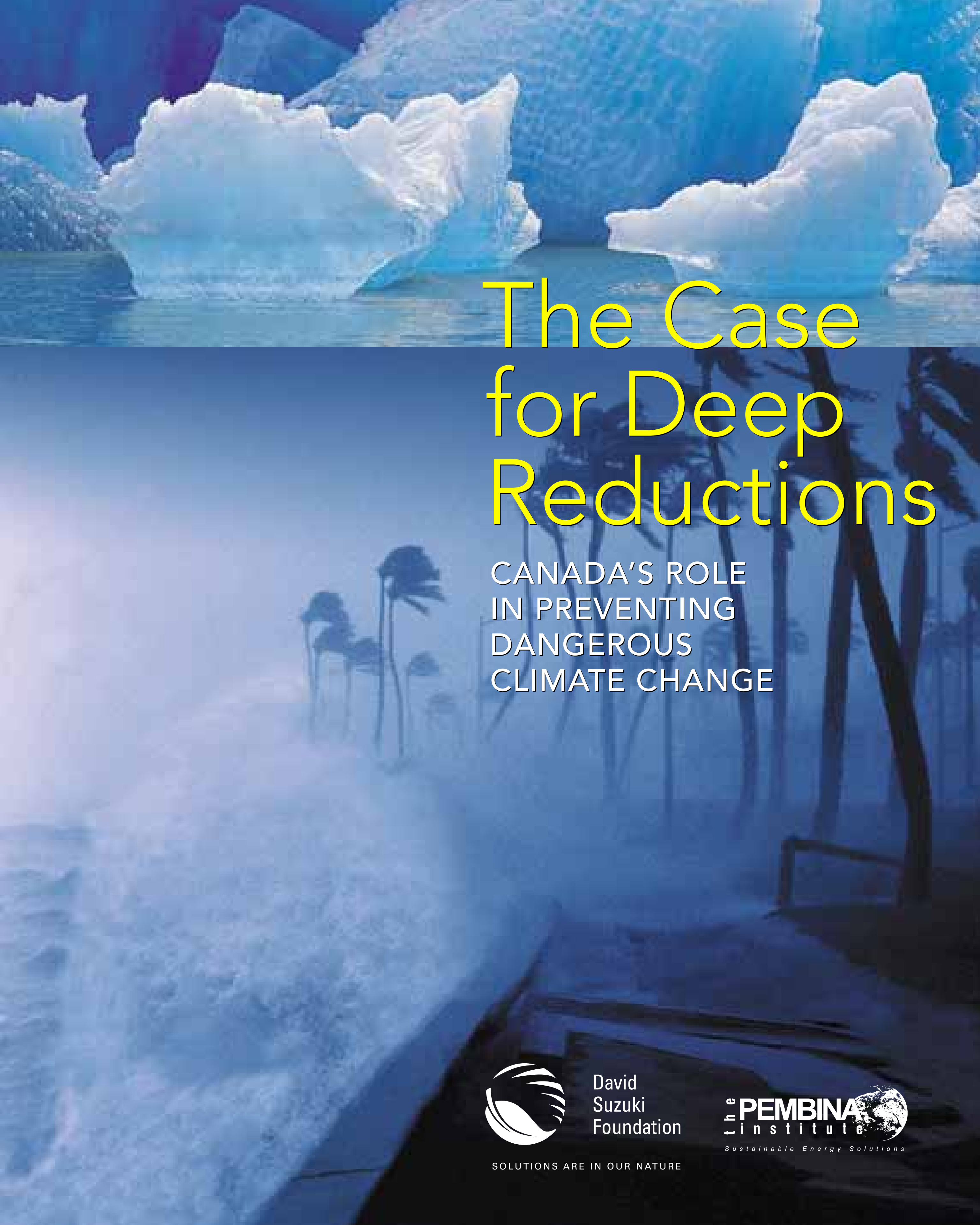

The Case for Deep Reductions

CANADA'S ROLE IN PREVENTING DANGEROUS CLIMATE CHANGE

David Suzuki Foundation
SOLUTIONS ARE IN OUR NATURE

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Sustainable Energy Solutions

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AN INVESTIGATION BY
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0. Executive Summary*

0.1 Purpose of this paper

Climate change caused by emissions of greenhouse gases (GHGs) from human activities is one of the greatest threats to people, economies and ecosystems in the 21st century. The international community must undertake a determined effort over several decades to cut emissions to a small fraction of their current level.

Canada has ratified the Kyoto Protocol, thereby accepting a challenging target to make an initial near-term reduction in our GHG emissions by 2008–12. Between November 28 and December 9, 2005, Canada is chairing the annual session of United Nations climate change negotiations in Montreal. This conference is the first session at which the Protocol requires participating countries to "initiate the consideration of" GHG targets for the post-2012 period. Canada will hold the presidency of the negotiations for approximately one year. This intensifies the urgency of defining our post-2012 climate policy and places our role in the long-term, global effort to cut GHG emissions in the spotlight.

Canada's responsibility is to make that role a leading one. Two key questions must be answered in determining what it should entail: what post-2012 GHG targets should Canada adopt; and how should Canada approach the negotiations on the post-2012 international regime for GHG reductions?

0.2 The need to stabilize GHG concentrations

Human activities have caused a dramatic increase in the amount of carbon dioxide (CO_2) in the earth's atmosphere. The main causes of increasing CO_2 concentrations are the burning of fossil fuels – coal, petroleum products, natural gas – and deforestation. Various industrial, transportation and agricultural activities are also responsible for increases in the atmospheric concentrations of other long-lived GHGs.

The Intergovernmental Panel on Climate Change (IPCC) has concluded that if no explicit action is taken to curb GHG emissions from human activities, the global average surface temperature is projected to increase by 1.4 to 5.8°C between 1990 and 2100. Warming of this magnitude would cause enormous disruption. The vast majority of professional

* For notes on information sources, see the main part of the paper. The section numbering in this summary follows the numbering in the main part of the paper, e.g., Section 0.1 here summarizes Section 1 in the paper.

climate scientists agree with the IPCC's conclusions. According to Canada's Environment Minister Stéphane Dion, "the science clearly demonstrates that global climate change is one of the greatest sustainability challenges of our time. The impacts of climate change will affect all countries and deep reductions in global emissions are essential if we are going to address it."

The United Nations Framework Convention on Climate Change (UNFCCC) represents a global consensus of governments that atmospheric concentrations of GHGs must be stabilized "at a level that would prevent dangerous anthropogenic [human-caused] interference with the climate system," and that, in pursuit of this objective, developed countries must lead the reduction of GHG emissions. The current US administration recently confirmed its adherence to the UNFCCC.

