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THE KYOTO PROTOCOL: THE BASICS OF CLIMATE CHANGE

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TABLE OF CONTENTS

Page

INTRODUCTION 1

THE ENHANCED GREENHOUSE EFFECT 1
A. Greenhouse Gases 1
B. The Warming Earth 4
C. Criticisms of the Instrumental Temperature Record 4

NATURAL CLIMATIC VARIATION 6
A. The Sun 7
1. The Little Ice Age 7
B. Atmosphere-Ocean General Circulation Models 8

PREDICTIONS OF THE FUTURE 9
A. How Is It Done? 9
B. Sinks 9
C. Future Temperature Estimates 10
D. Impacts 10

THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE 11
A. The Intergovernmental Panel on Climate Change 11
B. The Convention 12
C. The Kyoto Protocol 13
1. The Protocol's Mechanisms 14
2. Coming Into Force of the Protocol 14

CANADA AND THE KYOTO PROTOCOL 15
A. Commitments 15
B. Implementation 16
1. Past Actions 16
2. Kyoto Ratification 17
3. The Climate Change Plan 18
4. Clean Energy Exports 20
5. Sinks 21

CONCLUSION 21

TIMELINE 22

CANADA

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THE KYOTO PROTOCOL: THE BASICS OF CLIMATE CHANGE

INTRODUCTION

The climate change issue perhaps best represents the struggle that policy makers often encounter when facing science-based questions. The scientific basis of climate change is extremely complicated, and the consequences are very long-term. When scientists are asked for answers, often their reply is couched in terms of uncertainty. Moreover, vested interests on both sides of the argument lobby furiously to have their position entrenched in government policy. Through all this, parliamentarians are being asked to make decisions today that quite possibly could have profound impacts, not just on the lives and economies of generations to come, but also on the other organisms with which those generations will share the planet.

The following paper describes the basics of the climate change issue, including the scientific basis and its uncertainties; the international response, with emphasis on Canadian policy; and Canada's actions with regard to the Kyoto Protocol.

THE ENHANCED GREENHOUSE EFFECT

A. Greenhouse Gases

The sun's energy is absorbed by the earth's surface and transformed into heat, which then radiates back toward space. Gases in the atmosphere absorb some of the heat and reradiate a portion back to the earth, which results in the atmosphere being approximately 33°C warmer than it would be in their absence. This trapping of heat by the atmosphere has been called the greenhouse effect. The main greenhouse gas (GHG) is water, which, while highly variable, constitutes approximately 3% of the atmosphere and has been estimated to be responsible for 60 to 70% of the greenhouse effect.(1) Carbon dioxide (CO_2) is responsible for

(1) Intergovernmental Panel on Climate Change, Working Group I, *Scientific Assessment of Climate Change*, June 1990, p. 51.

most of the remaining greenhouse effect; other important GHGs are methane, nitrous oxide and hydrofluorocarbons.

Methane and nitrous oxide absorb more radiation than CO_2 per molecule, but the overall degree to which they trap outgoing energy is much less than that of CO_2 because there is less of them and they do not stay in the atmosphere for as long. The potential for CO_2 to continue to build up is very high, as it persists for approximately 100 years in the atmosphere. The earth's huge deposits of coal and methane clathrates,[(2)] should they be developed and burned, could thus yield extremely high levels of atmospheric CO_2. For all these reasons, discussions about climate change focus primarily on CO_2.

Atmospheric CO_2 concentrations during past eras are known from air bubbles trapped in polar ice sheets, records that extend back more than 400,000 years. Over longer periods, CO_2 concentrations are estimated from analysis of geological formations and fossils. On very long geological timescales, there is a lot of evidence that CO_2 has some effect on climate.[(3)] There are also many studies providing strong evidence that other factors besides CO_2 affect climate.[(4)]

One of the best-known and most valuable geological records of atmospheric CO_2 concentration is held within a core of ice taken from Antarctica, known as the Vostok ice core. The Vostok ice core reveals a record of CO_2 and temperature going back 420,000 years. It shows a rhythmic change in CO_2 varying between 180 and 300 ppm (parts per million) on a 100,000-year cycle strongly associated with the major ice ages; the change is thus very highly correlated with temperature. Another core of ice from Antarctica, the Taylor Dome core, does not go back as far in time as the Vostok core but yields data at a higher resolution. This core reveals that for approximately the last 10,000 years, CO_2 concentrations remained relatively constant at between 260 and 280 ppm.[(5)]

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(2) Methane clathrates are frozen methane deposits on the ocean floor.

(3) Thomas Crowley and Robert Berner, "Enhanced: CO_2 and Climate Change," *Science*, Vol. 292, May 2001, pp. 870-872.

(4) See, for instance: Daniel Rothman, "Atmospheric carbon dioxide levels for the last 500 million years," *Proceedings of the National Academy of Sciences*, Vol. 99, April 2002, pp. 4167-4171; Jan Veizer et al., "Evidence for decoupling of atmospheric CO_2 and global climate during the Phanerozoic eon," *Nature*, Vol. 408, December 2000, pp. 698-701.

(5) A. Indermuhle et al., "Holocene carbon-cycle dynamics based on CO_2 trapped in ice at Taylor Dome, Antarctica," *Nature,* Vol. 398, 1999, pp. 121-126.

Since the late 1800s, levels of CO_2 in the atmosphere have been building rapidly. In 2002, they averaged 373 ppm. The recent increase in CO_2 results from the burning of fossil fuels and anthropogenic land-use changes that have led to increased CO_2 emissions, largely from ancient pools of carbon that would not have been mobilized without human intervention.

Other naturally occurring greenhouse gases such as methane and nitrous oxide have also increased since the onset of the industrial revolution. The rate of increase of atmospheric methane has slowed over the last 20 years and the overall concentration has remained relatively steady for the last two or three years.(6) Nitrous oxide, on the other hand, continues to increase. Halocarbons are decreasing, largely in response to global action through the Montréal Protocol to reduce chemicals that deplete stratospheric ozone.

A study on levels of radiation re-emitted from the earth over time has confirmed that increases in greenhouse gases in the atmosphere are causing more energy to be trapped. The study made use of the fact that greenhouse gases, such as CO_2, absorb energy at specific wavelengths, which can be detected by satellite. Using satellite data, the study showed that in 1997, the earth was emitting less energy at the wavelengths absorbed by CO_2 than it was in 1970. This finding indicates that increasing CO_2 is causing more energy to be trapped in the atmosphere.(7)

In summary, the greenhouse effect is a natural phenomenon, of which the fundamental characteristics are well understood from theoretical and observational science. Approximately two-thirds of the natural greenhouse effect is due to water and about one-quarter to CO_2. Observation shows that GHGs, and in particular CO_2, are increasing because of human activity to levels not seen in 420,000 years, and that this build-up follows a period of 10,000 years of relatively stable concentrations. Satellite data show that the build-up is causing more energy to be trapped in the atmosphere, confirming what has been called the enhanced greenhouse effect. Temperature should therefore, theoretically, be rising at the earth's surface, a subject that is discussed in the next section.

