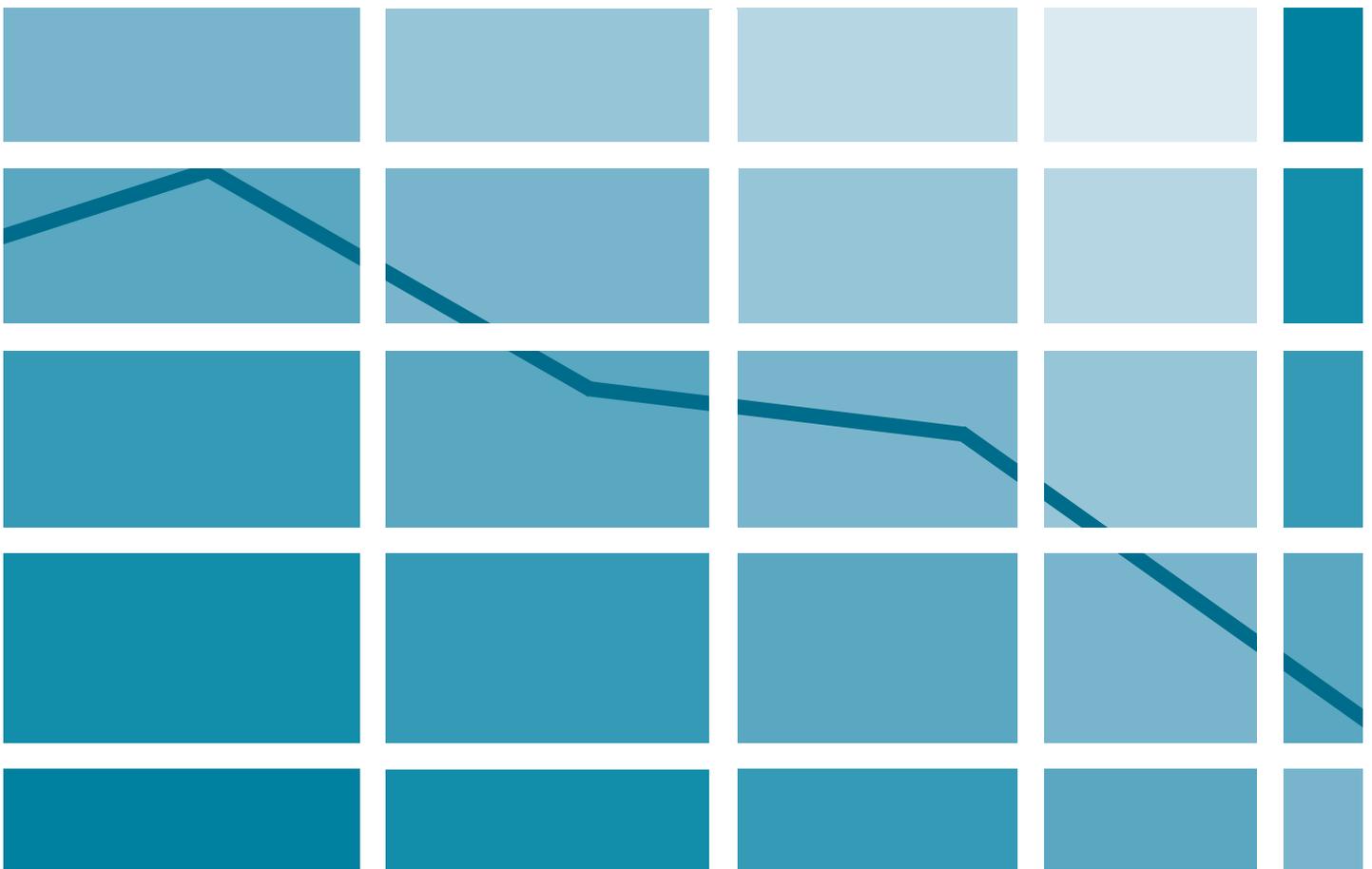


A Guide to Kyoto:

Climate Change and What it Means to Canadians



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A Guide to Kyoto: Climate Change and What it Means to Canadians

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DÉVELOPPEMENT DURABLE



A Guide to Kyoto: Climate Change and What it Means to Canadians

"In the end, negotiators set aside many of their differences for the sake of the planet." —

*Michael Oppenheimer, atmospheric physicist,
Environmental Defense Fund*

"The Kyoto Protocol was the most complex non-military treaty negotiations in history." —
The Wall Street Journal

"It's an historic agreement. If countries who sign the treaty put in place the requisite policies and actions, the world will be set on a new course, one which is less dependent on fossil fuels, less polluting and less a threat to human health." —

Jonathan Lash, President, World Resources Institute

"The treaty will fail to reduce the threat of climate change because key players—the U.S. and Japan—have refused to set realistic targets for emission reductions. They also inserted loopholes that would further reduce their already very low targets, and in some cases, even allow an increase in greenhouse gas production." —
World Wildlife Fund

"Most Canadians aren't aware of the economic impact of the Kyoto Protocol and the changes in lifestyle that will be required to meet such an ambitious target." —

John Dillon, Business Council on National Issues

"...Cutting our emissions by the amounts agreed to at Kyoto in little more than a decade will require a massive shift in the way we use energy. This is by far the most serious environmental promise Canada has ever made." —
Editorial, The Globe and Mail

After 48-hours of non-stop talks, 160 nations, including Canada, negotiated a global treaty on December 11, 1997, to limit the production of greenhouse gases. Known as the Kyoto Protocol (Kyoto Protocol to the United Nations Framework Convention on Climate Change) after the Japanese city where the final marathon bargaining session was held, this treaty will have profound implications on our economy and lifestyles.

What is the treaty's overall significance?

The Kyoto Protocol is the result of a consensus among the nations of the world that climate change caused by human activities is a definite risk, and that concrete action must be taken. The treaty goes beyond the voluntary emissions controls of previous international agreements. It is legally binding, with compliance measures to be determined at future negotiations.

The treaty is a recognition by the world's major industrial nations that the scientific evidence for climate change is now so strong, that it can no longer be ignored.

This is a view being adopted by a growing number of multinational corporations. "We've moved, as the psychologists would say, beyond denial," said John Browne, Group CEO of British Petroleum, in a speech on the treaty's implications. "There's a growing consensus that climate change is an issue we have to take seriously."

What are the possible implications of climate change?

A United Nations panel representing the majority of the world's climate scientists concluded in 1995 that "there is a discernible human influence on global climate." The clearest evidence of this is the changing chemical composition of the earth's atmosphere, says James Bruce, a scientist with the Canadian Climate Board. Since the Industrial Revolution, the concentration of carbon dioxide in the atmosphere has risen by 30 percent. Over the past few decades, scientists have measured a warming trend in the earth's surface temperature, and predict it will accelerate unless action is taken now to reduce the rate of increase of greenhouse gases.

