Commission (IJC) by the Great Lakes Water Quality Board in 2003, Environment Canada

and US EPA scientists extensively detailed documented and anticipated effects to the Great Lakes ecosystem due to climate change. The Union of Concerned Scientists also issued a report detailing similar changes. These include the following:

- Winters are getting shorter;
- Annual average temperatures are growing warmer, in fact increases are projected to be anywhere from 2°C to almost 4°C (Kling et al. 2003);
- Extreme heat events are occurring more frequently;
- The duration of lake ice cover is decreasing as air and water temperatures rise; and
- Heavy precipitation events, both rain and snow, are becoming more common.

In addition, anticipated changes include the following:

- Future lake levels are expected to decline as winter ice coverage decreases;
- Declines in the duration of winter ice cover are expected to continue;
- Earlier ice breakup and earlier peaks in spring runoff will change the timing of stream flows;
- The distributions of fish and other organisms in lakes and streams will change. Coldwater species such as lake trout, brook trout, and white fish are likely to decline in the southern parts of the Great Lakes region, while warm water species are likely to expand northward;
- Invasions by non-native species will likely be more common, increasing the stress on native plant and animal populations;
- Lower water levels coupled with warmer water temperatures may accelerate the accumulation of mercury in the aquatic food chain;
- Increased incidence of extreme events such as severe storms and floods;
- More forest fires will result from hotter and drier conditions; and
- Increases in the number and severity of summertime pollution episodes.



Figure 9-1. One of the expected effects of climate change is more frequent invasions of non-native species such as this Eurasian water milfoil. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

In short, the Great Lakes basin is already seeing significant impacts associated with global warming, and scenarios project far greater warming in the 21st century. Both adaptation and mitigation activities are necessary to begin to address climate change impacts.

9.2 ACTIVITIES

The Lake Superior LaMP is beginning to address the potential problems and effects of climate change on the basin, through outreach and education, mitigation activities, and adaptation projects. Some of these activities are detailed below.

9.2.1 LAMP ACTIVITIES

Climate change was a primary focus of the *Making a Great Lake Superior 2007* conference, held in Duluth, Minnesota, on October 29-31, 2007. Both a plenary session and a focused breakout session on climate change were included, with presentations by members of the United Nations IPCC (see text box on page 9-5).

Goals to address the issue of climate change have been incorporated into the revised LaMP Ecosystem Goals, including climate change mitigation and adaptation actions.

A US EPA grant to the Minnesota Pollution Control Agency and the Will Steger Foundation will focus on climate change outreach/education and adaptation and mitigation actions, consistent with the LaMP climate change Ecosystem Goals.

9.2.2 OTHER ACTIVITIES

The following are Lake Superior and Great Lakes basin activities related to climate change that support LaMP goals.

- The towns of Ashland and Washburn, Wisconsin, passed Eco-Municipality Designation Resolutions calling for reducing dependence on fossil fuels, the primary contributor to GHG emissions and ozone depletion.¹
- The Town of Bayfield unanimously passed a resolution on October 16, 2006, to follow the Natural Step framework and join Washburn and Ashland as eco-municipalities.
- The Sustainable Chequamegon Initiative, a project of the Alliance for Sustainability, has drafted a *Sustainable Chequamegon Initiative Strategic Plan for 2006-2011* that incorporates the Natural Step framework and climate change mitigation actions and activities.
- Apostle Islands National Lakeshore is educating the public on climate change as well as pursuing carbon mitigation strategies. The National Park Service provides a comprehensive list of climate change talking

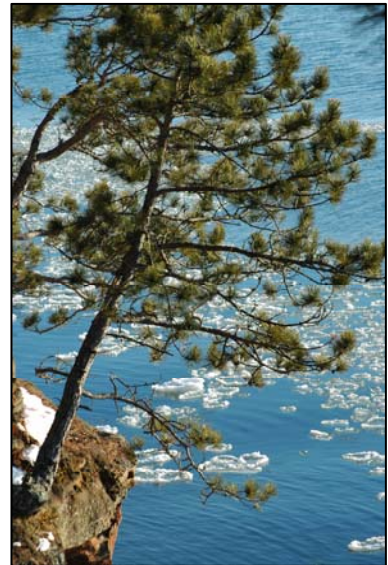


Figure 9-2. Apostle Islands National Lakeshore is educating the public on climate change and is pursuing carbon mitigation strategies. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

¹ North American EcoMunicipality Network Update. 2007. Available at www.lkfriends.org/documents/NAEco-MunicipalityNetworkUpdateforTNSIMeeting-January2007.pdf.