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(6) National Oceanic and Atmospheric Administration, Climate Monitoring and Diagnostics Laboratory, Carbon Cycle Greenhouse Gases, http://www.cmdl.noaa.gov/ccgg/.

(7) John Harries et al., "Increases in Greenhouse Forcing Inferred from the Outgoing Longwave Radiation Spectra of the Earth in 1970 and 1997," *Nature*, Vol. 410, 15 March 2001, pp. 355-357.

B. The Warming Earth

In the last 100 years, the instrumental temperature record shows that there have been two episodes of warming in the global surface air temperature: from 1900 to 1945, and from 1976 to 2000. The intermediate period included a time of slight cooling. Overall, the last century has seen a rise in average temperature of 0.6 ± 0.2ºC.

The average, however, does not tell the whole story, because various parts of the globe have experienced different changes. Parts of the eastern United States, for instance, have, on average, remained unchanged over the past 100 years while northwestern Canada and Scandinavia have warmed between 0.4 and 0.6ºC per decade. There is also an emerging trend that land temperatures are increasing faster than ocean surface temperatures. Moreover, the mean daily minimum land temperature has been increasing at approximately twice the rate of the mean daily maximum land temperature for the last 50 years. During the day, the atmosphere is better mixed than at night. The greater warming measured at night, therefore, might suggest that the temperature at the surface has been warming at a faster rate than the atmosphere as a whole.(8)

C. Criticisms of the Instrumental Temperature Record

The instrumental temperature record goes back about 150 years. Instruments are not placed evenly over the globe, however, and coverage is worse further back in the record. Calibration of the instruments may also vary from place to place, depending on the technical and financial support available to stations. Some people claim that the only surface temperature measurements that can be trusted are those of highly advanced countries such as the United States. By selectively ignoring large sections of the surface temperature record on the basis that the instrumentation could be faulty, they have tried to argue that the earth is not warming significantly. This claim arose in part because the criteria for sound measurement tend to exclude northern latitudes – areas that the surface record shows are warming to a greater extent than the average.

Another problem is that many sites are in urban areas that heat up as the result of land-use changes. The most rigorous assessment of the effect of this phenomenon (known as the urban heat island effect) on temperature records used satellite imagery to identify urban, near-

(8) Intergovernmental Panel on Climate Change, Working Group I, "Technical Summary," 2001.

urban and rural locations by the amount of light given off at night. The urban areas clearly warmed more than the rural areas, confirming the urban heat island effect. When the temperatures recorded in the urban areas were corrected to be consistent with those of the nearest rural site, it was estimated that the effect had increased the average surface record temperature by no more than 0.1ºC.[9]

In addition to the possible data quality problems mentioned above, there has been debate over the fact that balloon and satellite measurements of temperature in the troposphere[10] seem to differ significantly from surface measurements. The discrepancy, if real, would be troubling, because current understanding of atmospheric processes suggests that a well-mixed troposphere should warm as the result of increased greenhouse gases. Thus, if the surface temperature and tropospheric temperatures are both correct, the difference poses a challenge to our understanding of atmospheric processes. A paper published on-line in September 2003, however, included a re-analysis of the satellite data that showed an increase in tropospheric temperature, consistent with the surface measurements.[11]

Even if one were to ignore the instrumental surface temperature record, for whatever reasons, it is still hard to avoid the conclusion that the earth's surface is warming. A comprehensive examination of millions of historical deep-ocean temperature records showed that the top 300 m of the oceans has warmed by 0.31ºC over the 50 years of data.[12] The Intergovernmental Panel on Climate Change (IPCC) has concluded that there is a 90 to 99% chance that the well-documented retreat of glaciers and decrease in snow cover is the result of increasing temperature. Boreholes, which are used to deduce past temperatures by measuring evidence at various depths, and tree ring data all show a warming trend. Recent satellite evidence shows that between 1981 and 1999, the growing season increased by 18 days in Eurasia and 12 days in North America.[13] In addition, many studies show impacts on animals and plants that are consistent with responses to change in temperature.[14]

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(9) James Hansen et al., "A Closer Look at United States and Global Surface Temperature Change," *Journal of Geophysical Research, Atmospheres*, Vol. 106, 27 October 2001, p. 23947.

(10) Satellite measurements are of temperature focused at 4 km above the earth's surface.

(11) Konstantin Vinnikov and Norman Grody, "Global Warming Trend of Mean Tropospheric Temperature Observed by Satellites," *Science*, Vol. 302, 10 October 2003, p. 269.

(12) Sydney Levitus et al., "Warming of the World Ocean," *Science*, Vol. 287, 2000, p. 2225.

(13) L. Zhou et al., "Variations in Northern Vegetation Activity Inferred from Satellite Data of Vegetation Index During 1981 to 1999," *Journal of Geophysical Research*, Vol. 106, 16 September 2001, p. 20069.

(14) Intergovernmental Panel on Climate Change, Working Group II, "Technical Summary," *Impacts, Adaptation and Vulnerability*, February 2001.

With little doubt that the climate is warming, the question arises as to the cause and to what degree the warming is extraordinary. One major analysis of "proxy" indicators of temperature(15) combined 159 overlapping records, as well as the instrumental record, to produce a 600-year history of temperature (since extended to 1,000 years). The graph of temperature showed a marked increase over the last 100 years (sometimes referred to as "the hockey stick" because of its shape).(16) This has been interpreted to mean that the observed temperature increase is large and extraordinary. Other analyses have shown similar trends. A controversial re-analysis of the above-mentioned study removed some of the records on the grounds of apparent unreliability, added others and suggests that 20th-century warming is not extraordinary.(17) These researchers accuse the authors of the first study, Michael Mann and his co-workers, of poor data handling, use of obsolete data and incorrect calculations. Mann and his co-authors have described the re-analysis as seriously flawed and a gross misinterpretation of their work.(18) Even if the warming were not extraordinary in and of itself, if the warming is caused by human influence on atmospheric composition, then there would still be great cause for concern.