The IPCC has shown that 2°C of additional warming after 1990 would suffice to take the world into the realm of risks to many ecosystems and a large increase in extreme events. Above about 3°C, all regions would see negative impacts by any measure. Examples of impacts likely to occur during this century if GHG emissions are allowed to continue rising unchecked include:

- sea level rise sufficient to flood areas inhabited by millions of people;
- more intense rainfall events and tropical storms;
- tens of millions of additional people at risk from coastal flooding and hunger, hundreds of millions from malaria and billions from water shortage;
- a significant proportion of land-based species "committed to extinction";
- additional annual costs in the tens of billions of dollars for the world's water management, agriculture and forestry sectors;
- a decline in the extent of sea-ice around the North Pole in summer by more than 50% and a threat to the cultural survival of some Arctic communities;
- destruction of more than half of the world's coral reefs; and
- in Canada, reduced water quantities from the Great Lakes to the Rockies.

There is now quite wide support, both in the scientific community and among governments, for defining "dangerous" climate change as a rise in the global average surface temperature of 2°C above the pre-industrial level. The European Council (comprising the heads of government or state of all EU member states) first endorsed the 2°C limit in 1996. Since warming is projected to be greater than the global average for much of Canada, especially in the Arctic, a 2°C limit for global average temperature rise may be too high from a Canadian perspective. The Climate Action Network International has concluded that "climate action must be driven by the aim of keeping global warming as far below 2°C as possible [relative to the pre-industrial level]."

Research shows that if we are serious about limiting global warming to no more than 2°C above pre-industrial levels with a relatively high certainty, we need to adopt an objective of stabilizing atmospheric GHG concentrations at 400 parts per million (ppmv) of CO_2 equivalent (CO_2e). In the absence of explicit action to curb GHG emissions, the CO_2 concentration is projected to reach 490 to 1260 ppmv by 2100. Changes in other GHGs are likely to result in CO_2e concentrations approximately 100 ppmv higher.

0.3 By how much and by when must emissions be reduced?

It is essential to distinguish atmospheric *concentrations* of GHGs from annual *emissions* of GHGs. Global emissions are rising, but simply halting the rise by stabilizing *emissions* will not be sufficient to stabilize *concentrations*. The IPCC has shown clearly that stabilization of concentrations at any level requires emissions to be reduced eventually to a small fraction of the current level. Detailed trajectories of annual emissions over time, calculated to stabilize atmospheric concentrations at particular levels, suggest that to stabilize the atmospheric GHG concentration at 400 ppmv CO_2e, global GHG emissions must be limited to no more than about 15% above the 1990 level by 2020 and fall to at least 30–50% below the 1990 level by 2050.

Global emission reduction trajectories can be allocated among industrialized and developing countries in accordance with widely accepted equity principles, especially polluter-pays, historical responsibility and ability-to-pay. Under these conditions, to stabilize the atmospheric GHG concentration at 400 ppmv CO_2e, industrialized countries must reduce emissions by 25–30% between 1990 and 2020 and by 85–90% between 1990 and 2050.

Another approach to assessing what might be appropriate national emissions targets for industrialized countries such as Canada is to examine the targets to which some governments have already committed. Commitments regarding post-2012 GHG emissions targets are summarized below:

	% REDUCTION IN EMISSIONS 1990–2020	% REDUCTION IN EMISSIONS 1990–2050
California	0[a]	80
EU (25 countries)	15–30[b]	60–80[c]
France	–	75–80[d]
Germany	40[e]	–
New England states/ Eastern Canadian provinces	at least 10	75–85[f]
New South Wales	0[a,g,h]	60[h]
Sweden	–	43[i]
UK	ca. 27–33[j]	60[j]

a This does not imply zero effort but rather that emissions will be brought down after having risen.
b Government leaders' recommendation for developed countries, rather than a commitment.
c Environment ministers' recommendation for developed countries, rather than a commitment.
d Reduction below "current" level in 2004.
e Offer conditional on the EU committing to a 30% reduction by same date.
f Suggestion based on "current science"; reduction below "current" level in 2001.
g Reduction by 2025.
h Reductions below 2000 level.
i Reductions in per capita emissions below "current" level in 2001.
j Reductions apply to CO_2 only.

Deep reductions of the same order as those to which governments are now committing are beginning to find support among business organizations, including some of the world's largest GHG-emitting companies.

The long-term nature of the climate change problem, combined with the scale of the efforts needed to solve it, can deceive decision makers into thinking there is little or no urgency about initiating deep emission reductions. This is a grave error. The reality is that the emission reductions needed are so large that if they are not initiated immediately by enough countries, the lower levels of stabilization of GHG concentrations will become, for practical purposes, impossible to achieve. Even a delay of just five years could be significant, and if action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be three to seven times greater to meet the same global average temperature target.

0.4 Post-2012 GHG targets for Canada

The Government of Canada recognizes that "meeting the long-term objective of the UNFCCC will require reducing net GHG emissions to near zero," but it has not yet made any commitments regarding the far deeper reduction targets that will be needed post-2012. This is a serious problem requiring urgent attention because:

- It is not responsible for Canada to be silent on the part it intends to play post-2012.
- Without knowing where we want to be five decades from now, governments cannot make the right policy decisions about where we need to go over the next one or two decades.
- Canada's energy policies, which include support for rapid expansion of highly GHG-intensive activities such as oil sands development, need to be overhauled to make them consistent with our climate policy, but this cannot be achieved if our climate policy is limited to the near term.
- Canadian energy producers are contemplating investments in the order of $200 billion over the next 20 years in infrastructure with potentially enormous GHG emissions and operational lifetimes of 40 years or longer.
- Without clarity on medium- and long-term GHG objectives, the private sector does not have the necessary incentive to invest in the development and deployment of the technologies needed for deep GHG reductions.

The David Suzuki Foundation and the Pembina Institute therefore believe that the Government of Canada must move quickly to adopt medium- and long-term GHG emission reduction targets that will ensure Canada plays a responsible part in achieving deep reductions in the world's GHG emissions. There is strong evidence that targets along the lines we are proposing are technologically and economically feasible.

We propose that the Government of Canada adopt the following targets:

< RECOMMENDATION

- **a reduction in Canada's GHG emissions to 25% below the 1990 level by 2020**
- **a reduction in Canada's GHG emissions to 80% below the 1990 level by 2050**

These targets are based on the need to stabilize the atmospheric GHG concentration at no more than 400 ppmv CO_2e and our belief that Canada cannot justify making emission reductions by 2050 that are much smaller than those required by industrialized countries as a whole. The reduction target for 2020 lies on a straight line between our Kyoto target in 2010 and the target for 2050 (implying greater year-on-year percentage emission reductions at the end of the period than at the beginning). Our targets are well aligned with the David Suzuki Foundation's 2004 publication *Sustainability Within a Generation* and fall within the ranges of those to which governments in other industrialized countries have committed.