points and a brochure detailing the anticipated effects on the Great Lakes region. Apostle Islands National Lakeshore has also established a sustainability policy and a list of best management practices for climate change mitigation and adaptation. The park also participates in the national Climate Friendly Parks program.²

- Researchers at the Large Lakes Observatory at the University of Minnesota at Duluth spoke at the *Making a Great Lake Superior 2007* conference on the effects of temperature change on the lake. They have concluded that Lake Superior is responding more quickly to climate change than previously expected and that the surface water temperatures of Lake Superior are rising rapidly while annual ice coverage of the lake is simultaneously declining. The study looked at air temperatures, ice cover, and water temperature data collected at buoy sites since 1906.³



Figure 9-3. Research indicates that annual ice coverage on Lake Superior is declining.
Photo Credit: Frank Koshere, Wisconsin Department of Natural Resources.

- Minnesota, under the leadership of Governor Tim Pawlenty, has been a leader in pursuing reductions in GHG emissions. The Governor recently proposed, and the legislature passed, an energy plan that puts Minnesota squarely at the front of states leading the way toward increasing energy efficiency, expanding community-based energy development, and establishing a statewide goal to reduce GHG emissions. The Plan also requires Minnesota's electric utilities to provide 25 percent renewable electricity by 2025.

² National Park Service Climate Change and Sustainability website. Available at <http://www.nps.gov/apis/naturescience/climate-change-and-sustainability.htm>.

³ Austin, J. 2007. Rapid warming of Lake Superior. Available at <http://www.d.umn.edu/~jaustin/ICE.html>.

Making a Great Lake Superior 2007 Conference

The main message from the climate change experts at the Lake Superior conference could be summarized as:

Solutions to climate change are available to us, and the time to act is now.

This message was delivered by both elected officials and US EPA and Environment Canada climate change experts among the 500 people who participated in the Lake Superior conference in Duluth in October of 2007. Minnesota Governor Tim Pawlenty voiced his commitment to pursuing climate change actions, citing the creation of his own Climate Change Advisory Group as an example. Top officials from the US EPA and Environment Canada joined a keynote panel to detail the global causes and local effects of a changing climate on the environment. Dr. Joel Scheraga (US EPA) and Dr. Linda Mortsch (Environment Canada), both members of the 2007 Nobel Prize-winning Intergovernmental Panel on Climate Change, joined Environment Canada climatologist David Phillips in demonstrating that unprecedented weather conditions, such as extreme storm events and droughts, are expected and that communities must adapt their infrastructure to endure. Their message was backed by a full day of presentations and dialogue among scientists, natural resource managers, outreach specialists, and government officials.

Mitigation and adaptation actions were cited as the most important strategies by the keynote panel. Following the panel, participants had the chance to learn how the global phenomenon of a changing climate is expected to affect the Lake Superior ecosystem. During the climate change breakout session, presentations from university researchers from Minnesota, Wisconsin, and Ontario shared information with a captivated audience on the warming of surface waters, the decrease of ice coverage, and the decline in amphibian communities. Managers from the National Park Service and the City of Thunder Bay spoke to the ongoing challenges caused by changing ecological conditions and their methods of promoting sustainability as a means of mitigating the problem. After hearing the experts, plans for mitigation and adaptation actions varied, yet one component was agreed upon: the timeline for action is today.



Dr. Joel Scheraga and Dr. Linda Mortsch discuss climate change at the *Making a Great Lake Superior 2007* conference. Photo credit: Elizabeth LaPlante, US EPA.