NATURAL CLIMATIC VARIATION

As discussed above, the correlation over the last 50 years between CO_2 levels and temperature, supported by mechanistic theory, suggests a causal link between the two. Many other factors affect climate, however, and climate changes naturally even in the absence of human activity. Factors such as solar output, volcanic gases and orbital changes around the sun all influence climate. In the very long term, geological processes such as the movement of continents and the uplifting of mountains also have an impact. Another hypothesis suggests that, over the very long term, the position of the solar system within the galaxy can induce changes in climate by altering cloud cover.(19) In addition to these influences, climate can change on

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(15) Tree rings and boreholes are examples of proxy indicators (as opposed to direct instrumental measures).

(16) Michael Mann et al., "Global-Scale Temperature Patterns and Climate Forcing Over the Past Six Centuries," *Nature*, Vol. 392, 1998, p. 779.

(17) Stephen McIntyre and Ross McKitrick, "Corrections to the Mann et al. (1998) Proxy Data Base and Northern Hemispheric Average Temperature Series," *Energy and Environment*, Vol. 14, 2003, p. 751.

(18) Michael Mann et al., "Note on Paper by McIntyre and McKitrick in 'Energy and Environment,'" published on the personal Web site of Michael Mann, 2003, http://holocene.evsc.virginia.edu/Mann/EandEPaperProblem.pdf.

(19) Nir Shaviv and Ján Veizer, "Celestial Driver of Phanerozoic Climate?" *GSA Today*, Vol. 13, No. 7, July 2003.

millennial time scales as the result of changes to internal processes, such as oceanic (e.g., El Niño) and atmospheric (e.g., North Atlantic Oscillation) circulation. One little-understood and potentially important aspect of climate change is variation in the amount of energy received from the sun.

A. The Sun

A combination of orbital changes is thought to have caused the 100,000-year ice age cycle seen in the Vostok ice core and various geological phenomena. The decrease in solar input caused by orbital changes, however, is not sufficient to cause an ice age; other factors, such as GHGs, must have acted to amplify the signal.

In addition to orbital changes, the actual output of the sun can also change, in part as the result of sunspot activity, which changes on an 11-year cycle. Satellite data indicate that upper atmosphere temperatures also vary in an 11-year cycle. While the cycle seems too short to allow climate systems to react on the earth's surface, there do seem to be some 11-year cycles in climate; the connection between them, however, is unknown. It has also been theorized that longer-term variations in sunspot activity affect climate on a millennial time scale. One low point in sunspot activity, called the Maunder Minimum, is thought by some to have been responsible for an overall cooling of the earth that has been dubbed the "Little Ice Age."

1. The Little Ice Age

During a period between roughly 1550 and 1850, many parts of the globe were cooler than today and in the preceding centuries. While the cooling seems to have been (fairly) global, it does not seem to have been synchronous; different locations exhibited cooling at different times, implicating internal changes to the climate systems. This cooler period corresponds to the Maunder Minimum. The data on sunspot activity that identify the Maunder Minimum, however, have not been thoroughly validated. Should these data be confirmed as accurate, they would indicate that changes in sunspot activity could be responsible for up to 0.5ºC of warming since 1700, perhaps half of the warming since 1850 and less than a third of the warming in the last quarter of the 20^{th} century. Should current trends in sunspot activity continue, the solar output would have a negligible impact on climate compared to the estimated effects of GHGs. If a fortuitous drop to levels estimated for the Maunder Minimum should occur, however, then the effect of GHGs might be entirely masked by reduced levels of solar output.[20] The IPCC has stated that solar activity may have contributed a little over one-tenth of the warming seen since 1750; most of that contribution occurred in the early 20th century.

B. Atmosphere-Ocean General Circulation Models

To help understand climate, and to predict future climates, climatologists use highly complex computer models known as Atmosphere-Ocean General Circulation Models (AOGCM). The ultimate goal of AOGCMs is to be able to integrate all aspects of the earth's climate system so that predictions take into account the interactions of the different components. Only recently, however, have AOGCMs taken aerosols into account, and they are only beginning to incorporate land and oceanic carbon cycles.

With the inclusion of aerosols, replication by AOGCMs of the temperature trends in the late 20th century has become more accurate, and aspects of our understanding of climate have increased. For instance, when the models included the aerosols released by the 1991 Mount Pinatubo eruption, it was shown that the cooling caused by the aerosols was correctly modelled only after including the fact that cooler air holds less water, which amplified the effect of the aerosols by reducing energy trapped by the greenhouse effect.[21] Similarly, if the models are run without including a build-up of GHGs, using only solar and volcanic changes, the warming in the last 50 years is not well replicated. The addition to the model of anthropogenic factors, including GHGs, restores the replication of the warming. Such simulations provide more evidence of a causal link between CO_2 and recently observed temperature warming. Although the AOGCMs are currently at a low resolution and do not include potentially very important parts of the climate system, they will improve as computer power increases.

The combination of paleoclimate data, knowledge of the mechanisms underlying heat trapping by GHGs, and an understanding of other forces that affect climate have led many to the conclusion that anthropogenic inputs of GHGs have already affected atmospheric temperature.

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(20) Judith Lean and David Rind, "The Sun and Climate," *Consequences*, Vol. 2, No. 1, 1996, http://www.gcrio.org/CONSEQUENCES/winter96/sunclimate.html.

(21) Brian Soden et al., "Global Cooling After the Eruption of Mount Pinatubo: A Test of Climate Feedback by Water Vapor," *Science*, Vol. 296, April 2002, p. 727.

PREDICTIONS OF THE FUTURE

A. How Is It Done?

Climate change predictions depend on estimates of future atmospheric GHGs, in particular carbon dioxide, as well as other factors such as reflective and absorptive aerosols, and on predictions of their effects on the climate system.

Predicting emissions depends heavily on estimates of economic growth and the degree to which economic growth can be uncoupled from carbon-based energy sources. Such forecasting involves, among other things, estimates of population growth, assumptions about living standards within the population, assumptions about changes in the end-use efficiency of fossil fuel burning, and the introduction of new technologies.

Climate, however, reacts not to emissions but to concentrations, which in turn depend on what happens to the CO_2 after it is emitted. Future atmospheric CO_2 concentrations will depend on how the earth's carbon cycle reacts to increased CO_2. Climate will also react through feedback mechanisms such as CO_2-induced changes in temperature affecting other GHGs such as water.

B. Sinks

Almost half of the emitted CO_2 to date has found its way into the oceans and into forests.[22] These pools of CO_2 are called sinks, as long as there is a net movement of CO_2 into them.