Our targets should apply to Canada's emissions net of purchases or sales of emission credits. However, it is important that Canada should only purchase credits that correspond to genuine emission reductions and ensure that it is exhausting all opportunities to reduce emissions domestically at a reasonable cost before purchasing foreign credits.

Obvious objections to our proposed targets, and reasons why these objections should be rejected, are listed below.

- *We don't have the technology yet*. A broad range of evidence, notably from the IPCC, shows that deep GHG emission reductions can be achieved with known options such as energy conservation, efficiency and renewable energy. Researchers at Princeton University recently put forward 15 technology options for GHG reduction and concluded: "Humanity can solve the carbon and climate problem in the first half of this century simply by scaling up what we already know how to do.... Every one of these options is already implemented at an industrial scale."
- *It will cost too much*. Evidence covering the availability of technology, opportunities for cost savings and economic modelling results suggests that deep emission reductions can be achieved at no more than modest cost. For example, modelling undertaken by the UK government suggests the country's 60% emission reduction target can be achieved while delaying growth in GDP up to 2050 by about one year at most.
- *We're a special case because of our energy exports*. Some argue that Canada is not really responsible for rapidly rising emissions from the production of oil and gas for export because we cannot control the market's demand. Several considerations contradict this argument; notably, it contravenes the polluter-pays principle. Also, Canadian producers could offset emissions from production by purchasing emission credits at a cost that is very modest compared to current oil prices.

- *Canada can't act without the US*. It is a mistake to look solely at the position of the Bush administration. Many states are forging ahead with policies addressing GHG emissions, and there is now both in Congress and the private sector considerable interest in and support for legislation to cap GHG emissions. For example, four states have enacted regulated limits on CO_2 emissions from fossil-fuelled electricity generation, and in June 2005, the Senate approved a non-binding resolution in favour of a comprehensive, national program of mandatory limits on GHG emissions.
- *We need more time because we've started late*. Canada's emissions had risen to 24% above the 1990 level by 2003. However, Canada's failure to take meaningful action until very recently is Canada's responsibility. Emissions trading provides Canada with flexibility to meet targets that are missed through domestic reductions and flexibility to get back on track after our late start.

0.5 How should Canada approach the negotiations on the post-2012 international regime?

Broad international agreement on coordinated action to reduce GHG emissions is essential because the global emission reductions needed are very large, and the reductions that industrialized countries need to make are larger still. The Kyoto Protocol, which became international law in February 2005, currently sets GHG targets for the period 2008–12 and only for industrialized countries. If fully implemented, the protocol would reduce those countries' emissions only by about 5% overall, relative to the 1990 level. It is therefore essential to reach a broad international agreement that will result in much larger GHG reductions for the period post-2012.

It is urgent that the international community agree on post-2012 GHG reductions for the same reasons for which it is urgent that Canada do so (see above) and also to prevent collapse of the international GHG emissions trading market, commonly referred to as the "carbon market," which is now creating a price signal for emission reductions around the world.

It is critical for Canada to approach negotiations on the international regime for longer-term GHG reductions with appropriate ambitions.

RECOMMENDATION > **The David Suzuki Foundation and the Pembina Institute believe that Canada's initial objective must be to achieve agreement, during the Canadian presidency, on a process to negotiate, by 2008, a broad international regime for post-2012 GHG reductions consistent with preventing dangerous climate change. This process must be rooted in both the Kyoto Protocol and the UNFCCC and must not be allowed to be hindered by any one country.**

This recommendation recognizes that significant time is required for difficult negotiations but that a deadline is essential to clarify expectations and focus efforts. It is critical to retain the Kyoto Protocol as a legal platform for the negotiations because of its effective approach of mandatory emissions targets combined with emissions trading. Moving away from the protocol would result in wasting years of effort devoted to elaborating its detailed operational rules; also the protocol provides the legal basis and operational mechanisms of the international carbon market.

The current US administration has shown no interest in developing an effective international regime for GHG reduction. This position cannot be reconciled with the reductions needed. An attempt to accommodate it at the start of the negotiation process can only lead to failure. Instead, the process should take careful account of the anticipated views of a future US administration committed to effective action on climate change, based on the considerable support for capping GHG emissions that already exists in the US.

Once the negotiation process has been agreed upon and is underway, which should be the case early in 2006, countries will begin in earnest to develop the detailed framework of the post-2012 regime.

The David Suzuki Foundation and the Pembina Institute urge the Government of Canada to endorse the three-track framework that the Climate Action Network (CAN) International proposes for the post-2012 international regime.

< RECOMMENDATION

The CAN International framework involves three parallel tracks:

- A **Kyoto Track** for industrialized countries, with legally binding absolute emissions targets that are progressively reduced in successive time periods.
- A **Greening** or **Decarbonization Track** for the majority of developing countries, where emissions growth is slowed and countries are enabled to follow a low GHG path to development via rapid adoption of energy conservation, energy efficiency and low-impact renewable energy.
- An **Adaptation Track** for the most vulnerable countries and regions, involving assistance and compensation funded by industrialized countries, to deal with unavoidable impacts of climate change.

In the immediate post-2012 period, the Kyoto Track would include the countries that already face targets under the Kyoto Protocol, plus a relatively small number of countries currently classified as "developing" but whose per capita emissions, cumulative historical emissions and per capita GDP are sufficiently high. Countries would progressively move from the Decarbonization Track to the Kyoto Track. This framework accommodates well the equity principles evoked in the UNFCCC.

Although the Government of Canada is not currently advocating a particular framework for the post-2012 international regime, it has laid out six "elements of an effective international approach." We offer initial comments in response to the Government's discussion of these elements. Notably, the Government must recognize that:

- Limiting the atmospheric CO_2 concentration to 550 ppmv is not sufficient.
- Commitments such as technology agreements, policies and measures, or sectoral goals can complement absolute emissions targets and be explored for use in the Decarbonization Track, but they cannot replace absolute emission targets for countries that meet the criteria for the Kyoto Track.
- A strong carbon market requires agreement to be reached by 2008 on GHG targets for the immediate post-2012 period.
- While it can be said that a "technological revolution" is needed, the problem is primarily one of deploying existing technologies and only secondarily one of reducing their costs and developing new ones. The need for technological innovation must be not be used as an excuse to avoid, delay or weaken binding emissions targets.