- Environment Canada and Ontario Ministry of Natural Resources have contributed to a publication released by Natural Resources Canada called *Coastal Zone and Climate Change on the Great Lakes*.⁴ The report details on a lake-by-lake basis expected climate change variables, impacts, and adaptation strategies based upon a series of community-based workshops held in the Great Lakes basin, plus the review of scientific, peer-reviewed literature, scientific assessment of changes in climatic variables (e.g., temperature and precipitation) and evaluation of GCM (global climate models) climate change scenario data. The impacts to the coastal region of Lake Superior are expected to be less than those associated with the other Great Lakes. This is because of the low level of human settlement in the Ontario portion of the Lake Superior basin and the great size and depth of the lake, which will moderate warming trends. Monitoring these impacts and the adaptation strategies are key to moving forward with the LaMP.
- In 2003, the Water Quality Board issued a report to the International Joint Commission on the projected effects of climate change on the Great Lakes basin and recommended management strategies.⁵
- Lake Superior Work Group members participated in the “Pileus Project,” coordinated by Michigan State University (MSU) and US EPA’s Office of Research and Development. This project provides useful climate information to assist decision makers. The current focus is on two leading industries in the Great Lakes region: agriculture and tourism. Through the use of climate models and participatory workshops, Pileus seeks to: provide a better understanding of historical climate trends, variability, and their past impacts on people and industry; evaluate how future climate trends and variability may impact people and industry, using newly developed, climate-related models; and create an economic framework which explicitly incorporates climate into the decision-making process. Stakeholders and researchers from the Pileus Project are building on each other’s experiences, pooling expertise, and expanding knowledge about climate impacts on industry. The core research team is located at MSU and consists of scientists from diverse disciplines. For more information about the Pileus Project, see <http://pileus.msu.edu>.
- US EPA Region 5 recently released its climate change strategy, entitled *USEPA Region 5 Framework for Addressing Climate Change and Clean Energy* (presented in Addendum 9A to this chapter).⁶ The framework focuses on:
 - Changing how our energy is produced;
 - Changing how our energy is used;
 - Changing how materials, products, and waste are managed; and
 - Integrating climate change considerations into US EPA operations and core programs.

⁴ Coastal Zone and Climate Change on the Great Lakes. 2006. Available at http://adaptation.nrcan.gc.ca/projdb/pdf/85a_e.pdf.

⁵ Climate Change and Water Quality in the Great Lakes Basin; Report of the Great Lakes Water Quality Board to the International Joint Commission, ISBN 1-894280-42-3. 2003. Available at <http://www.ijc.org/php/publications/html/climate/index.html>.

⁶ US EPA Region 5 Framework for Addressing Climate Change and Clean Energy. 2008. Available at <http://www.epa.gov/region5/aboutr5/index.htm>.

- Annex 3 (Lake and Basin Sustainability) of the *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA) addresses ecosystem sustainability, including climate change. It is agreed that climate change will affect the Great Lakes basin ecosystem. Understanding the impacts of climate change on the Great Lakes basin ecosystem in support of the development of adaptation strategies is one goal of COA. Over the next three years, Canada and Ontario will work together to develop a comprehensive management framework that considers the full range of impacts that can be expected for the Great Lakes basin from present and future climatic changes. The framework will incorporate four elements:
 1. Identifying and projecting changes to climate and ecosystems;
 2. Assessing impacts and vulnerabilities;
 3. Adapting to change; and
 4. Learning from impacts and adaptation research internationally and domestically.

In order to achieve the goal of understanding the impacts of climate change on the Great Lakes basin ecosystem in support of the development of adaptation strategies, two results have been identified. Canada and Ontario have made commitments in order to achieve these results.

Result 1: The impacts of climate change on ecosystem composition, structure, and function, including biodiversity (organisms and their habitat), water quality and quantity, human health and safety (including access to clean drinking water), social well-being and economic prosperity are understood in support of the development of adaptation strategies. Canada and Ontario commitments:

- a) Support the development of evidence, indicators, and model projections of climate and ecosystem change in the Great Lakes basin;
- b) Increase understanding of the impacts on and vulnerabilities of the Great Lakes, including biodiversity, natural resources, water assets, human health and safety, the economy and infrastructure in support of the development of adaptation strategies; and
- c) Facilitate linkages to climate change science, impacts, adaptation, and policy work of international, national, provincial and municipal governments, non-governmental organizations, industry, and academia.

Result 2: The capacity of Great Lakes communities to adapt to a changing climate is increased. Canada commitment:

- a) Provide information to decision-makers and the public on scientific studies of atmospheric hazards and regional atmospheric change impacts.

Ontario commitment:

- b) Continue working with other agencies and organizations to help communities around the Great Lakes ensure that foundation work is begun on managing the impacts of climate change.