The forest sink is thought to be caused by a longer growing season, higher photosynthetic rates and, most importantly, the reforestation of abandoned unproductive agricultural land. Rising levels of CO_2 increase the rate at which plants use this GHG in the process called photosynthesis, and so may increase the movement of CO_2 into forests. The ocean sink is derived from small plants that fall through the water column, or from dissolved CO_2 being entrained in the deep ocean by the downward movement of cold water at the poles.

The capacity of these sinks, and the length of time that CO_2 resides in them, will determine the quantity of emissions that they offset. That capacity is unknown, as is their duration as sinks – but they, and in particular the terrestrial sink, are unlikely to be permanent.

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(22) Recent evidence, however, suggests that land-use changes in the tropics have contributed fewer emissions than previously thought. If this is the case, less CO_2 is "missing" than current estimates assume.

C. Future Temperature Estimates

The IPCC has created a set of 35 different emission scenarios grouped into what it terms "story lines," ranging from massive economic growth and no restrictions on carbon-based fuels to scenarios that lead to far fewer emissions. When these scenarios are input into a variety of AOGCMs, the predicted range in temperature increases from +1.4 ºC to +5.8ºC by 2100. Some scientists have noted that since many of the AOGCMs are related, they may incorporate common errors. If this is the case, the variation in possible outcomes could be even greater.(23) Others have suggested that the IPCC scenarios use unrealistically high estimates of emissions, so that the upper end of the estimated increases is too high.(24) However, to avoid the upper estimates it is necessary either to stop using coal, which is abundant and cheap, or to find some way of permanently sequestering the carbon. Some groups have also suggested that even a 2ºC increase in global temperatures could lead to intolerable consequences.(25)

D. Impacts

Increases in temperature may increase the production of smog in cities and will affect organisms sensitive to temperature, either negatively or by expanding their range. Forest fires may intensify.

Direct changes in temperature, however, may well play a secondary role to changes in the hydrologic cycle. For instance, higher temperatures and lengthening seasons will affect the amount and timing of meltwater from glaciers, which will in turn affect irrigation and electricity production. Storms may intensify, and the sea level will rise. Atmospheric water may already be returning to the surface in a less even manner, causing droughts in some regions and floods in others. According to some scenarios, so much fresh water may return to the oceans that the density change will stop the circulation of water from the tropics to the poles, causing massive disruption to regional climate mechanisms. It has been suggested that similar changes in the past may have been responsible for very cold periods in Europe. Large observed changes

(23) Myles Allen and William Ingram, "Constraints on future changes in climate and the hydrologic cycle," *Nature*, Vol. 419, September 2002, p. 224.

(24) Jim Hansen, as reported by Peter Calamai, "Drastic measures on climate downplayed; Multiple global deals not needed: Scientist," *The Toronto Star*, 20 September 2002.

(25) Quirin Schiermeier, "Climate study highlights inadequacy of emissions cuts," *Nature*, Vol. 426, December 2003, p. 486.

in the salinity of the oceans[26] suggest that such a possibility cannot be dismissed. Such massive changes fall into a category known as threshold changes. In such cases, the Earth's internal climate systems are thought to flip between very different states as a response to relatively small perturbations in climate forcings (greenhouse gases or solar input, for instance).

Much of the difficulty in deciding what to do about GHG emissions hinges on the fact that probabilities cannot be assigned to the various possible temperature scenarios. The outputs of models of short-term meteorological changes (weather) can be assigned probabilities based on how many times in the past similar inputs have yielded an accurate prediction. This is not possible with long-term climate change, and so a robust risk analysis is not possible.

The uncertainty is exacerbated by the lack of detail about the meaning of a warmer world as deduced from the results of AOGCMs. Knowing that the global average temperature will rise is of little help to policy makers in Europe if fresh water stops the Gulf Stream and cools Europe. It is almost certain that the earth will be affected by GHG emissions; what policies should be implemented is much less clear. Nevertheless, in 1992 the nations of the world gathered in Rio for the United Nations Conference on Environment and Development, which led to the decision to act through the United Nations Framework Convention on Climate Change (UNFCCC).

THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

A. The Intergovernmental Panel on Climate Change

Recognizing the problem of global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change in 1988. The IPCC is open to all members of UNEP and the WMO. Its role is to assess the scientific, technical and socio-economic information that is relevant to understanding the risk of human-induced climate change.

The IPCC's First Assessment Report, completed in 1990, played an important role in establishing the Intergovernmental Negotiating Committee that developed the UNFCCC. The text of the Convention was adopted at the United Nations headquarters in New York on

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(26) Ruth Curry et al., "A Change in the Freshwater Balance of the Atlantic Ocean Over the Past Four Decades," *Nature*, Vol. 426, December 2003, p. 826.

9 May 1992; it was opened for signature at the United Nations Conference on Environment and Development held in Rio de Janeiro during 4-14 June 1992. The Convention provides the overall policy framework for addressing the issue of climate change.

B. The Convention

The UNFCCC responded to climate change in a number of ways. One of the most important aspects was simply that it acknowledged that there was a problem. As of 24 September 2002, 186 countries had ratified the Convention, in effect agreeing that climate change is a problem that should be addressed. The Convention set an "ultimate objective" of stabilizing "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The objective did not specify what these concentrations should be, only that they should be at a level that is not dangerous – wording that acknowledged the lack of scientific certainty about what a dangerous level would be.

The Convention noted that the largest share of historical and current emissions originates in developed countries. Its first basic principle was that these countries should take the lead in combatting climate change and its adverse impacts. Specific commitments in the treaty relating to financial and technological transfers applied only to the 24 developed countries belonging to the Organisation for Economic Co-operation and Development (OECD – excepting Mexico, which joined the OECD in 1994). These countries agreed to support climate change reduction activities in developing countries by providing financial support above and beyond any assistance they already provided to these countries. Specific commitments concerning efforts to limit greenhouse gas emissions and enhance natural sinks applied to the OECD countries as well as to 12 "economies in transition" (Central and Eastern Europe and the former Soviet Union). The OECD countries and the economies in transition comprised Annex I of the Convention.

Although negotiations left the treaty language less than clear, it is generally accepted that the OECD and transition countries should have, at a minimum, returned by the year 2000 to the greenhouse gas emission levels they had in 1990. This target was seen as a preliminary step, one insufficient to attain the Convention's goals. Even so, most developed countries, including Canada, missed the target by a considerable amount.

Governments knew, when they adopted the Convention, that the commitments it entailed would not be sufficient to bring climate change under control. At the first Conference of the Parties to the Convention (COP 1, held in Berlin in March/April 1995), in a decision known as the Berlin Mandate, the Parties launched a new round of talks to decide on stronger and more detailed commitments for industrialized countries. After two and a half years of intense negotiations, the Kyoto Protocol was adopted at COP 3 in Kyoto, Japan, on 11 December 1997.