RECOMMENDATION >

Finally, the David Suzuki Foundation and the Pembina Institute call on the Government of Canada to desist from seeking operational rules for the post-2012 regime that threaten the environmental integrity of emissions targets.

In the Kyoto negotiations, Canada sought at various times, and with varying success, to weaken requirements to prioritize domestic emission reductions over purchases of foreign emission credits, and to obtain credits for business-as-usual activities, export of "clean energy" to the US and export of nuclear technology to developing countries. Although Canada did ratify the Kyoto Protocol, these positions significantly damaged our reputation and are not consistent with playing a responsible and leading role in the global effort to cut GHG emissions.

With Canada presiding at the international climate change negotiations and the Government now clearly stating the necessity of deep reductions in GHG emissions, there could be no better moment for Canada to move to a position of real leadership at the global level – both by adopting responsible GHG targets consistent with preventing dangerous climate change and by approaching the negotiations on the international regime for post-2012 GHG reductions with ambitions and positions commensurate with the challenge.

1. Introduction

Climate change caused by emissions of greenhouse gases (GHGs) from human activities is one of the greatest threats to people, economies and ecosystems in the 21st century. Allowed to continue rising unchecked, GHG emissions will have profound negative impacts worldwide.[1] To minimize these impacts, the international community must undertake a determined effort over several decades to cut emissions to a small fraction of their current level.[2]

Canada's emissions of GHGs are, on a per-capita basis, among the highest in the world;[3] relative to GDP they are 25% higher than for the industrialized world as a whole.[4] Our abundant export of fossil fuels results in additional emissions outside our borders. At the same time, Canada is one of the world's wealthiest countries in terms of GDP, natural resources and technological know-how. And some of the most severe impacts of climate change are already unfolding in our own territory, in the Arctic.[5]

In sum, our responsibility to play a leading role in the global effort to cut GHG emissions could not be more evident.

Canada's role to date in international action to combat climate change has some positive aspects and some negative ones.[6] Most notably, we have ratified the Kyoto Protocol, thereby accepting a challenging target to make an initial near-term reduction in our GHG emissions by 2008–12. But the Government of Canada has not yet made any commitments regarding the far deeper reduction targets that will be needed post-2012. In effect, Canada's current climate change policy ends abruptly on January 1, 2013.

Between November 28 and December 9, 2005, Canada is chairing the annual session of the United Nations climate change negotiations in Montreal. This conference, known in short as COP-11,[7] is the first annual negotiating session since the Kyoto Protocol became international law and the first session at which the Protocol requires[8] participating countries to "initiate the consideration of" GHG targets for the post-2012 period. Canada will hold the presidency of the negotiations for approximately one year, until the next annual conference. This intensifies the urgency of defining our post-2012 climate policy and places our role in the long-term, global effort to cut GHG emissions in the spotlight.

Canada's responsibility is to make that role a leading one. Two key questions must be answered in determining what it should entail: what post-2012 GHG targets should Canada adopt; and how should Canada approach the negotiations on the post-2012 international regime for GHG reductions? This paper seeks to provide answers to these questions.

NOTES TO SECTION 1

1 See Section 2.2.
2 See Section 3.1.
3 World Resources Institute. 2005. *Climate Analysis Indicators Tool (CAIT)* Version 2.0, http://cait.wri.org/cait.php.
4 *Ibid.* Here the industrialized world is taken to comprise the member countries of the Organization for Economic Co-operation and Development (OECD).
5 See Section 2.2.
6 See Section 5.2.3.
7 The eleventh session of the Conference of Parties to the United Nations Framework Convention on Climate Change.
8 Article 3.9, http://unfccc.int/essential_background/kyoto_protocol/items/1678.php.

2. The need to stabilize GHG concentrations

2.1 A scientific and legal imperative

2.1.1 SCIENTIFIC CONCERN

Human activities associated with two-and-a-half centuries of industrialization have caused a dramatic increase in the amount of carbon dioxide (CO_2) in the earth's atmosphere. For three-quarters of the past millennium, the concentration of CO_2 stayed close to 280 parts per million by volume (ppmv).[1] But since about 1750, it has risen in a smoothly accelerating curve to reach a level of 377 ppmv in 2004[2] – a value that has not been exceeded during the past 420,000 years, and likely not during the past 20 million years.[3] The current rate of increase is unprecedented for at least the past 20,000 years.[4]

CO_2 is a long-lived greenhouse gas (GHG) – a gas which, once emitted, remains in the atmosphere for many years, where it absorbs heat radiated from the earth's surface. Extra CO_2 in the atmosphere results in a "radiative forcing" i.e., a reduction in the energy radiated outwards from the top of the atmosphere. When the intensity of the energy leaving the atmosphere is reduced while the sun's energy continues to arrive with the same intensity as before, the atmosphere must warm.

The main causes of increasing CO_2 concentrations are the burning of fossil fuels – coal, petroleum products, natural gas – and deforestation. Currently, about three-quarters of the increase is being caused by fossil fuel burning.[5] Various industrial, transportation and agricultural activities are also responsible for increases in the atmospheric concentrations of other long-lived GHGs, notably methane, nitrous oxide, man-made fluorinated and chlorinated gases, and ground-level ozone. These other GHGs make significant additional contributions to radiative forcing, although the contribution from CO_2 remains the largest.[6]

By 1988 governments had become sufficiently concerned about this situation to establish the Intergovernmental Panel on Climate Change (IPCC) to advise them on the scientific basis, impacts, and means of adapting to and preventing global climate change caused by GHG emissions from human activities. The IPCC's reports are comprehensive reviews of the scholarly, peer-reviewed technical literature, authored by hundreds of the world's most respected physical and social scientists specializing in climate change. The texts of the IPCC's Summaries for Policymakers are co-authored by government representatives and the lead scientific authors, subject to the full agreement of the latter.

The IPCC's three formal Assessment Reports (1990, 1996 and 2001) show key conclusions being reached at steadily increasing levels of confidence and scientific understanding. The Third Assessment Report (2001) concluded that:

- The global average surface temperature rose by approximately 0.6°C over the 20th century, a warming trend unprecedented in the past millennium.[7]
- "Most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."[8]
- "Emissions of CO_2 due to fossil fuel burning are virtually certain to be the dominant influence on the trends in atmospheric CO_2 concentration during the 21st century."[9]
- If no explicit action is taken to curb GHG emissions from human activities, the global average surface temperature is projected to increase by 1.4 to 5.8°C between 1990 and 2100. About half of this range is due to differences in models of the climate; the other half is due to different scenarios of future emissions.[10]

The significance of these temperature increases is underscored by noting that the difference in global average surface temperature between the last ice age and today is only about 4–6°C.[11] Clearly, then, warming of the magnitude projected during the 21st century would cause enormous disruption not just to the climate, but to people, economies and ecosystems worldwide. Some of the key negative impacts projected are reviewed in Section 2.2.