The consequences of climate change are wide-ranging and unpredictable. A rise in the earth's average temperature of just a few degrees will cause glaciers in the polar regions to melt. This could result in rising sea levels, causing flooding of major coastal cities such as Tokyo, Miami, Venice and Alexandria. Canada has its own vulnerable areas, such as the Fraser Delta of British Columbia and parts of Prince Edward Island.

The Intergovernmental Panel on Climate Change (IPCC), made up of the world's leading climate scientists, predicts sea levels could rise by as much as 90 cm by 2100. Using the panel's conservative estimate of 48 cm, scientists from the Environmental Defense Fund calculate that:

- 10 percent of Bangladesh will be flooded
- 600 square kilometers of land in Japan will be inundated during high tides
- more than 30 metres will erode from most North American beaches
- almost 2,000 square kilometres of dry land will be lost in Florida
- 4,000 hectares of coastal property will be lost in Massachusetts

Severe weather, such as floods, wind, hail and ice storms will likely increase, predict many climatologists, although the precise link with global warming remains to be proven. What is known is that warmer air can hold more water than cooler air, and our atmosphere already contains more moisture than it did 25 years ago.

Thomas Karl, a climate analyst at the U.S. National Oceanic and Atmospheric Administration, estimates that for every one degree Celsius increase in the global temperature of the atmosphere, its capacity to hold water vapour will increase by six percent. The result is that wet areas will get wetter, and dry areas dryer, says Karl. Although the frequency of rain or snowfall may increase slightly, the most probable impact is that the average amount of precipitation in any given weather event will be greater, Karl predicts. These intense storms will cause more flooding and erosion. The meteorological records support this: Environment Canada's national network of weather stations has recorded a 10 percent average increase in precipitation since 1955.

What are the treaty's key elements?

The commitments agreed to at Kyoto apply only to 38 developed nations and the countries in transition in Central and Eastern Europe (Russia, Ukraine, etc.). While individual nations have different targets, the overall reduction in greenhouse gases from 1990 levels is 5.2 percent. Rather than setting a single year as the deadline, the treaty allows countries to average their emissions over a five-year period (2008-2012), to allow for variations in economic growth, weather and other factors. (Details on the six greenhouse gases covered by the Treaty and their chemical properties are listed in an accompanying chart.)

The treaty also has a number of "flexibility provisions" to allow countries to find the lowest cost options to meet their targets. These include: investing in activities which store carbon; emissions banking and trading; and joint implementation of projects with developing countries. Let's look at these in more detail:

1. Removing carbon dioxide from the atmosphere

Countries can claim "credits" for investing in tree-planting or other activities which take carbon out of the atmosphere. These are called carbon sinks (see glossary). Starting with tiny phytoplankton—which drift with the currents in the oceans—members of the plant kingdom are unique in their ability to absorb carbon dioxide through photosynthesis in order to produce starches for growth. But since the Industrial Revolution, the recycling of carbon has been out of balance. The rapid cutting of the earth's forests since the 19th century accounts for about half the build-up of carbon dioxide in our atmosphere, calculates Stephen Schneider, a climatologist at Stanford University. Countries that help reverse this trend by expanding their forest cover can claim credits to offset their emissions of greenhouse gases.

In essence, each nation that implements the Kyoto Protocol will have a greenhouse gas "bank account." Rules for calculating credits and deductions of emissions and offsets will be the subject of negotiations at the next U.N. climate change conference in Buenos Aires in November 1998.

2. Clean Development Mechanism and Joint Implementation

The Clean Development Mechanism provides an incentive for industrialized countries to invest in initiatives in developing countries that reduce net greenhouse gas emissions. Eligible clean energy projects could include: building a small-scale hydro plant or replacing an old, coal-fired electrical generating plant with a high-efficiency natural gas turbine. Under the clean development mechanism, the savings in carbon dioxide emissions will be recorded as a credit, which will be shared among the parties to the transaction.

Greenhouse gases covered by the Kyoto Protocol

Substance	Chemical symbol	Sources/Use	Damage to atmosphere	Lifespan
Carbon dioxide	CO ₂	<ul style="list-style-type: none"> - occurs naturally - combustion of fossil fuels (coal, natural gas, petroleum) - deforestation (CO₂ released when trees decay or burn) 	<ul style="list-style-type: none"> - United Nations estimates that CO₂ is currently responsible for over 60% of the “enhanced” greenhouse effect, which is responsible for climate change 	<ul style="list-style-type: none"> - calculations are imprecise because billions of tonnes of CO₂ are exchanged naturally each year - CO₂ levels varied by less than 10% before industrialization - in the 200 years since 1800, levels have risen by almost 30%
Nitrous oxide	N ₂ O	<ul style="list-style-type: none"> - occurs naturally - fertilizers - high temperature combustion of fossil fuels 	<ul style="list-style-type: none"> - a molecule of N₂O is 200-300 times more effective than a molecule of CO₂ in greenhouse warming 	<ul style="list-style-type: none"> - 150 years
Methane	CH ₄	<ul style="list-style-type: none"> - occurs naturally - flooded rice paddies - farm animals - waste dumps - coal mining and natural gas production 	<ul style="list-style-type: none"> - currently contributes 15–20% of the enhanced greenhouse effect 	<ul style="list-style-type: none"> - 11 to 12 years
Halocarbons - chlorofluorocarbons (CFCs) - hydrochlorofluorocarbons (HCFCs)	- multiple (there are many types)	<ul style="list-style-type: none"> - used to make foam, cleaners, aerosol sprays, and coolants for refrigeration and air conditioning equipment 	<ul style="list-style-type: none"> - destroys ozone layer - contributes to the enhanced greenhouse effect 	<ul style="list-style-type: none"> - up to 400 years
Perfluorocarbons (PFCs)	- multiple (there are many types)	<ul style="list-style-type: none"> - used in solvents (particularly for cleaning electronic equipment) and fire suppression equipment 	<ul style="list-style-type: none"> - global warming potential is 5,000-10,000 times greater than CO₂ 	<ul style="list-style-type: none"> - 3,000-5,000 years
Sulphur hexafluoride	SF ₆	<ul style="list-style-type: none"> - an insulating alternative to mineral oil or air in some high-voltage equipment as well as for water leak detection in cable cooling systems 	<ul style="list-style-type: none"> - has a much greater greenhouse potential than CO₂, but concentrations in atmosphere are very low 	<ul style="list-style-type: none"> - on-going research

Generally, investments in developing countries offer opportunities for greater reduction in greenhouse gas emissions per dollar than in developed countries. Industrial economies have already achieved higher levels of efficiency in their factories and infrastructure. Furthermore, the higher growth rates in many developing countries create more opportunities for earlier deployment of energy efficient technologies.

Joint implementation is the name given to projects carried out in partnership among developed nations and economies in transition in Central and Eastern Europe. For example, it has been estimated that Russia loses a significant amount of its oil and gas as a result of leaks in pipelines, and inefficient refining and materials handling. Many firms from Alberta's oil patch already have contracts to transfer management and engineering skills to Russia's energy industry. Under the Kyoto Protocol, these projects may earn emissions reduction credits.