C. The Kyoto Protocol

The original text of the Protocol was a framework, and difficult negotiations were required to define the rules on how to achieve its goal of reducing emissions in the industrialized countries to 5.2% below 1990 levels between 2008 and 2012. At COP 6 (held in November 2000 in The Hague), negotiations broke down largely over the role carbon sinks could play in the Protocol. The following winter, the United States withdrew from negotiations, on the grounds that the lack of emissions targets for the developing world might make the United States uncompetitive. That withdrawal, combined with the failure in The Hague, made many believe that the Protocol would fail. At Bonn, in June 2001, a second session of COP 6 succeeded in drafting a political document to resolve outstanding issues. At COP 7, held in Marrakesh in October 2001, the Parties agreed on a final set of rules entitled the Marrakesh Accords.

The Kyoto Protocol and its rulebook, set out in the Marrakesh Accords, consist of five main elements:

- **Commitments**: At the heart of the Protocol lie its ***legally binding emissions targets*** for Annex I Parties. All Parties are also subject to a set of ***general commitments***.

- **Implementation**: To meet their targets, Annex I Parties must put in place ***domestic policies and measures*** that cut their greenhouse gas emissions. They may also offset their emissions by increasing the removal of greenhouse gases by ***carbon sinks***. Supplementary to domestic actions, Parties may also use three mechanisms – ***joint implementation***, the ***clean development mechanism*** and ***emissions trading*** – to gain credit for emissions reduced (or greenhouse gases removed) at lower cost abroad than at home.

- **Minimizing impacts on developing countries**: The Protocol and its rulebook include provisions to address the specific needs and concerns of developing countries, especially those most vulnerable to the adverse effects of climate change and to the economic impact of response measures. These include the establishment of a new ***adaptation fund***.

- **Accounting, reporting and review**: Rigorous monitoring procedures are in place to safeguard the Kyoto Protocol's integrity, including an ***accounting system***, regular ***reporting*** by Parties and ***in-depth review*** of those reports by expert review teams.

- **Compliance**: A ***Compliance Committee***, consisting of a facilitative and an enforcement branch, will assess and deal with any cases of non-compliance.(27)

1. The Protocol's Mechanisms

The Protocol contains three mechanisms: joint implementation, the clean development mechanism and emissions trading. The mechanisms aim to maximize the cost-effectiveness of climate change mitigation by allowing Parties to pursue opportunities to cut emissions, or enhance carbon sinks, more cheaply abroad than at home. The cost of curbing emissions varies considerably from region to region as a result of differences in, for example, energy sources, energy efficiency and waste management. It therefore makes economic sense to cut emissions, or increase removals, where it is cheapest to do so, given that the impact on the atmosphere is the same.

- **Joint implementation** allows Annex I Parties to implement projects that reduce emissions, or increase removals by sinks, in the territories of other Annex I Parties.

- The **clean development mechanism** allows Annex I Parties to implement projects that reduce emissions in the territories of non-Annex I Parties.

- Through **emissions trading**, Annex I Parties may acquire credits from other Annex I Parties that find it easier, relatively speaking, to meet their emissions targets. This enables Parties to use lower-cost opportunities to curb emissions or increase removals, irrespective of where those opportunities exist, in order to reduce the overall cost of mitigating climate change.

2. Coming Into Force of the Protocol

The Kyoto Protocol has two criteria that must both be met for it to come into force. The first requirement is that at least 55 parties to the Convention must ratify the Protocol. The second is that the ratifying Annex I countries (the industrialized countries for which the Protocol would be binding) must be collectively responsible for at least 55% of Annex I

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(27) UNFCCC Climate Change Secretariat, *A Guide to the Climate Change Convention and its Kyoto Protocol*, Bonn, 2002; accessible on-line at: http://unfccc.int/resource/guideconvkp-p.pdf.

emissions. As of 26 November 2003, 120 countries had ratified the Protocol, including Canada, Japan and the countries of the European Union; but so far the Annex I countries that have ratified are responsible for only 44.2% of Annex I emissions. The United States, in the Protocol baseline year, was responsible for 36.1% of emissions. The withdrawal of the United States, therefore, makes it difficult to meet the requirements for the Protocol's coming into force. The key country remaining is the Russian Federation, which was responsible for 17.4% of emissions in 1990. Should it refuse to ratify, the Protocol cannot come into force. Should it decide to ratify, the Protocol will come into force. In September 2002, at the World Summit on Sustainable Development (WSSD) in Johannesburg, Russia signified its intention to ratify the Protocol; it is expected to announce its decision in 2004.

CANADA AND THE KYOTO PROTOCOL

A. Commitments

Canada has made a commitment to reduce its GHG emissions to 6% below this country's 1990 emissions level. In absolute terms, this means that Canada's target is 571 megatonnes (Mt) of CO_2 equivalent.(28) In 2001, Canada emitted 720 Mt; the latest estimates, should no action be taken (i.e., the "business as usual" scenario), suggest that Canada would emit 809 Mt by 2010. Canada must therefore reduce its emissions by 30% from business as usual in the next eight years.

Of the 720 Mt that Canada emitted in 2001, 584 Mt came from the use of energy. The following is a breakdown of some of the major emitters in 2001:

- transportation sector, 187 Mt
- electricity and heat generating sector, 137 Mt
- manufacturing energy use and industrial processes, 97.9 Mt
- fossil fuel industries, 67.3 Mt
- agricultural sector, 60 Mt
- residential energy use, 41.9 Mt
- waste handling, 24.8 Mt

(28) As mentioned previously, there are many different greenhouse gases with different potentials to warm the atmosphere, depending on their absorptive strength and residence time in the atmosphere. The term "global warming potential" (GWP) is used to describe the relative potency, molecule for molecule, of a GHG, taking account of how long it remains active in the atmosphere. The GWP values currently used are those calculated over 100 years. Carbon dioxide is taken as the gas of reference, with a 100-year GWP of 1. The term "CO_2 equivalent" thus covers all GHGs.