- As of February 2008, four of the larger cities in the Lake Superior basin, Marquette, Ashland, Superior, and Duluth, had signed on to the U.S. Mayors' Climate Protection Agreement. Under the Agreement, participating cities commit to take the following three actions:

- Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns;
 - Urge their state governments, and the federal government, to enact policies and programs to meet or beat the GHG emission reduction target suggested for the U.S. in the Kyoto Protocol—a 7 percent reduction from 1990 levels by 2012; and
 - Urge the U.S. Congress to pass bipartisan GHG reduction legislation, which would establish a national emission trading system.
- The *National Summit on Coping with Climate Change* took place on May 8-10, 2007, in Ann Arbor, Michigan, and included participants from the Binational Program. The summit brought together leading scientists and scholars with key decision makers in a structured discussion that addressed the options available to institutions, firms, and societies in the U.S. for adapting and responding to climate change. The summit focused on four specific sectors that represent illustrative examples of the social, economic, environmental, and natural resource issues that need to be addressed. The chosen areas of focus were public health, the energy industry, water quality, and fisheries. The summit then turned its attention to general models for how different kinds of organizations, within these sectors and more generally, can put into place structures or processes that help them to anticipate and adapt to near- and long-term change.⁷
 - The National Governor's Association (NGA), chaired by Governor Tim Pawlenty of Minnesota, has developed a publication entitled *Securing a Clean Energy Future: A Call to Action*, which outlines a strategy for reducing dependence on oil and reducing emissions of GHGs.⁸
 - In October 2006, Canada announced *The Action Plan to Reduce Greenhouse Gases and Air Pollution* – including the intention to regulate GHGs that cause climate change. *The Action Plan to Reduce Greenhouse Gases and Air Pollution* will:
 - Impose mandatory targets on industry to achieve a goal of an absolute reduction of 150 megatonnes in GHG emissions by 2020;
 - Impose targets on industry so that air pollution from industry is cut in half by 2015;
 - Regulate the fuel efficiency of cars and light duty trucks, beginning with the 2011 model year; and
 - Strengthen energy efficiency standards for a number of energy-using products, including light bulbs.

As part of the action plan, the Regulatory Framework for Air Emissions presents mandatory and enforceable reductions in emissions of GHGs and air pollutants from industrial sectors and other sources. This regulatory system will place Canada on the path to achieving sustained absolute reductions in industrial GHG emissions.

More information about The Regulatory Framework for Air Emissions can be found in Addendum 9B to this chapter and at: <http://www.ecoaction.gc.ca/turning-virage/index-eng.cfm>.

⁷ Background papers and other information about the summit are available on the internet at http://www.snre.umich.edu/climate_change/sector_papers.

⁸ *Securing a Clean Energy Future: A Call to Action*. 2008. Available at <http://www.subnet.nga.org/ci/scef/>.

9.3 OUTREACH

- Minnesota Sea Grant provides education and outreach on climate change through its award-winning program “View From the Lake.” Since 2004, this program has brought over 1,800 people from 150 communities out onto Lake Superior to see their community from the water and discuss issues related to protecting local natural resources and Lake Superior. The program takes place on the University of Wisconsin’s *L.L. Smith, Jr.* Research Vessel and sails to eight ports in Minnesota and Wisconsin, bringing local government officials, residents, teachers, and others out to learn about the newest research on climate change, water quality, and a variety of other issues. The program gives the public options and resources for taking action in their community and at their own homes.⁹
- EarthWise Thunder Bay is a partnership between the City of Thunder Bay and a network of volunteers who have agreed to work together on the issues of climate change and community sustainability.¹⁰ The main priority of EarthWise is to create a Community Environmental Action Plan. In March 2003, the City of Thunder Bay unanimously passed a resolution to participate in the Partners for Climate Protection (PCP) program. With this resolution, Thunder Bay made a commitment to work towards reducing GHG emissions in municipal operations by 20 percent below 1990 levels, and at least 6 percent throughout the municipal area, joining a network of more than 150 Canadian municipal governments who have committed to taking action on climate change by reducing GHG emissions. The mission of EarthWise Thunder Bay is to focus the energy, involvement, and collective wisdom of the community to secure the environmental health of our region, and thereby improve the social and economic well-being of future generations.

9.4 CHALLENGES

The issue of climate change raises many challenges, which the Binational Program must seek to address, including:

- Communicating climate change information (especially climate change information specific to the Lake Superior basin), impacts, and priority actions from the scientific community to decision/policymakers and the broader public;
- Preparing for potentially dramatic changes in the Lake Superior climate—and the ability of the Binational Program to help Lake Superior stakeholders adapt to these changes;



Figure 9-4. Lake Superior stakeholders will need to adapt to potential climate change impacts, such as more frequent and severe storm events. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

⁹ Minnesota Sea Grant. A View From the Lake program website: <http://www.seagrants.umn.edu/vfl/>.

¹⁰ EarthWise Thunder Bay website: www.earthwisethunderbay.com.

- Assisting Lake Superior stakeholders in both understanding and mitigating the potential impacts of climate change; and
- Obtaining sufficient resources to help stakeholders adapt to climate change impacts, such as more frequent and severe storm events.