Other countries are also interested in joint implementation projects with Russia to earn emissions credits. In April 1998, Japan signed an agreement to study ways of reducing emissions at 20 Russian power plants and factories.

3. Emissions trading

The Kyoto agreement permits the trading of emissions reductions among countries. It provides for countries with commitments under the treaty to buy and sell units of emission reduction among themselves. The kind of valuation system that would apply to such transactions, and the identification of an international body to monitor and regulate this trade will be determined at future negotiations.

In the meantime, international emissions trading has already started in advance of hard and fast rules. Suncor Energy of Calgary announced in March 1998 that it has purchased 100,000 tonnes of greenhouse gas credits from Niagara Mohawk Power of Syracuse, N.Y. Suncor also has an option on another 10 million tonnes of credits over a ten year period, with a potential value of \$10 million.

The two companies are hoping their agreement will be a model for a global system of emissions trading under the Kyoto Protocol. Both firms say they benefit from the deal: Suncor is planning to expand its oil sands operations at Fort McMurray, Alta., by 64 percent in the next two years. Even after reducing its own emissions on a per unit basis by a third, this will still result in a net 12 percent increase in greenhouse gases between 1990 and 2000. Purchasing credits from another company is the cheapest way to offset those emissions, and in this case, also has further environmental benefits. Under the terms of the agreement, Niagara Mohawk Power will invest a minimum of 70 percent of the proceeds from the sale in energy conservation projects.

Two countries likely to have credits for sale are Russia and Ukraine, whose economies have contracted since 1990. Simply put, they have fewer factories burning less fossil fuel. In the longer term, the idea is to foster a free market in emissions credits, and reward countries that are most efficient.

What about the participation of developing countries?

Developing countries did not commit to specific reductions, primarily for two reasons. Their priorities are economic growth and poverty reduction; and secondly, industrialized countries consume far more energy, and thus produce far more greenhouse gases. For example, Canadians use 30 times more energy than citizens of India on a per capita basis. Furthermore, it has been estimated that since the Industrial Revolution in the 19th century, Europe and North America have produced 85 percent of the *human-induced* carbon dioxide in the atmosphere today.

The developing nations see Kyoto as a test of whether the world's economic superpowers are serious about climate change. But while developing countries didn't create the problem, they will have to be part of the solution, because many—China, India, South Korea and Brazil—now have large, rapidly expanding industrial sectors. Indeed, sometime after 2015, developing countries will produce more than 50 percent of the world's greenhouse gas emissions.

Clearly, global warming cannot be addressed without the involvement of developing countries. Through its "Clean Development Mechanism," the Kyoto Protocol will encourage industrialized countries to invest in "green" projects that transfer climate-friendly efficient technologies to the developing world.

When does the Kyoto Protocol come into force?

Although the majority of the world's nations have negotiated the treaty, it still has to be formally signed and ratified. At least 55 countries representing 55 percent of emissions from developed countries, plus Central and Eastern Europe, have to sign the treaty by March 1999, and then take the legal steps necessary to ratify it.

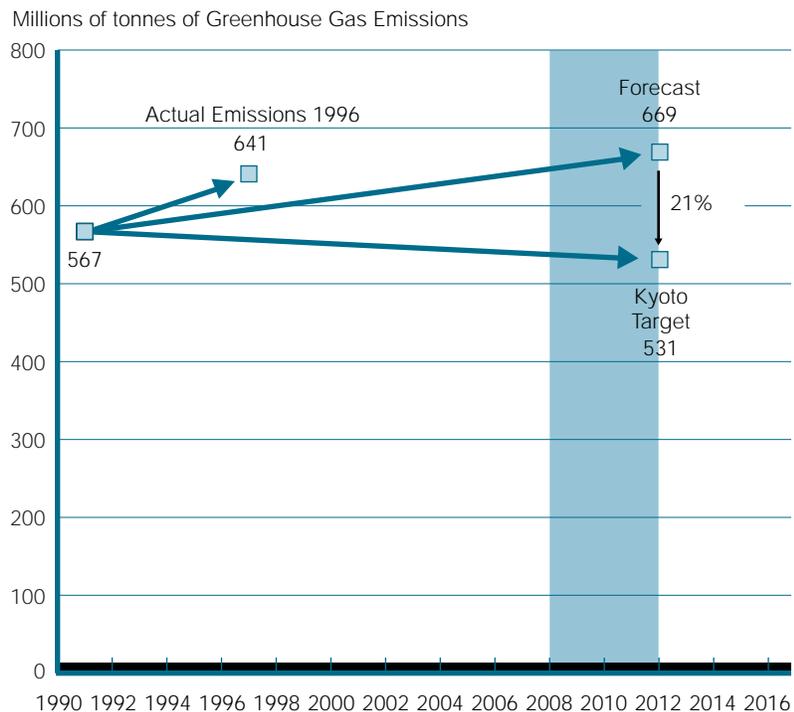
What does the treaty commit Canada to doing?

Canada has agreed to reduce its greenhouse gas emissions by six percent from 1990 levels by 2008-2012. At first glance, this sounds like a small amount. In fact, it isn't, because our emissions are growing rapidly. From 1990 to 1996, total emissions increased within a range of 10 to 13 percent.

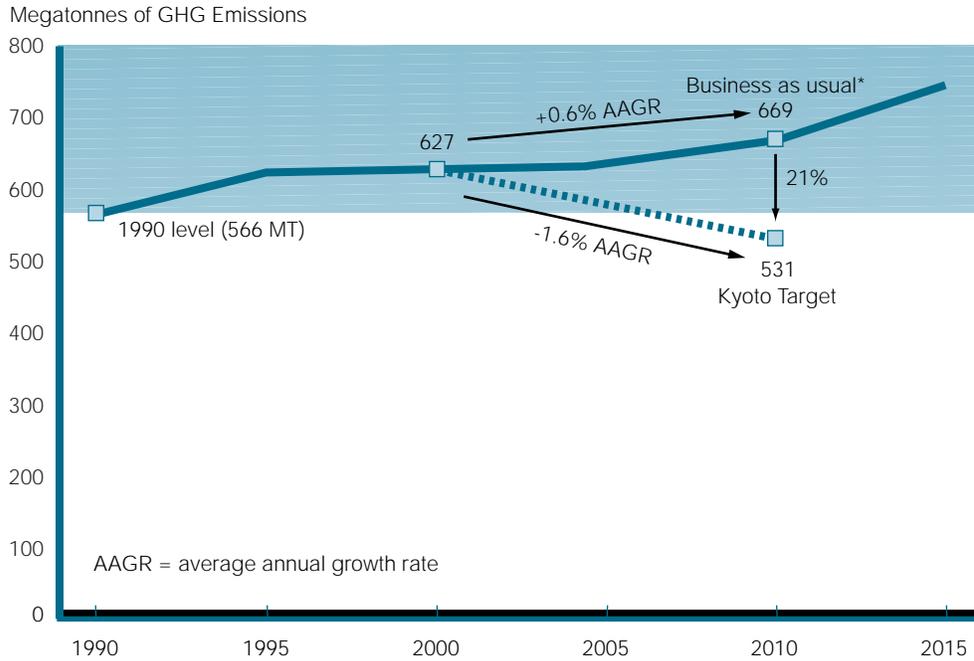
Canada's greenhouse gas emissions are projected to keep rising unless action is taken. So to meet our commitment under the Kyoto treaty, we will actually have to reduce greenhouse gas emissions by 21-25 percent (see accompanying charts) over the next 14 years.