B. Implementation

The Protocol does not oblige governments to implement any particular policy; rather, it gives an indicative list of policies and measures that might help mitigate climate change and promote sustainable development. This list includes:

- Enhancing energy efficiency;
- Protecting and enhancing greenhouse gas sinks;
- Promoting sustainable agriculture;
- Promoting renewable energy, carbon sequestration and other environmentally friendly technologies;
- Removing subsidies and other market imperfections for environmentally damaging activities;
- Encouraging reforms in relevant sectors to promote emission reductions;
- Tackling transport sector emissions; and
- Controlling methane emissions through recovery and use in waste management.(29)

1. Past Actions

Following the adoption of the Kyoto Protocol, Canada's federal, provincial and territorial First Ministers met, and directed federal, provincial and territorial ministers of Energy and Environment to establish a national process to examine the impacts, costs and benefits of implementing the Kyoto Protocol and the various implementation options open to Canada. At the Joint Meeting of Ministers of Energy and Environment (JMM) in April 1998, federal, provincial and territorial ministers approved a process for engaging governments and stakeholders in examining the impacts, costs and benefits of addressing climate change.

The National Climate Change Secretariat, comprising representatives from federal and provincial/territorial governments, was created following the April 1998 JMM to manage the National Climate Change Process. The Process involves 16 Issue Tables/Working Groups, consisting of 450 experts from government, industry, academia and non-governmental organizations.

Beginning in July 1998, the Issue Tables/Working Groups prepared foundation papers that reviewed the current status of their respective sector/issue, including challenges and opportunities. They then began sector-specific and cross-cutting analysis of emission reductions opportunities and barriers, and identified reduction and adaptation options for consideration in developing a national climate change strategy for Canada.

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(29) UNFCCC Climate Change Secretariat (2002).

Following the completion of the Issue Tables/Working Groups' Options Reports at the end of 1999, and a JMM in March 2000, a series of cross-country stakeholder sessions was held in every province and territory in Canada during May and June 2000. The sessions were designed to build upon the options put forward by the Issue Tables/Working Groups, and to seek input on the proposed objectives and actions to implement a national business plan to address climate change.

At a JMM in October 2000, the ministers (with the exception of Ontario) reviewed and approved the National Implementation Strategy on Climate Change and publicly released the First National Climate Change Business Plan, which sets out concrete measures to reduce greenhouse gas emissions.(30)

At the federal level, on 6 October 2000, the Government of Canada announced its Action Plan 2000 on Climate Change. This plan sets out actions to reduce Canada's greenhouse gas emissions by an estimated 65 Mt per year by the period 2008-2012, and reflects the Government of Canada's contribution to the First National Climate Change Business Plan.

The National Implementation Strategy on Climate Change is planned in phases. For example, Phase One discusses and analyzes alternative approaches such as allocation (i.e., the responsibilities of regions and sectors) and domestic emissions trading, and also explores options such as sink enhancement, voluntary emissions trading and international flexibility mechanisms. Future phases depend on decisions about the Canadian response to climate change and the nature of international commitments. The decision to move to Phase Two is linked to greater international certainty of the ratification of the Kyoto Protocol, the actions of Canada's major trading partners, and greater domestic clarity concerning the major policy approaches and actions required to implement an agreement.(31)

2. Kyoto Ratification

As indicated above, Phase Two of Canada's National Implementation Strategy is linked to the ratification of the Protocol and its coming into force, as well as to the actions of our major trading partners. Since the release of the Strategy, the United States has withdrawn from the Protocol, and its coming into force now depends on the Russian Federation.

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(30) Canada's National Climate Change Process, History, http://www.nccp.ca/NCCP/national_process/history/index_e.html.

(31) *Canada's National Implementation Strategy on Climate Change*, October 2000, p. 10; accessible on-line at: http://www.nccp.ca/NCCP/pdf/media/JMM-fed-en.pdf.

In September 2002, Prime Minister Chrétien stated at the World Summit on Sustainable Development in Johannesburg that:

> before the end of the year, the Canadian Parliament will be asked to vote on the ratification of the Kyoto Accord.(32)

This statement was confirmed on 30 September 2002, in the Speech From the Throne, when the Governor General announced that:

> Before the end of this year, the government will bring forward a resolution to Parliament on the issue of ratifying the Kyoto Protocol on Climate Change.

After approximately 40 hours of sometimes acrimonious debate, the House of Commons voted on 10 December 2002 in favour (196-77) of ratification. (The Senate also voted for ratification two days later.) The debate centred on two differing visions. One painted a devastating picture of the Canadian economy, the result of a competitive disadvantage with the United States.(33) Others believed that a lean, efficient economy in a post-Kyoto Canada would offer advantages.(34) It was also argued that the Climate Change Plan for Canada, released on 21 November 2002, was too vague and did not adequately account for Canada's emissions target.

3. The Climate Change Plan

In May 2002, *A Discussion Paper on Canada's Contribution to Addressing Climate Change* was released by the federal government as a lead-up to the drafting of post-ratification implementation plans. The paper outlined four broad policy options:

- Option 1 would have involved the use of a "broad as practical" domestic emissions trading (DET) system. Such a system would have required fossil fuel suppliers, such as refiners, natural gas distributors, coal mines and fossil fuel importers, to hold permits equivalent to the CO_2 emissions resulting from the combustion of the fossil fuels they sell.

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(32) Address by Prime Minister Jean Chrétien at the World Summit on Sustainable Development, 2 September 2002.

(33) Canadian Manufacturers and Exporters, *Pain Without Gain, Canada and the Kyoto Protocol*; accessible on-line at: http://www.cme-mec.ca/kyoto/.

(34) Sylvie Boustie, Marlo Raynolds and Matthew Bramley, *How Ratifying the Kyoto Protocol Will Benefit Canada's Competitiveness*, Pembina Institute for Appropriate Development, June 2002; accessible on-line at: http://www.climateactionnetwork.ca/Competitive.pdf.

- Option 2 was to achieve climate change commitments entirely through a broad range of policy instruments, including incentives, covenants, regulations and, possibly, fiscal measures. Rather than being driven by market forces, it was built around government programs or initiatives, many of which would have been the responsibility of provincial governments, necessarily requiring a good deal of intergovernmental cooperation.

- Option 3 was a mix of DET, targeted measures and the government purchase of international permits. Under this mixed approach, a different sort of emissions trading system would have been introduced. In this case, permits would have been allocated to so-called "Large Final Emitters" and the permit requirement would have been applied directly to emissions, rather than to the fossil fuels that create emissions as a result of combustion.

- Option 4 would have seen a mixed approach similar to Option 3 but with some important differences, the most important being that 70 Mt of emissions would have been offset by clean energy exports.