Review of the scholarly scientific literature[12] and public statements by numerous professional scientific societies indicate that the vast majority of professional climate scientists agree with the IPCC's conclusions. Indeed, the world's most authoritative and broad-based scientific societies are now expressing a strong degree of concern. In June 2005, the national science academies of all the G8 countries (including Canada and the US) plus China, India and Brazil stated:

> *The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions.... Failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future.... We urge all nations ... to take prompt action to reduce the causes*

of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies.[13]

While scientists tend to be professionally cautious in their choice of language, politicians' paraphrasing of the scientific concern about climate change may provide a clearer expression of what is at stake. Prime Minister Tony Blair recently described climate change caused by GHG emissions from human activities as "unquestionably the most urgent environmental challenge"[14] and "a challenge so far-reaching in its impact and irreversible in its destructive power, that it alters radically human existence."[15] According to Canada's Environment Minister Stéphane Dion, "the science clearly demonstrates that global climate change is one of the greatest sustainability challenges of our time. The impacts of climate change will affect all countries and deep reductions in global emissions are essential if we are going to address it."[16]

2.1.2 STABILIZATION: AN OBJECTIVE UNDER INTERNATIONAL LAW

The scientific concern about climate change caused by human activities was already strong enough in 1992 for countries to reach agreement on the text of the United Nations Framework Convention on Climate Change (UNFCCC), which was opened for signature at the Earth Summit in Rio de Janeiro. By March 1994, the UNFCCC had been ratified by enough countries to become international law. It has now been ratified by 188 countries, virtually the entire international community.[17]

The UNFCCC's "ultimate objective" is to stabilize atmospheric concentrations of GHGs:

> *The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-caused] interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.*[18]

The UNFCCC requires each industrialized (Annex I) country to

> *adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic [human-caused] emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention.*[19]

It is worth noting that while the current US administration remains opposed to mandatory GHG emissions targets, it recently confirmed its adherence to the UNFCCC by signing the G8 Gleneagles Communiqué, in which national leaders "reaffirm[ed] our commitment to the UNFCCC and to its ultimate objective to stabilize greenhouse gas concentrations."[20] Shortly before the July 2005 G8 Summit, President George W. Bush also set aside the doubts that his administration had previously cast on the reality of human-caused climate change by stating: "I recognize that the surface of the earth is warmer and that an increase in greenhouse gases caused by humans is contributing to the problem."[21]

In summary, it can be said that there is a global consensus of governments, expressed in international law, that atmospheric concentrations of GHGs must be stabilized, and that, in pursuit of that objective, industrialized countries must lead the reduction of GHG emissions from human activities.

2.2 The consequences of failing to act: climate change impacts

The IPCC's Third Assessment Report (2001) attributed a wide range of observed impacts to the approximately 0.6°C of global warming that has already occurred.[22] More recently there has been a dramatic increase in the number of studies published in the scientific literature that provide evidence of ecosystem changes.[23] Some impacts already observed are spectacular: for example, it is likely that there has been about a 40% decline in Arctic sea-ice thickness during late summer to early autumn in recent decades.[24] The increase in forest fires in Canada over the past few decades can be attributed, at least in part, to the human-caused warming that has already occurred.[25]

The IPCC also projected much larger impacts as a result of additional future warming. Figure 1 summarizes the IPCC's conclusions regarding projections of impacts on vulnerable ecosystems; extreme events such as storms, floods and droughts; the balance between positive and negative impacts; and the risk of sudden climate shifts such as large reductions in the Greenland and Antarctic ice sheets or in the ocean current that maintains Western Europe's mild climate.

Figure 1 shows that 2°C of additional warming after 1990 would suffice to take the world into the realm of risks to many ecosystems and a large increase in extreme events. Above about 3°C, all regions would see negative impacts by any measure. Towards the high end of the IPCC's projected warming by 2100 (5.8°C), the risk of sudden climate shifts would become a major concern. The IPCC also noted that damage to ecosystems could be irreversible,[26] that impacts are expected to be greatest in developing countries[27] and on the poor,[28] and that "more people are projected to be harmed than benefited by climate change, even for global mean temperature increases of less than a few °C."[29]

A key finding of the International Symposium on the Stabilisation of GHG Concentrations, convened by the UK government in February 2005, was that research completed since the publication of the IPCC's Third Assessment Report has led to "greater clarity and reduced uncertainty about the impacts of climate change across a wide range of systems, sectors and societies. In many cases the risks are more serious than previously thought."[30]

It is beyond the scope of this paper to provide a comprehensive account of the impacts to be expected if GHG emissions are allowed to continue rising unchecked, but the following examples give a sense of their magnitude:

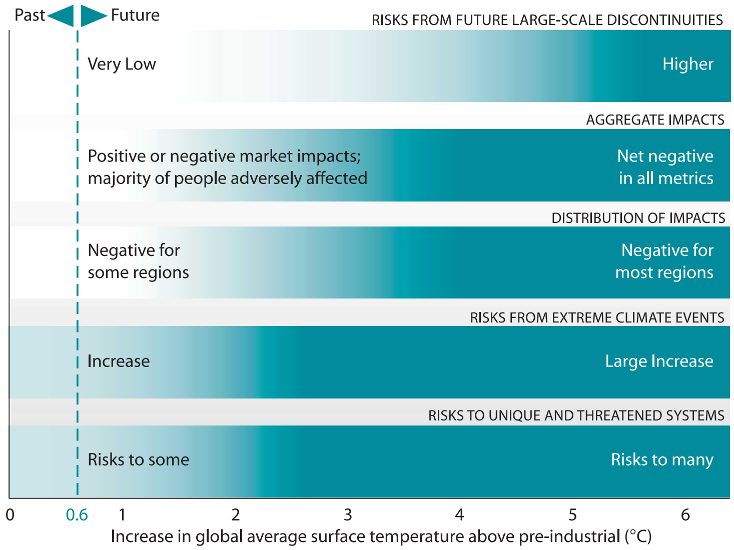

FIGURE 1. The IPCC's summary of impacts associated with increasing global warming.[31]