Canada's Kyoto Target

Source: Natural Resources Canada (April 1998)



Achieving Kyoto: The Challenge for Canada



Source: Canada's Energy Outlook 1996-2020

* Business as usual includes existing mitigative measures for emissions reduction and the estimated impact of the Ontario Hydro lay-up of nuclear units.

Why have Canada's emissions increased so rapidly since 1990?

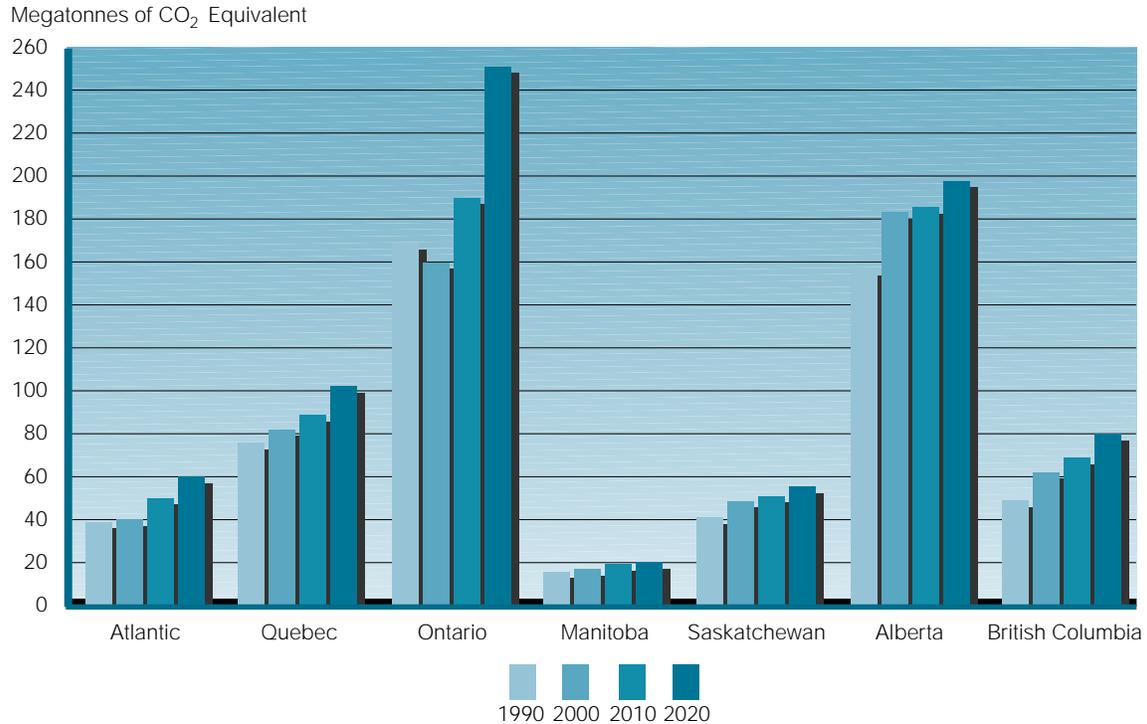
Over the past eight years, our population has been growing by almost one percent per year. As well our economy is expanding—our Gross Domestic Product is forecast to grow by three percent in 1998 alone. Each new house that is built; each new car on the road, adds to our emissions. Motor vehicles are becoming more efficient at burning gasoline, but the sheer increase in the number of vehicles and the miles we are driving are outstripping these efficiencies. As well, vans and sport utility vehicles are becoming very popular, and they are not as fuel efficient as smaller, lighter passenger cars.

Another factor is that the volume of natural gas we are exporting to the U.S. is growing rapidly, and its production and transportation results in emissions of methane and other gases. While we are exporting a clean fuel to the U.S., the emissions resulting from its production occur in Canada.

How will the Kyoto Protocol affect our energy sector?

Meeting the Kyoto targets will require a major restructuring of the Canadian energy sector. Currently we are on a steep upward growth curve of greenhouse gas emissions. Changing that will be like changing the course of a huge super tanker. How smart we are about doing that will determine how competitive and vibrant our economy will be in the next century. The challenge is to figure out how to have growth, without putting more carbon dioxide into the atmosphere.

Greenhouse Gas Emissions by Province



Source: Natural Resources Canada, *Canada's Energy Outlook: 1996-2020*

Already in North America there is a trend to move away from fuels with a high carbon content, such as coal, to cleaner fuels, such as natural gas. Provinces that rely on coal for part of their electricity generation (Nova Scotia, New Brunswick, Ontario, Saskatchewan and Alberta) will face a particular challenge in making the transition. To reduce greenhouse gas emissions from electricity, they will have several choices, including investing in high efficiency coal combustion technology, increasing end use efficiency, switching to other energy sources and investing in offsets that reduce emissions or sequester carbon.

The Kyoto Protocol will create a higher demand for natural gas, both domestically and in the U.S., since it is the cleanest burning fossil fuel. The treaty will also spur a re-evaluation of potential hydro-electric projects and renewable energy sources.

Investment in research on clean fuels and renewable energy technologies will increase substantially. The meteoric rise in the price of shares of Ballard Power in 1997 and the first quarter of 1998 is an indication of the value investors are placing on the potential of fuel cells.

“By 2050, half of the world’s energy demand will come from renewable energy sources not linked to coal, oil or gas.” — forecast from Royal Dutch/Shell Group

What are the risks of doing nothing as compared to the costs of implementing the Kyoto Protocol?

Warmer temperatures will bring some benefits: reduced heating costs; more frost-free days for farmers in northern areas like Alberta’s Peace River District; and a longer ice-free navigation season on the Great Lakes and in the Arctic. (And on a lighter note: the golfing season will be longer.)

But a growing number of studies warn that the cost of doing nothing—while difficult to measure—will outweigh these gains. Already, public health physicians are seeing a northwards spread of malaria and other infectious diseases previously confined to the subtropics. Increased humidity, mould spores and pollen will affect those suffering from asthma and allergies.

Global warming will spur desertification, reducing agricultural production in Sub-Saharan Africa and other regions already struggling with food supplies. Here in Canada, it will severely disrupt farming in the dry lands of southern Saskatchewan and Alberta and increase the frequency of forest fires.