On 21 November 2002, four days before the motion on Kyoto ratification was tabled in the House of Commons, the government released the Climate Change Plan for Canada. Essentially it was a form of Option 3 from the Discussion Paper. Large industrial emitters will be expected to reduce emissions by a total of 91 Mt, 36 of which are expected from Action Plan 2000 initiatives and from future innovation, while 55 Mt are expected from negotiated agreements with industry. Negotiations with industry also concluded with the government guaranteeing a maximum price of $15 per tonne of carbon dioxide. Forest and agricultural sinks are expected to reduce emissions by almost 40 Mt, 30 of which are from existing practices. The remainder is to come from actions by Canadians to reduce energy usage in the home and in transportation. The Climate Change Plan for Canada leaves approximately 60 Mt unaccounted for; one option for accommodating this is through clean energy exports (see below).

The details of the incentives and regulations that will be implemented to achieve these goals have yet to be elaborated, though a considerable amount of money has been dedicated to climate change initiatives. Between 1998 and November 2002, C$1.6 billion was allocated to the Action Plan, which, along with sinks, is estimated to achieve 80 Mt of reductions by the commitment period. The government allotted C$1.7 billion to the Climate Change Plan in the 2003 Budget, bringing the total outlay on climate change initiatives to approximately $3.7 billion since 1998. In August 2003, the government described further how the 2003 Budget money would be allotted, though the programs have yet to be set out in detail.

4. Clean Energy Exports

Given the competitive disadvantage that Canada might experience as a result of the United States not being a party to the Protocol, Canada wishes to obtain credit within the Protocol for its exports of so-called clean energy.

In hope of gaining international support for the concept of cleaner energy export (CEE) credits, Canada volunteered to host a UN workshop on the topic. At the workshop in Whistler in May 2002, Canada presented a paper outlining the analysis and methodology used in calculating a Canadian CEE credit of 70 Mt of CO_2. The paper, *Impacts of Canada's Cleaner Energy Exports on Global Greenhouse Gas Emissions,* outlines that the demand for credit for CEE is based on a scenario in which Canadian natural gas and hydro electricity are not produced and not exported to the United States. The analysis assesses how the U.S. market would adjust to this situation and what impact those adjustments would have on global CO_2 emissions. It also notes the reduced emissions in Canada from the lower level of natural gas production under this situation.

Many have been critical of this proposal. The European Union has flatly rejected it, saying that the rules for the Protocol have been set and that credit for CEE would throw the rulebook into disarray. Others have pointed out an imbalance in the analysis, in that the paper asks "What would the world do without our natural gas and hydro electricity?" but does not ask "What would the world do without our oil sands and coal?" The assumptions built into assessing the impact of removing Canada's natural gas and hydro electricity from the U.S. market are extensive and, at least in the paper, are not explained.

Based on comments in the document that summarize the consultations following the release of the discussion paper, there seems to be little support for the concept of CEE credits. Industry was skeptical that the international community would accept them. Environmental non-governmental organizations felt that it weakened the Protocol and Canada's credibility on environmental issues. Despite this opposition, both Environment Minister David Anderson and Natural Resources Minister Herb Dhaliwal apparently maintain that clean energy credits must obtain international recognition and that Canada's Kyoto target is 70 Mt below that agreed to in the Protocol.(35)

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(35) Alan Toulin, "Liberal rebels warn against weaker Kyoto: MPs will 'keep pushing' for deal that fulfills 1997 targets," *National Post*, 6 September 2002.

5. Sinks

Another controversial method that Canada wished to have accepted in the Protocol is that of sinks. Canada negotiated forcefully to be able to use its forest and agricultural land as sinks of CO_2 that would be credited against its emissions, an issue that led to the breakdown of negotiations at COP 6 in The Hague. In the end, Canada was given the capacity to claim 44 Mt of CO_2,[(36)] though the government has said that it will use only 24 of these 44 Mt toward the estimated 240 Mt deficit.

The most important factor that increases the forest sink is the reforestation of abandoned, unproductive agricultural land. Manipulating this sink to increase absorption of CO_2 requires changing forestry and agricultural practices to encourage more CO_2 to move into the land. In the short term, such as the timescale encompassed by the Kyoto targets, this may be a viable option. In the long term, however, much of the carbon stored in the sink will most likely return to the atmosphere (as part of the natural carbon cycle). The total capacity for reforestation is also limited. If all forests that have been cut globally in the past were replaced, this might offset a final stable atmospheric CO_2 concentration by 50 or 60 ppm – i.e., not enough to return atmospheric CO_2 to its typical pre-industrial levels.

CONCLUSION

That CO_2 traps heat in the atmosphere and helps make the earth hospitable to human life is not in dispute. Increased CO_2 should naturally trap more heat. In a little over a century, human activity has increased atmospheric CO_2 to levels a third higher than any seen in the last 420,000 years, ending a 10,000-year period of relatively stable CO_2.

The question now arises as to what will happen as a result. The Earth will get warmer, but by how much? For example, will increased water vapour in the atmosphere enhance the greenhouse effect by trapping radiation, or will it counteract heating through more extensive reflective cloud cover? How will climate systems react to increased temperature and evaporation? The answers to these questions will almost never be certain enough to give policy makers clear choices. What is certain is that, while the risks may not be well defined, the stakes

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(36) Note that the Marrakesh Accords give Canada 12 Mt of carbon; Canada uses units of CO_2 as opposed to carbon, and the conversion factor is 44/12.

are very high. The outcome of future climate change has been likened to that of rolling dice. With every increase in greenhouse gases, the dice become more loaded toward serious and possibly catastrophic climate change.[37] Humanity must now decide exactly what actions to take in order to try to reduce the degree to which the dice are loaded, knowing that the outcome could have serious consequences for us and for generations to come.

TIMELINE[38]

1988

The Intergovernmental Panel on Climate Change (IPCC) established internationally agreed-upon assessments of the science on climate change, including causes, impacts and possible responses. This was a critical step in establishing the scientific foundation upon which global consensus for action would be built.

Delegates from 46 countries to the Toronto Conference on the Changing Atmosphere called for a reduction of global carbon dioxide (CO_2) emissions by 20% from 1988 levels by the year 2005.

1990

The first IPCC report initiated the beginning of formal negotiations toward an international agreement on climate change, which resulted in the signing of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.

In Canada, federal, provincial and territorial governments developed the National Action Strategy on Global Warming.

1992

Canada signed the UNFCCC at the "Earth Summit" in Rio de Janeiro. The Convention's aim was to "prevent dangerous [human] interference with the climate system." Industrialized nations agreed to implement policies and measures with the aim of stabilizing greenhouse gas (GHG) emissions at 1990 levels by 2000.

1993

Federal, provincial and territorial ministers of Energy and Environment approved the Comprehensive Air Quality Management Framework Agreement to coordinate approaches to climate change and other air issues.