- The IPCC concluded that the projected global warming of 1.4 to 5.8°C between 1990 and 2100 corresponds to a rise in sea level of between 0.09 and 0.88 metres in the same timeframe. A rise in sea level of just half a metre, in the middle of this range, would flood an area of Bangladesh currently inhabited by eight million people.[32] A local warming of 3°C over Greenland, which corresponds to global warming of only about 1.5°C,[33] would be enough to cause a virtually complete melting of the ice sheet, adding seven metres to sea level (although this would take thousands of years).[34]
- More intense rainfall events are "very likely, over many areas" and more intense tropical storms are "likely, over some areas" under the IPCC's warming scenarios.[35]
- Tens of millions of additional people are projected to be at risk from coastal flooding and hunger, hundreds of millions from malaria and billions from water shortage by the 2080s if the global average surface temperature approaches 2°C above the pre-industrial level (see Figure 2).
- Under mid-range climate-warming scenarios, 15–37% of species in sample regions covering 20% of the earth's land surface would be "committed to extinction" by 2050.[36]
- In a report for the United Nations Environment Program, insurance company Munich Re evaluated the cost of impacts resulting from a rise in the atmospheric concentration of CO_2 to twice the pre-industrial level by 2050.[37] The total cost was estimated to be $US 300 billion annually including, for example, $US 47 billion of additional annual costs for the world's water management industry by 2050,

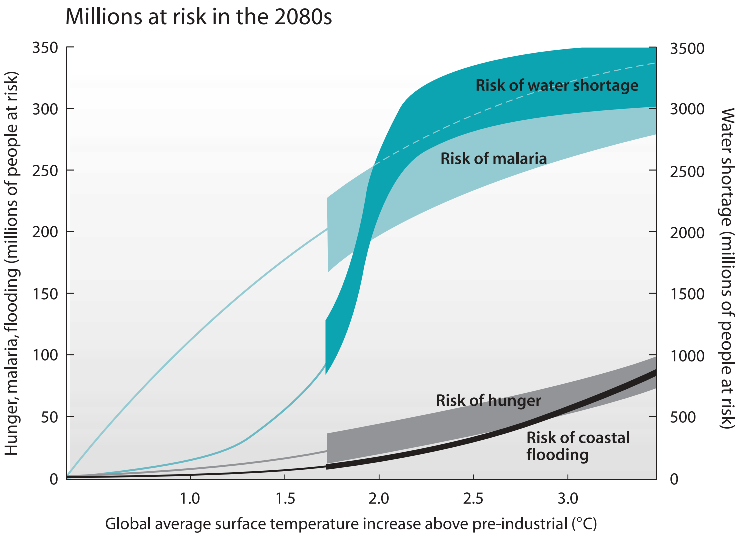

FIGURE 2. Additional millions of people at risk from key impacts associated with increasing global warming.[40]

and $US 42 billion of additional annual costs for agriculture and forestry.[38]

- The Arctic Climate Impact Assessment (2004), commissioned by eight Arctic governments, including Canada's, found that even under a moderate global warming scenario in the middle of the IPCC's range, climate models project, on average, that the extent of sea-ice around the North Pole in summer will decline by more than 50% by 2100. Some models project a near-complete disappearance of summer sea-ice by century's end.[39] Climate change is already strongly affecting people in many Arctic communities, and in some cases, threatening their cultural survival.[41]
- Coral reefs are one of the world's most fragile ecosystems, with 20% of the world's reefs already effectively destroyed under human pressures and showing no immediate prospects of recovery. It is estimated that climate change could destroy more than half of the world's reefs by 2030 to 2050.[42]
- All Canadians will be impacted by climate change. Some of the most significant projected impacts in Canada, apart from the transformation of the Arctic, include reduced water quantities from the Great Lakes to the Rockies, sea level rise on our coasts, and increased extreme weather and climate events.[43]

2.3 Stabilization at what level?

The international community has agreed that atmospheric concentrations of GHGs must be stabilized at a level that would prevent "dangerous" climate change (Section 2.1.2). But how can we determine what that level is?

2.3.1 A 2°C LIMIT

Given that concern about climate change derives from its projected impacts, the answer must start by defining a level of impacts that is deemed dangerous. Since there are many kinds of impacts, each measured in different ways, an obvious and convenient single impact measure is global average temperature increase. However, even if there were no uncertainty about the impacts associated with each degree of warming, the question of what would represent a "dangerous" temperature increase would always be open to debate, since deciding what is and what is not dangerous involves a value judgement that goes beyond the scope of conventional scientific analysis.[44] The IPCC, for example, has chosen not to make a judgement on this question.[45]

In practice, this does not seem to be a serious difficulty. Even the brief summary of projected climate change impacts presented in Section 2.2 suggests quite clearly that a rise in the global average surface temperature of about 2˚C above the pre-industrial level would lead to a realm of impacts that most people would likely agree to be a "danger zone." More exhaustive reviews and analysis of the available research results have, in fact, led to quite wide support for a 2˚C limit, both in the scientific community and among governments:

- The European Council (comprising the heads of government or state of all EU member states) first endorsed the 2˚C limit nearly a decade ago in 1996.[46] In March 2005, the Council reaffirmed its position, stating that "with a view to achieving the ultimate objective of the UN Framework Convention on Climate Change, the global annual mean surface temperature increase should not exceed 2˚C above pre-industrial levels."[47]
- In 2003 the German Advisory Council on Global Change, a group of physical and social scientists mandated to provide independent advice to the German government, published a detailed investigation into the meaning of "dangerous climate change." Based on available research, the Council concluded that an increase in global average surface temperature over the pre-industrial level of more than 2˚C would be "intolerable" with regard to impacts on ecosystems, biodiversity and (with some uncertainty) the economies of "large regions," and that the same amount of warming would be "dangerous" for food production and a limit that "should not be exceeded" with regard to "large-scale singular events" (i.e., sudden climate shifts).[48]
- In fall 2004, the European Climate Forum, a collaboration among academic research institutes, private sector companies and NGOs, convened more than 60 scientists to assess the latest scientific evidence relevant to the question "what constitutes dangerous climate change?" Based on this evidence, the Forum concluded that "for the time being it would be irresponsible to accept a course of action that would commit the world to sustained global warming of more than 2 degrees [Celsius]."[49]
- John Schellnhuber, Research Director of the Tyndall Centre (one of the UK's two main climate change research centres) and Director of the Potsdam Institute for Climate Impact Research, points to an emerging scientific consensus around the 2ºC limit: "In the scientific community we think an atmospheric CO_2 concentration of about 450 ppm[v] – the equivalent of a 2˚C rise in temperature – is about the

most we can allow. Beyond that you start to reach the 'tipping points,' the unpredictable areas where rapid changes can set in."[50]