Mitigating and adapting to the effects of climate change will require huge investments in infrastructure, such as dikes to control rising sea levels. A 1997 Environment Canada report concludes: “Although there remains considerable uncertainty regarding projections of changes in flooding and other extreme [weather] events, the potential implications of these changes for buildings and construction warrant their consideration. The flooding of low-lying homes, docks and port facilities, as well as stresses on water distribution and sewer systems associated with projected increases in sea level, extreme rain/snow fall, and spring ice jams on rivers are a major concern. Particularly vulnerable to changes in extreme events are electricity transmission and utility lines (due to changes in wind and ice loading), bridge piers, and dams (due to changes in flood levels and ice jams). ”

This last sentence seems prophetic in light of the ice storm which crumpled transmission towers and blacked out large parts of southern Quebec and Eastern Ontario in January 1998. Environment Canada predicts rising losses due to storm-related damage to homes and commercial buildings, roads and bridges.

Other costs are no less serious, but difficult to estimate: water shortages affecting municipal water supplies, hydro-electricity generation and navigation of waterways and rivers.

But reducing greenhouse gas emissions will also have costs. A survey of macroeconomic models by the Conference Board of Canada concludes that the Kyoto targets will stunt growth by 1.3-2.3 percent by 2010, which translates into a loss of \$18-\$28 billion to the Canadian economy. The Business Council on National Issues predicts the treaty will cost jobs in Canada and other developed countries.

Janet Yellen, chair of President Clinton’s Council of Economic Advisers, has predicted that in the U.S., the cost of meeting its reductions will mean consumers will pay between 3-10 percent more for energy by the years 2008-2012, depending on whether there is an efficient global system in place for trading emissions permits.

Cleaner technology is already available, so the cost of reducing emissions is a function of the timeline for meeting targets. Homeowners can switch to high-efficiency furnaces, and upgrade insulation. Corporations can invest in solar power and switch their fleets of vehicles to propane or ethanol. Utilities can build gas-fired cogeneration plants, which are twice as efficient as traditional coal generating stations. But this will require a huge capital investment. If furnaces or vehicles or generating plants are replaced after their normal service periods, the cost of emissions reductions is relatively low. But if appliances and plants have to be replaced sooner, before the end of their normal service life, the cost will be relatively high.

Instead of acting now to reduce greenhouse gas emissions, wouldn't it be better to wait until cheaper technologies are available?

The World Resources Institute in Washington has studied the economics of a delaying strategy, and concludes:

1. Policies and tax incentives are needed now to spur research, mass production and marketing of less carbon-intensive energy alternatives.
2. The longer we wait, the greater the accumulation of fossil-fuel dependent vehicles, appliances and machinery, and the more disruptive and costly future greenhouse gas reductions will be.
3. Without early action, the potential benefits from greenhouse gas reduction policies, such as improved air quality, increased savings from energy efficiency, and enhanced energy security, will be lost.
4. Duncan Austin, a WRI researcher states: "A climate protection policy based on an explicit strategy of delay—doing little or nothing now and more later—is not credible. Without explicit market and policy signals in the near term, emissions will continue to rise while capital investments and technological developments will continue much as before, making it harder, not easier, to implement policies and threatening greater, not less, disruption in the future."

Does the Kyoto treaty go far enough... or too far?

Opinions are decidedly divided on this point.

"While some Canadian businesses see opportunities to sell new technologies, most of our major resource and manufacturing industries believe Kyoto is a bad deal for Canada," says John Dillon of the Business Council on National Issues. There is a great deal of unease about the practical realities of achieving emissions reductions. In the opinion of David Manning, president of the Canadian Association of Petroleum Producers, "The real issue is how the government will reconcile the targets agreed to at Kyoto and its commitment to no punitive taxes, more jobs and continued economic growth for Canada."

The Business Council has two main criticisms of the treaty: the time frame is too short, and the targets are inequitable. Depending on how steeply our emissions increase over the next decade, Canada could be facing a reduction in greenhouse gases of more than 21 percent. Canada, with its resource-based, energy intensive economy has taken on a greater burden than other countries, Dillon argues. Australia will be allowed to increase emissions by eight percent over 1990 levels. The European Union will be allowed to average emissions among its members, giving it a great deal of flexibility. This will allow it to take advantage of economic restructuring in the former East Germany and the switch from coal to natural gas in Great Britain. In effect, the EU has committed itself to reducing emissions from projected "business as usual" levels by only 15 percent, significantly less than Canada and the U.S.

As his bottom line, Dillon doesn't believe Canada should ratify the Kyoto Protocol unless the U.S. does, because our economies are so integrated due to the North American Free Trade Agreement. To go it alone would put Canada at a serious trade disadvantage.

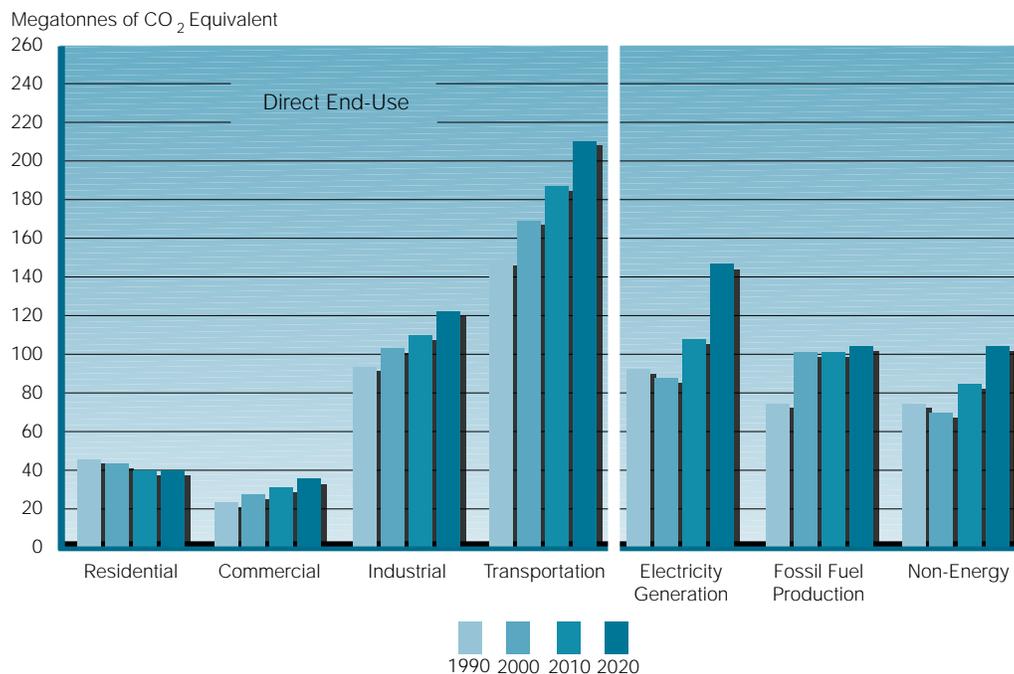
In any case, the treaty would be ineffective without the participation of the world's largest producer of greenhouse gases, and Dillon believes there are strong signals coming from important players in Washington that ratification of the treaty is questionable, unless there are major changes.