9.5 NEXT STEPS

Next steps for the Lake Superior Binational Program and Work Group include the following:

- Determine climate change adaptation and mitigation actions and projects that can be undertaken by the LaMP and the Binational Program, and seek support as feasible;
- Incorporate these climate change mitigation and adaptation actions into Lake Superior Binational Program and Work Group workplans, grants, and priorities;
- Distribute important reports such as the “Climate Change and Water Quality in the Great Lakes Basin” paper, written by the Great Lakes Water Quality Board to the IJC, to Lake Superior stakeholders;
- Collate all Lake Superior-related climate change research and studies for use by the Lake Superior Binational Program and stakeholders; and
- Coordinate with state, provincial, regional, and federal climate change strategies, frameworks, and priorities as much as possible.



Figure 9-5. Next steps include determining mitigation actions for climate change impacts, such as anticipated declines in future lake levels. Photo credit: John Marsden, Environment Canada.

9.6 REFERENCES

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ADDENDUM 9A:

U.S. EPA Region 5 Framework for Addressing Climate Change and Clean Energy



U. S. Environmental Protection Agency Region 5 recognizes the need to address climate change and reduce greenhouse gas emissions in our six states. Climate models predict increased variability in precipitation, with longer droughts and larger storms, boosting the need for water conservation and prevention of sewer overflows. With our public and private partners, we will evaluate our programs and policies for opportunities to address the effects of climate change on the environment and to promote energy efficiency, clean energy, cleaner transportation practices and sustainable development. Many governments and organizations in the region are working to reduce greenhouse gas emissions. Region 5 will use its leadership role to add value to these efforts by focusing on:

- **Changing how our energy is produced**
- **Changing how our energy is used**
- **Changing how materials, products and waste are managed**
- **Integrating climate change considerations into Agency operations and core programs**

We will engage and promote environmental stewardship among key stakeholders in Region 5 including the public; federal, state, tribal and local governments; and electric power utilities and other large companies.

Changing How Our Energy Is Produced

One-third of greenhouse gas emissions in the U.S. come from electric power generation. Seventy percent of the region's electricity is generated from coal, which produces more greenhouse gas emissions per kilowatt produced than other fossil fuels. We will:



- Challenge electric utilities in the region to reduce their greenhouse gas emissions through measures such as increased renewable energy production and energy efficiency programs to decrease costs to households and businesses
- Encourage governments and corporations to purchase renewable energy through EPA's Green Power Partnership
- Promote the use of combined heat and power systems, focusing initially on wastewater treatment plants, ethanol facilities and large hotels and casinos
- Collaborate with Region 5 states to promote combined heat and power and energy efficiency through state regulations

Changing How Our Energy Is Used

Electricity and fuel use in homes, commercial buildings and industries result in 62 percent of U.S. greenhouse gas emissions (17, 17, and 28 percent, respectively). Transportation contributes much of the rest—28 percent. We will:

- Provide information to the public to help them green their homes, schools, workplaces and cars through measures such as energy conservation, recycling and fuel-efficient transportation
- Reduce energy use in communities by:
 - Recruiting local governments to take the ENERGY STAR Challenge and assisting them in improving energy efficiency in government, residential and commercial buildings in their communities
 - Promoting green building and sustainable development on the state, local and developer level to address the engineering and market barriers that limit such development
 - Training wastewater and drinking water utilities to conduct energy audits at their facilities to reduce energy use and encourage on-site energy production
- Call on large companies in Region 5 to join the Climate Leaders and Performance Track programs; Climate Leaders works with companies to inventory their greenhouse gas emissions, develop a plan to reduce those emissions and set a public reduction goal
- Recruit new partners to the SmartWay Transport Partnership, a voluntary program that reduces greenhouse gas emissions from the freight industry
- Work with other federal agencies, states and industry to expand the use of agricultural waste digesters through innovative permitting and funding mechanisms



Changing How Materials, Products and Waste Are Managed

Reducing waste and increasing recycling and reuse of materials saves energy and reduces greenhouse gas emissions by avoiding effects associated with resource extraction and waste disposal. We will:

- Promote reduction of municipal, industrial and construction waste in the region
- Recruit governments and companies to become partners in the WasteWise program; WasteWise works with Region 5's partners to reduce nonhazardous waste through measures such as use of recycled materials



- Collaborate with large public venues such as stadiums and convention centers to make them Green Venues, using practices such as energy efficient heating and cooling systems, increased recycling, use of local food in concessions, and environmental outreach to the millions of people who visit these venues