- The French government's long-term GHG emission reduction objective, adopted in 2004 (see Section 3.2.2), is based on the need "to avoid an increase in global average temperature of more than 2°C."[51]
- The International Climate Change Taskforce, co-chaired by Olympia Snowe, a Republican senator from Maine, and Steven Byers, former UK Minister for Transport, recommended in January 2005 that "A long-term objective be established to prevent global average temperature from rising more than 2°C above the pre-industrial level."[52] Other members of the Taskforce include the (now former) premier of New South Wales and a former Director General of the Confederation of British Industry.[53]

Some scientists and NGOs take the stronger position that global warming of 2ºC above the pre-industrial level should be regarded as a limit to be avoided, as opposed to one that we should feel comfortable about reaching:

- The German Advisory Council on Global Change, in the report cited above, concluded that warming "above 1.5–2°C" would be "dangerous" for water availability and that a range of warming up to 2°C "will tend to be too wide, certainly not too narrow" with regard to human health. While the Council concluded that "globally aggregated, danger begins at 2°C mean temperature rise relative to pre-industrial level," it also warned that "warming may ... already be dangerous at lower levels of global mean temperature rise."[54]
- A recent Canadian draft assessment of "dangerous" climate change noted that since warming is projected to be greater than the global average for much of Canada, especially in the Arctic, a 2°C limit for global average temperature rise may be too high from a Canadian perspective.[55] As noted in Section 2.2, climate change is already strongly affecting people in many Arctic communities, and in some cases, threatening their cultural survival.
- The Climate Action Network International, which includes the major environmental NGOs working on climate change, has concluded that "climate action must be driven by the aim of keeping global warming as far below 2°C as possible [relative to the pre-industrial level] in order to prevent dangerous interference with the climate system." This conclusion is based on a list of numerous negative impacts that have been projected for warming *below* 2°C.[56]

2.3.2 FROM A TEMPERATURE LIMIT TO A CONCENTRATION OBJECTIVE

If we adopt a temperature limit such as 2°C, or any other environmental limit, as a definition of what constitutes "dangerous" climate change, such a limit needs to be translated into equivalent atmospheric concentrations of GHGs to arrive at an explicit interpretation of the international community's objective (Section 2.1.2) of stabilizing those concentrations at a level that would prevent dangerous climate change.

Translating a temperature limit into a concentration stabilization objective requires the use of climate models that project the future climate based on atmospheric GHG concentrations. Those concentrations are, in turn, generated from scenarios of future GHG emissions, so once a concentration stabilization objective has been settled on, it can be converted into acceptable scenarios for future global and national emissions. Figure 3 summarizes the logic of the entire process.

In the past, the literature on stabilizing atmospheric GHG concentrations commonly referred to a limit of 550 ppmv for CO_2, which would be approximately double the pre-industrial concentration (see Section 2.1.1). For example, the UK's independent Royal Commission on Environmental Pollution, which published a pioneering report on this topic in 2000, adopted a 550 ppmv CO_2 stabilization objective as the basis for recommending that the UK's CO_2 emissions be reduced by 60% from "current" levels by 2050.[57] The World Business Council for Sustainable Development suggested only recently that 550 ppmv CO_2 is an "acceptable limit."[58]

Unfortunately, a 550 ppmv CO_2 objective is not well supported by current science. First, changes in other GHGs are likely to contribute the equivalent of an additional 50–150 ppmv of CO_2 to the warming.[59] This means that if we estimate, on the basis of climate models that consider only CO_2, that the CO_2 concentration needs to be stabilized at 550 ppmv, in practice it will need to be stabilized at a lower level to allow for increased concentrations of the other long-lived GHGs. A rule of thumb used in the literature is to add 100 ppmv to a CO_2 concentration objective to obtain the corresponding "CO_2 equivalent" (CO_2e) objective.[60,61]

Second, even when GHGs other than CO_2 are accounted for, 550 ppmv CO_2e (i.e., about 450 ppmv CO_2) is still too high to be compatible with a 2°C global warming limit. The EU's national governments noted in March 2005 that "recent scientific research and work under the IPCC indicate that it is unlikely that stabilisation of concentrations above 550 ppmv CO_2 equivalent would be consistent with meeting the 2°C objective and that in order to have a reasonable chance to limit global warming to no more than 2°C, stabilisation of concentrations well below 550 ppmv CO_2 equivalent may be needed."[62]

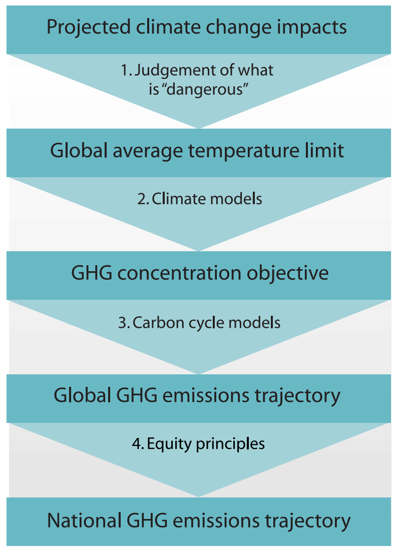

FIGURE 3. The logical flow from projected climate change impacts (Section 2.2) to a temperature limit (Section 2.3.1), GHG concentration objective (Section 2.3.2), global emissions trajectory (Section 3.1) and national emissions trajectory (Section 3.2.1).

The EU's position is based on scientific investigations such as the one illustrated in Figure 4, where multiple climate models were used to gauge the probability of staying within the 2°C limit at different levels of stabilization of CO_2e concentrations. Figure 4 shows that the risk of overshooting the limit is very high with a stabilization level of 550 ppmv CO_2e, and that even a stabilization level of 450 ppmv CO_2e corresponds only to about a 50–50 chance of staying within the 2°C limit. The implication of this work is that if we are serious about limiting global warming to no more than 2°C, we need to adopt a lower objective such as 400 ppmv CO_2e.