On the other side of the table is Louise Comeau, formerly of the Sierra Club of Canada and now manager of climate programs for the Federation of Canadian Municipalities. She describes Kyoto as a positive first step, but concludes "the targets are too little to actually prevent climate change. Furthermore, our concern is that there are too many loopholes, and through future negotiations, they could become even larger."

Comeau would like to see two main sections of the treaty tightened up. There should be a separate protocol to protect carbon reservoirs, such as forests; and there should be no trading in credits for carbon sinks, she contends.

As well, the Sierra Club wants to see the general trading provisions apply only to real investments in reducing emissions, so that countries like Russia or Ukraine cannot sell credits because of previous involuntary reductions in emissions due to the contraction of their economies.

Greenhouse Gas Emissions by Sector



Source: Natural Resources Canada, *Canada's Energy Outlook: 1996-2020*

Overall, Comeau is worried that the treaty will make it more attractive for Canada, the U.S. and Japan to buy emissions credits from other countries, rather than tackling the problem at home. This will just postpone investment in energy efficient technology and renewable energy domestically, she believes.

Testimony by Janet Yellen, chair of U.S. President Bill Clinton's Council of Economic Advisors, confirms that this is the American scenario. In making her predictions for the cost of implementing the Kyoto reductions, Yellen's underlying assumption was that the U.S. will achieve most of its 26 percent reduction by purchasing credits from other countries.

Is there a game plan for meeting our Kyoto target?

While none of the nations that negotiated the treaty has a firm plan yet on how to meet its cuts, many scientists, corporations and environmental organizations have developed preliminary scenarios. Here are some broad considerations for the Canadian situation:

The burning of fossil fuels for manufacturing, moving people and goods, and generating electricity is responsible for the majority of our greenhouse gas emissions (see chart). To meet our Kyoto target, Canada will have to make reductions in these key areas:

1. Transportation

With the rapid increase in the number of vehicles on our roads, and the dominance of trucking for freight transportation, emissions in this sector are growing faster than any other. In the past two decades, many models of cars have become more fuel efficient, but to meet our emissions targets, we can no longer be satisfied with efficiency gains of two to five percent every few years. To meet our overall reduction target of 21-25 percent, we will have to cut emissions sharply in this sector. There are two options:

Incentives designed to reduce the use of cars and to encourage people to take public transit. These may include negative incentives or "sticks," such as raising taxes on gasoline and implementing road tolls, but in the short term are more likely to concentrate on positive incentives, or "carrots," such as reducing public transportation fares or providing tax credits for the purchase of ultra fuel efficient vehicles. In addition to incentives, governments can use public education campaigns to encourage people to ride bicycles, and they can influence the way goods and people are transported through urban planning.

On the other hand, mobility—or automobility—is one of the defining aspects of the 20th century. Use of public transit, despite awareness campaigns, is not increasing. In fact, in some Canadian cities, such as Ottawa, ridership is actually decreasing.

The second option is a technological fix: developing cars that consume clean fuels which either emit less greenhouse gases or none at all:

- major car manufacturers are producing prototype electric cars, and are continuing research on more efficient batteries.
- Companies in Canada, Japan and Spain are developing fuel cells powered by hydrogen, whose only by-product is moisture. Hydrogen-powered buses have been tested in British Columbia and Germany, but commercially available cars are still some years away.

Given the long lead times needed to develop and produce alternate fuel cars, together with the eight to ten years required to replace existing vehicles on the road, it is unclear how much of a contribution a new generation of “green” cars can make within the Kyoto time frame.

- A solution in the shorter term would be to switch to a fuel mix of gasoline and ethanol. Ethanol is a fuel made from the sugars in plants. Currently, most ethanol is now made from corn or sugar cane. Petro-Canada and Iogen, an Ottawa-based biotechnology company, have launched a pilot plant to make ethanol on a commercial scale from waste wood, straw and other agricultural wastes, using enzymes which break down cellulose to produce sugars. Ethanol produced from such biomass results in a greater-than-90 percent reduction in greenhouse gas emissions.

A number of analysts point out that since Canada does not have a domestically owned automobile industry, we can promote research on cleaner fuels, but have little influence on the next generation of automotive engineering. We are dependent on priorities and timetables set by U.S., Japanese, and other foreign-based auto makers.

Our love affair with the car

The internal combustion engine is the single greatest source of our greenhouse gas emissions. There are more than 17 million motor vehicles in Canada, one for every second Canadian, and then some.

Eighty percent of Canadians commute to work by car. Only ten percent use public transit.

Source: Statistics Canada

2. Electricity generation

There are a variety of options for reducing emissions in this sector:

- switch from coal to natural gas for generating electricity
- build more natural gas co-generation plants which supply both electricity and heat
- promote small-scale, hydro projects on smaller rivers
- provide incentives for developing wind, solar and other renewable energy sources

A shift is already underway in this sector towards more gas-fired co-generation plants, and several provincial utilities have started encouraging the development of small hydro projects.

3. Industrial Sector

Cutting emissions in this sector will be challenging. A number of industries, including chemicals, cement, petroleum refining, textiles, electronics, pulp and paper, steel and aluminum makers have all reduced their emissions per unit of production in the past decade. The challenge is one of increasing production and exports while stabilizing and then reducing emissions of greenhouse gases.

Canada's fossil fuel sector is also challenged by the need to increase production and exports while reducing emissions.

4. Residential and Commercial Buildings

While this sector is responsible for a relatively small percentage of carbon dioxide emissions, it may be one of the most cost-effective areas to invest in. Retrofitting older buildings with insulation and efficient windows, and upgrading heating and cooling systems could yield significant cuts in emissions at a relatively low cost, as well as creating jobs. As with the other sectors, the question is, where will the money come from? Many homeowners are willing to upgrade to higher efficiency furnaces, if they don't have to borrow to do so, and if they can see future savings in energy costs.

5. Enhancing carbon sinks

As well as reducing emissions, the other available option is to increase the rate of removal of carbon dioxide from the atmosphere. Environment Canada and the Canadian Forestry Service are currently studying what the impact would be if large areas of marginal or abandoned farmland were reforested with genetically engineered, fast growing trees.

Wood used for construction or manufacturing is a carbon sink, since its carbon content is "locked in" for long periods. Soils are another potential sink. The cultivation of the Prairies over the past 150 years released large amounts of carbon dioxide into the atmosphere, as wind and water erosion removed much of the soils' organic content.

Environment Canada's studies show that soil erosion currently releases about 2.5 million tonnes of carbon dioxide into the atmosphere every year. But that figure is less than two-thirds of what it was 15 years ago, as farmers are increasingly adopting better soil management practices.