The first annual meeting of federal, provincial and territorial Energy and Environment ministers was held to review progress and provide direction on the Framework Agreement.

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(37) Stephen Schneider, "Mediarology," http://stephenschneider.stanford.edu/Mediarology/Mediarology.html.

(38) As modified from Environment Canada, http://www2.ec.gc.ca/climate/timeline-e.html.

The National Climate Change Task Group was formed, with representatives from industry associations, environmental groups and all levels of government, to develop options for a national action program on climate change.

1994

On 21 March 1994, the UNFCCC, which was signed at the "Earth Summit" in Rio de Janeiro in 1992, entered into force. To date, it has been ratified by 186 countries.

1995

The First Annual Conference of the Parties (COP 1) to the UNFCCC was held in Berlin; at the conference, the Berlin mandate was adopted, the first step leading to the Kyoto Protocol.

The second IPCC report declared ". . . the balance of evidence suggests that there is a discernible human influence on global climate."

Canada's National Action Program on Climate Change was tabled, following the work of the National Climate Change Task Group. It supported government programs and other initiatives, as well as a voluntary approach to reducing GHG emissions.

The Voluntary Challenge and Registry signed up industries and businesses to voluntarily limit or reduce GHG emissions. Subsequently incorporated in 1997, this program now includes more than 650 enterprises, representing 75% of the business and industrial potential for GHG reductions.

The provinces each began to produce and then table a climate change action plan.

1996

The Second Annual Conference of the Parties (COP 2) was held in Geneva. It endorsed the IPCC finding that "there is a discernible human influence on global climate" and that "projected change in climate will result in significant, often adverse, impacts on many ecological systems and socio-economic sectors, including food supply and water resources and on human health."

The Government of Canada introduced the Federal Action Program on Climate Change, committing the government to reduce GHG emissions from its own operations, by 2005, by at least 20% from 1990 levels. Emissions from federal operations were estimated to have decreased by 16% between 1990 and 1998.

The Federal Renewable Energy Strategy was announced in an effort to support the development and deployment of cost-effective renewable energy technologies across the country.

1997

COP 3 was held in Kyoto, Japan, and delegates from 160 countries agreed to the Kyoto Protocol. Under the Protocol, Canada's target was to reduce its emissions to 6% below 1990 levels for the period from 2008 to 2012. The agreement, should its targets be met, would result in industrialized countries reducing their GHG emissions by 5.2% below 1990 levels.

Following the conclusion of the Kyoto Protocol, Canada's First Ministers met. They directed federal, provincial and territorial ministers of Energy and Environment to put in place a national process to examine the impacts, costs and benefits of the Protocol's implementation and the various implementation options open to Canada.

Canada's *Second National Report*, required under the UNFCCC, provided an update of Canada's situation and responses to climate change.

The first *Canada Country Study* was published, providing a comprehensive examination of the potential impacts of climate change on the different regions and sectors of Canada.

1998

Canada formally signed the Kyoto Protocol on climate change on 29 April, signalling its intention to ratify the Protocol when Canada has a national strategy and the international mechanisms are agreed on.

Federal, provincial and territorial ministers of Energy and Environment met and approved a process, agreed to by First Ministers, to develop a national implementation strategy on climate change.

The 1998 federal budget established the Climate Change Action Fund (CCAF), providing $150 million over three years to help develop Canada's response to the Kyoto Protocol. The fund supports initiatives that advance science, increase public awareness and reduce GHG emissions.

Federal, provincial and territorial governments launched a national process to develop a step-by-step National Strategy on Climate Change to respond to Canada's Kyoto commitments. Issue Tables were set up in 16 areas. A National Climate Change Secretariat was established to provide overall support and coordination of the process.

The Office of Energy Efficiency was established within Natural Resources Canada in an effort to focus and accelerate Canadians' awareness of and involvement with energy efficiency.

COP 4 was held in Buenos Aires. The international community agreed on an action plan to set guidelines and rules needed to implement the Kyoto Protocol.

1999

Energy and Environment ministers announced a baseline protection initiative as part of early action on climate change. Baseline protection addressed concerns of Canadian industries that wanted assurances from governments that early actions to reduce GHGs would not be penalized under future government policies.

Canada released *Canada's Greenhouse Gas Inventory: 1997 Emissions and Removals with Trends*, as required under the UNFCCC.

COP 5 took place in Bonn, and included discussions aimed at setting the rules for achieving the Kyoto Protocol targets. At COP 5, Canada released *Canada's Perspective on Climate Change*, which provided an overview of the science of climate change and Canada's actions to date.

Canada released *Canada's Emissions Outlook: An Update*, which provided an outlook for GHG emissions over the next 20 years. It served as an important tool in developing Canada's national strategy on climate change.

The Issue Tables in Canada's national process began to submit their reports.

2000

On 28 February, the Government of Canada announced $625 million over the next three to four years for programs designed to accelerate climate change research and science and curb Canada's greenhouse gas emissions. Included in the budget was $150 million to renew the Climate Change Action Fund for three years.

Energy and Environment ministers met in March to discuss the Issue Tables' Options Reports and next steps for Canada.

On 6 October, the Government of Canada announced its five-year Action Plan, which allocates approximately $500 million towards measures to reduce greenhouse gases by about 65 Mt each year. When fully implemented, it should take Canada about one-third of the way to its Kyoto targets.

On 17 October, Energy and Environment ministers met again and (with the exception of Ontario) released the National Implementation Strategy on Climate Change, which included the First National Climate Change Business Plan.

COP 6 took place in November in The Hague; a package of rules and guidelines for the Kyoto Protocol were discussed. Talks broke down largely over the issue of sinks.

2001

The United States withdrew from the negotiations, declaring the Protocol fatally flawed because non-industrialized countries did not have binding targets.

A second session of COP 6 was held in Bonn, Germany, to continue discussions on rules and guidelines for implementing the Protocol. On 27 July 2001, 178 countries agreed in a political document to key elements of an international global framework of action on climate change.

The legal text for the Protocol was developed at COP 7, held in Marrakesh in November 2001.

2002

In May 2002, the Government of Canada released *A Discussion Paper on Canada's Contribution to Addressing Climate Change*. In September, at the World Summit on Sustainable Development, the Prime Minister announced that "before the end of the year, the Canadian Parliament will be asked to vote on the ratification of the Kyoto Accord."

In November 2002, the Government of Canada released the Climate Change Plan for Canada.

On 10 December, the House of Commons voted in favour of ratifying the Protocol. The Senate also voted in favour of ratification, on 12 December.

2003

Budget 2003 allotted C$1.7 billion to the Climate Change Plan for Canada.