Integrating Climate Change Considerations into Agency Operations and Core Programs

We will:

- Seek to include greenhouse gas reductions in Supplemental Environmental Projects that result from enforcement settlements within Region 5 and incorporate climate change considerations into reviews of Environmental Impact Statements



- Educate our employees so they can reduce their carbon footprint at home, at work and in their communities; for example, we will encourage employees to switch to compact fluorescent lamps (CFLs) and recruit organizations in their community to become Change-a-Light Pledge Drivers
- Review and revise policies to improve environmental performance of Region 5 operations in areas such as energy efficiency, use of alternative fuels, reduction of paper use and fleet fuel economy

ADDENDUM 9B: CANADA'S REGULATORY FRAMEWORK FOR AIR EMISSIONS

In October 2006, Canada's new government made clear its intention to regulate greenhouse gases that cause climate change, as well as air pollutants that cause smog and acid rain.

The Regulatory Framework for Air Emissions is one of the main features of our ambitious agenda to tackle climate change and clean up the air we breathe. Consistent with the polluter-pays principle, our Regulatory Framework includes strong short-term regulatory targets to reduce air emissions from major industries, including the following sectors:

- electricity produced by combustion,
- oil and gas,
- forest products,
- smelting and refining,
- iron and steel,
- cement, lime, and chemicals production,
- some mining sectors.

Action on Greenhouse Gases

Industry accounts for about half of Canada's greenhouse gas emissions that cause climate change. The Government is mandating the reduction of industrial greenhouse gas emissions through the introduction of a robust regulatory regime that includes access to domestic emissions trading, the Kyoto Protocol's Clean Development Mechanism and a technology fund.

This regulatory system will place Canada on the path to achieving sustained absolute reductions in industrial greenhouse gas emissions. More specifically, it will ensure that as early as 2010 total greenhouse gases stop rising, and that by 2020 we achieve absolute reductions of 150 megatonnes compared to this year's levels.

Action on Air Pollutants

About half of Canada's air pollution is produced by industry. The Regulatory Framework for Air Emissions sets overall national fixed emissions caps for air pollutants. This will lead to reductions in air pollutant emissions that cause smog and acid rain by up to 55% as early as 2012 compared to 2006 levels. These targets will specify the maximum level of pollutant that can be emitted from a given sector in a given year.

Regulations will place caps on total emissions of four acid rain and smog -causing air pollutants:

- Nitrogen oxides (NO_x),
- Sulphur oxides (SO_x),
- Volatile organic compounds (VOCs), and
- Particulate matter (PM).

Sector specific caps on these and other pollutants, such as mercury, will also be included.

Other Emission Reduction Initiatives

In addition to measures to reduce air emissions from industry, the Government is committed to addressing emissions from transportation, strengthening energy efficiency standards for a number of energy-using products, and for the first time, the Government has recognized the urgent need to take action to improve indoor air quality and committed to implement measures to do so.

Cooperation with Provinces and Territories

We will continue to work in partnership with provinces and territories to promote approaches that avoid unnecessary duplication of effort so that we get the maximum amount of environmental benefits with the least amount of administrative and cost burden for industry.

Benefits & Costs

These actions will reduce the impact of greenhouse gases and air pollution on the environment and the health of Canadians. These regulations will have real, tangible health and environmental benefits for everyone, as well as positive economic effects. The estimated benefits as of 2015 from the reduced risk of death and illness associated with our air quality improvements are over \$6 billion annually.

The Government's regulatory approach will promote investment in technology and innovation in Canada, yielding long-term economic benefits from enhanced productivity, improved energy efficiency, greater competitiveness, more opportunity to sell Canadian environmental products and know-how abroad and more jobs for Canadians.

A reduction in air emissions will also raise the productivity of some sectors. For example, reduced pollution is expected to lead to an increase in production of up to \$150 million for key agricultural crops. Other industries will also benefit, including tourism, forestry and in-land fishing.

The health benefits will include reductions in the number of premature deaths related to air pollution, strokes, heart attacks, hospital admissions and emergency room visits, cases of child acute bronchitis, and the number of days where asthma symptoms occur. There will be many environmental benefits as well, including improved conditions for nature and wildlife. Strong actions inevitably come at a cost, and those costs will be borne, at least in part, by individual Canadians and their families. The costs associated with this initiative are real but manageable. This can include increased prices for consumer products such as vehicles, natural gas, electricity, and household appliances.