Within the next decade, our soils have the potential to become a net carbon sink. To test their capacity to absorb carbon dioxide, TransAlta Corporation of Calgary is funding the Saskatchewan Soil Enhancement project. The program encourages farmers to practice low-tillage techniques and leave crop residue on their fields, which protects the soil from wind erosion. In 1996, the project reduced net carbon dioxide emissions by an estimated 1.2 million tonnes. Over the next 12 to 15 years, the pilot project will remove an estimated 11 million tonnes of carbon dioxide. As well, the low disturbance cultivation practices are building up the soils' organic content, increasing its capacity to hold moisture and nutrients. The result will be more productive land.

What can businesses do?

Reducing carbon dioxide emissions has already become part of the business plan of many progressive corporations, who see cost savings in energy efficiencies. Suncor recently teamed up with Calgary-based Mercury Electric Corporation to install mini-turbines to generate electricity from waste flare gas. The power will be used for Suncor operations, thus reducing net emissions.

Businesses have a number of strategies and tools at their disposal:

- **employee incentives:** workers and engineers on the plant floor are the greatest source of ideas for energy conservation. Many companies offer rewards for suggestions that produce results. “We’re learning about the extraordinary motivating power of a constructive environmental stance,” says John Browne, BP Group CEO. “We’re learning there is no trade-off between profits and pollution, and we’re learning about the potential for lateral thinking in this area.”
- **promoting benchmarking and best practices:** Natural Resources Canada is working with industries to rank their energy use against the performance of similar industrial processes in Canada and internationally. The information is being used to develop energy consumption guidelines that will help companies assess their energy efficiency.
- **energy audits:** businesses can commission studies to assess potential energy savings and identify lowest-cost options for reducing carbon dioxide emissions. Many utilities and private consultants provide energy audits. For example, B.C. Hydro’s Power Smart program has worked with 485,000 clients over a five-year period, and achieved annual savings of 1,457 gigawatt-hours of electricity, enough to power a city the size of Richmond, B.C. Ontario Hydro’s energy audit program is known as Custom Solutions. A study it undertook for Cadillac Fairview of 20 commercial properties in Ontario recommended investing \$3.9 million in energy efficiency measures and lower wattage lighting. With annual savings of \$1.1 million, the investment will pay off in four years.
- **life-cycle analysis:** by analyzing the energy content and life span of materials used in a particular manufacturing process or product, often more efficient materials can be substituted. For example, automobile makers have replaced steel with synthetic plastics in many body components because the new materials are lighter, more resistant to corrosion, and are less energy intensive to produce.
- **marketing waste products:** studies of by-products often suggest ways of recycling waste materials, which can lead to greenhouse gas reductions. For example, ash from coal-fired, electrical generating plants is now being used to make cement, rather than being dumped in landfills. Nova Scotia Power sold 15,000 tonnes of fly ash from its thermal plants to the contractor building Confederation Bridge connecting Prince Edward Island to the mainland. The result was a saving of 15,000 tonnes of carbon dioxide emissions. Natural Resources Canada, which pioneered the recycling of fly ash, has found that concrete made with ash is of higher quality than conventionally made concrete.
- **offsets and emission credits:** identify opportunities for enhancing carbon sinks, such as forests and soils; and pursue opportunities for purchasing credits domestically and internationally.

What can communities do?

Climate change is the result of activities of billions of individuals living and working in their communities. Local groups and municipalities thus have a tremendous potential to achieve emissions reductions through such initiatives as home energy efficiency programs and public transport policies.

The Federation of Canadian Municipalities' 20 percent Club is a group of municipal and regional governments across Canada working together to reduce greenhouse gases produced locally by 20 percent.

To do this, it encourages networking and partnerships among municipalities concerned with climate change in order to create tailored emissions reduction plans that address local needs and resources while building on the resources of others.

Among the strategies it promotes are:

- capturing methane gas from landfill sites
- tax-free bus passes to encourage use of public transit
- building co-generation power plants
- retrofitting homes and commercial buildings to make them more energy efficient
- planting shade trees to reduce energy consumption for air conditioning

Is there a timetable for action?

Since many sectors affected by climate change are shared federal-provincial responsibilities, the Canadian action plan will require extensive coordination. Ottawa has created a Climate Change Secretariat and is working with the provinces to set up a national secretariat to provide the national coordinating agency to develop a national implementation strategy.

The federal government has set a timetable of 18 months to two years to develop a national implementation strategy with the provinces to meet Canada's Kyoto commitment. The task is to identify which actions are the most cost-effective, and to develop equitable ways of achieving reductions.

But environmental groups say we can't afford another two years of studies, and are urging early action now, such as pilot projects to test green technology. For their part, federal officials say devising a smart game plan will be a complex process, given the number of stakeholders and the necessity of mitigating regional hardships. They also point out that the federal government has been funding clean energy research for years—having provided seed money to Ballard Power for hydrogen cells, Iogen for its ethanol research and funding a variety of demonstration co-generation projects.

What issues remain to be resolved at future negotiations?

All the controversial flexibility aspects of the Kyoto Protocol remain to be spelled out. For example, the treaty does not specify rules for such things as emissions trading or how to bank credits for planting trees or for carbon absorbed by soils.

“The inclusion of sinks might one day be considered the biggest flaw of the Kyoto Protocol,” predicts Dr. Hermann E. Ott of Germany’s Wuppertal Institute for Climate, Environment and Energy. He is concerned that the treaty’s ambiguous language allows for too many interpretations, which could “undermine the credibility of the treaty.”

Transparent, equitable compliance measures also need to be negotiated. An international system has to be established so that countries can use standard methods to calculate both emissions of greenhouse gases and their absorption in carbon sinks.

In the U.S., the Clinton administration has said it will not submit the treaty for ratification unless two key changes are made. It wants to enable larger developing countries, such as China and India, to take on meaningful commitments and to participate in emission permits trading.

“It is often said that the devil is in the details, and there are a lot of difficult negotiations that are going to continue up until the next U.N. climate change meeting in Buenos Aires in November 1998, and beyond,” predicts Alex Manson of Environment Canada.

Or as John Browne, Group CEO of British Petroleum put it: “We are at a historic moment. Kyoto has moved us from analysis towards action. It is one step on a very long journey.”

Talking Climate Change

Like every specialized subject, climate change has its own terminology that can at first baffle anyone new to the debate. Here’s a brief guide to some of the most common terms:

Annex B countries. Industrialized nations, as well as countries in Central and Eastern Europe, which committed to emissions reductions at Kyoto. “Annex” refers to an appendix to the Kyoto Protocol document, and Canada is one of the so-called Annex B countries.

Annex 1 Parties. Refers to OECD countries and those making the transition to a market economy, such as Russia and the former East Bloc countries, who are signatories to the Framework Convention on Climate Change, and who agreed in Rio to aim to return greenhouse gas emissions to 1990 levels by 2000.

Anthropogenic emissions. Greenhouse gas emissions that result from the activities of humans, such as burning fossil fuels.

Banking. The principle that credits for greenhouse gas emission reductions can be accumulated in order to contribute to meeting future emission reduction commitments.

Carbon sequestering. Another way of describing the ability of plants to absorb carbon dioxide from the atmosphere through photosynthesis, and use it to produce leaves, roots and seeds. Low-tillage and other agricultural practices which add organic debris (rotting leaves, etc.) to soils also help remove carbon from the atmosphere.

Carbon sink. Ecosystems, such as the oceans, forests and soils, which remove and store carbon from the atmosphere.

COP. Conference of the Parties, meaning the nations that are taking part in the United Nations' on-going climate change negotiations.

Credit. A credit for greenhouse gas emission reduction provides assurance that the reduction can be registered and applied against future obligations.

Framework Convention on Climate Change (FCCC). The agreement signed by 154 countries, including Canada, at the Earth Summit in Rio in June 1992, under which climate change is monitored and addressed globally. Developed countries agreed to reduce emissions to 1990 levels by 2000.

Greenhouse gases (GHG). Gases which accumulate in the earth's atmosphere and trap heat, thus contributing to the greenhouse effect. Some occur naturally, like carbon dioxide. Others are man-made, like halocarbons, which also contribute to the thinning of the layer of ozone that shields the earth from the sun's harmful ultraviolet radiation. (See accompanying chart, page 3.)

Intergovernmental Panel on Climate Change (IPCC). A body made up of the world's leading climate scientists, established in 1988 by the UN Environment Programme and the World's Meteorological Organization to assess the scientific research on climate change and its environmental and economic impacts.

Joint implementation (JI). An international project, involving joint action by Annex B countries, which results in a real, measurable reduction in net greenhouse gas emissions in a host country. The current pilot phase for such activities, called Activities Implemented Jointly (AIJ), is open to voluntary participation by all countries. Under AIJ, no credits are allowed against current (pre-2000) commitments.

"Hot" Sites on Climate Change

Want to know more? Here are ten web sites with a wealth of additional information:

1. *Linkages Journal and Earth Negotiations Bulletin*. analysis of climate change issues and daily reports on international conferences published by the International Institute for Sustainable Development, Winnipeg.
www.iisd.ca
2. United Nations Framework Convention on Climate Change. Complete text of the Kyoto Protocol available for download, plus statistics and background on climate change.
www.unfccc.de
3. Government of Canada Climate Change Site. Has links to sites maintained by federal departments, including Environment Canada and Natural Resources Canada.
www.canada.gc.ca/cc/change.html
4. *Weathervane: A Digital Forum on Global Climate Policy* published by Resources for the Future, Washington, D.C.
www.weathervane.rff.org
5. World Resources Institute, Washington, D.C., "Taking Action on Climate Change: Debunking the Myths."
www.wri.org/cpi/climyths
6. Environmental Defense Fund, New York, N.Y.: Current research and analysis.
www.edf.org
7. Canadian Global Change Program, Royal Society of Canada. "Understanding Climate Change".
www.rsc.ca/english/html-documents/climate/climate.htm
8. World Wildlife Fund. Recent polling on climate change.
www.panda.org/climate
9. Sierra Club of Canada. "The Rational Energy Program," an action plan for reducing greenhouse gas emissions.
www.sierraclub.ca
10. Wuppertal Institute for Climate, Environment and Energy, Germany. "The Kyoto Protocol to the UN Framework Convention on Climate Change: Finished and Unfinished Business."
www.wupperinst.org

The Road to Kyoto

A timeline of scientific research and conferences that led to the Kyoto Protocol.

- 1896** Svante Arrhenius, a Swedish chemist, predicts carbon dioxide emissions from burning of coal will lead to global warming.
- 1957** Revelle and Seuss, scientists with the Scripps Institute of Oceanography, report that much of the CO₂ emitted into the atmosphere by industrial activities is not absorbed by the oceans, as some researchers had proposed. They describe the build-up of carbon dioxide in the atmosphere as “a large-scale geophysical experiment” with the Earth’s climate.
- 1958** Keeling, a scientist with the Scripps Institute, initiates the first reliable and continuous measurements of atmospheric carbon dioxide at Hawaii’s Mauna Loa Observatory.
- 1972** Stockholm: first U.N. Conference on the Human Environment where human induced climate change was identified as a pressing issue. United Nations Environment Programme founded.
- 1979** Geneva: first World Climate Conference: launched the World Climate Program to coordinate global research on climate change and collect meteorological data.
- 1985** Dr. Joe Farmer, British Antarctica Survey, discovers a hole in the ozone layer over the Antarctic. His ground-based measurements are later confirmed by satellite images.
- 1985** Villach (Austria) Conference: issued a warning that: “Many important economic decisions are based on the assumption that past climate is a reliable guide to the future. This is no longer a good assumption.”
- 1987** Montreal Protocol on chemicals that deplete the ozone layer signed by 24 countries. They agreed to freeze consumption of CFCs and halons at 1986 levels, and reduce consumption by 50 percent by 1997.
- 1988** The Intergovernmental Panel on Climate Change (IPCC), made up of the world’s leading climate scientists, is established by the U.N. Environment Programme and the World Meteorological Organization to assess the scientific research on climate change and its environmental impacts.
- 1988** Toronto: The Conference on the Changing Atmosphere calls for a 20 percent reduction in carbon dioxide emissions, and issues this statement: “Humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war.”
- 1990** Geneva: First assessment report of the Intergovernmental Panel on Climate Change is endorsed at the second World Climate Conference by more than 100 scientists and world leaders. A call is issued for an international agreement to mitigate global warming.
- 1992** Rio de Janeiro: One of the results of the United Nations Conference on Environment and Development (UNCED) was that 154 nations signed the U.N. Framework Convention on Climate Change, voluntarily agreeing to stabilize greenhouse gas emissions at 1990 levels by the year 2000.

- 1995** The Intergovernmental Panel on Climate Change, representing the consensus of the world's climate scientists, concludes that "... the balance of evidence suggests that there is a discernible human influence on global climate." It also concludes that the net benefits of greenhouse gas mitigation exceed the costs in most countries.
- 1997** Warmest year on record since scientists began keeping accurate meteorological logs in 1860. The next two warmest years are also in the past decade: 1995, 1990.
- 1997** Kyoto, Japan: 159 nations negotiate a treaty setting out legally binding reduction targets averaging 5 percent below 1990 levels for industrialized countries for six greenhouse gases. The timetable agreed to is 2008-2012.

Sources: James P. Bruce, David Runnalls, Environment Canada, United Nations, Environmental Defense Fund

Canada's largest wind farm, at Cowley Ridge, Alberta, produces more than 55,000,000 kilowatt-hours per year, enough to meet the electrical needs of 6,800 typical Canadian homes. If this power is used to displace coal-generated electricity, it offsets about 55,000 tonnes of carbon dioxide that would otherwise be emitted into the atmosphere annually.



Cowley Ridge wind farm