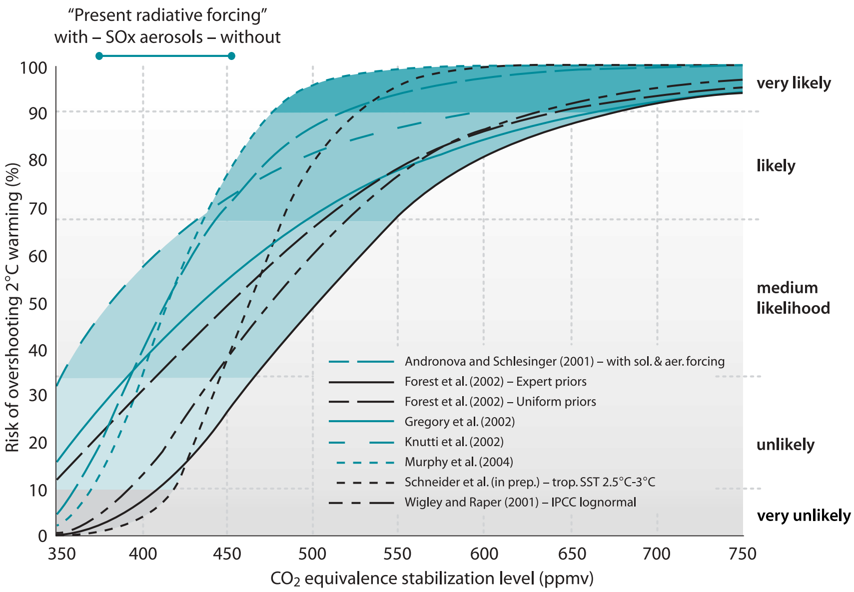

FIGURE 4. The risk of a long-term increase of more than 2°C in global average surface temperature, relative to the pre-industrial level, for different levels of stabilization of GHG concentrations.[64]

The International Symposium on the Stabilisation of GHG Concentrations convened in February 2005 by the UK government confirmed that "limiting warming to 2°C above pre-industrial levels with a relatively high certainty requires the equivalent concentration of CO_2 [i.e., the CO_2e concentration] to stay below 400 ppm[v]."[63]

Is a stabilization objective of 400 ppmv CO_2e still attainable? The concentration of CO_2 alone had already reached 377 ppmv in 2004 and is increasing by an average of about 1.8 ppmv every year.[65] Worse, when GHGs other than CO_2 are taken into account, the CO_2e concentration has already reached 450 ppmv.

The answer is yes. First, it must be understood that if emissions are low enough, concentrations will fall as GHGs are re-absorbed from the atmosphere by the oceans and land-based ecosystems. Because the climate system takes time to respond to GHG concentration levels, concentrations can remain temporarily higher than 400 ppmv CO_2e for a few decades without the atmosphere warming to the extent that it would if concentrations remained high.[66]

Second, the effects of pollutants other than GHGs must be considered. Emissions of sulphur dioxide (SO_2) from industrial activities are particularly important. SO_2 emissions produce fine particles in the atmosphere called "sulphate aerosols" that exert a negative "radiative forcing" (Section 2.1.1). This results in a cooling effect that is currently shielding us from the full warming effect of GHGs.[67] As shown at the top left of Figure 4, the current CO_2e concentration is reduced from 450 to about 370 ppmv if this negative radiative forcing is included. However, it is anticipated that SO_2 emissions will fall to a small fraction of their current level by the end of this century as a result both of efforts to curb regional air pollution and the reduction in fossil fuel burning needed to cut GHG emissions. Since GHG concentrations cannot realistically be stabilized before the next century, including aerosols in the definition of CO_2e concentration does not have much effect on the numerical value of CO_2e stabilization objectives.[68,69]

Figure 4 also shows the considerable uncertainty that remains in the sensitivity of the amount of global warming to the level of stabilization of GHG concentrations. Different climate models embody various estimates of this "climate sensitivity," which is defined as the equilibrium change in global average surface temperature following a doubling of the atmospheric CO_2e concentration,[70] i.e., the eventual global warming relative to the pre-industrial level under an approximate 550 ppmv CO_2e stabilization scenario.[71] The IPCC's view is that the climate sensitivity is most likely to lie in the range 1.5–4.5°C, with no guidance as to the distribution of probabilities within this range. Recently, however, several estimates of this distribution have been made; they were used to construct Figure 4.[72]

Optimal (cost minimizing) behaviour in the presence of this uncertainty is to deploy a "hedging strategy" in which lower concentration targets are pursued than would be optimal if there were no uncertainty. This is because the risk of incurring the high costs of delayed action to correct to a lower target, after the uncertainty is removed, outweighs the costs of early action. As the German Advisory Council on Climate Change puts it: "Even if, for example, a CO_2 stabilization level of 450 ppm[v] is regarded as a best guess for a safe level, it is more cost effective to follow a lower emission path than the one leading to stabilization of 450 ppm[v], as long as the tolerable stabilization level is uncertain."[73] The Swedish Environmental Protection Agency has made the same point.[74]

Relatively few business organizations have yet publicly endorsed a particular GHG concentration stabilization objective, and those who have done so have stayed away from the objectives below 500 ppmv CO_2e that are needed to have much confidence of keeping global warming within 2°C:

- The CEO of BP, the major oil company, stated in 2003: "We've come to the judgement that to avoid serious impact upon societies or the environment it is necessary to stabilise atmospheric concentrations of greenhouse gases at around 500–550 parts per million"; and that "stabilisation in the range 500–550 ppm[v] is possible, and with care could be achieved without disrupting economic growth."[75] It is not clear whether this statement refers to concentrations of CO_2 or CO_2e.
- Shell has also put forward scenarios of energy futures that allow the atmospheric CO_2 concentration to stabilize below 550 ppmv.[76]

- As noted above, the World Business Council for Sustainable Development recently suggested that 550 ppmv CO_2 is an "acceptable limit." The Council argues that "a level of stabilization of less than 500 ppm[v] [CO_2, i.e., about 600 ppmv CO_2e] will be very difficult to achieve ... Stabilization at a somewhat higher level would be more achievable as it allows a timeframe in which significant change in our energy infrastructure could take place."[77]

We will return to the question of "achievability," as raised in these business views, in Sections 4.3.1 and 4.3.2.

2.3.3 CONCENTRATION LEVELS IF NO ACTION IS TAKEN TO CURB EMISSIONS

To place Section 2.3.2 in context, and to provide an initial sense of the amount by which GHG emissions will need to be reduced to stabilize atmospheric concentrations (Section 3), it is instructive to look at the concentrations that would result if no explicit action is taken to curb GHG emissions. Figure 5 shows the concentrations resulting from the full range of the IPCC's emission scenarios that correspond to a projected global average surface temperature increase of 1.4 to 5.8°C by 2100 (Section 2.1.1).

Figure 5 shows that in the absence of explicit action to curb GHG emissions, the CO_2 concentration will reach 540 to 970 ppmv by 2100 (or 490 to 1260 ppmv including uncertainties in the carbon cycle models used to translate emissions into concentrations[78]). It should be recalled (Section 2.3.2) that changes in other GHGs are likely to result in CO_2e concentrations approximately 100 ppmv higher than those shown in the figure. The CO_2e concentration will therefore likely exceed 600 ppmv even in the lowest scenario.

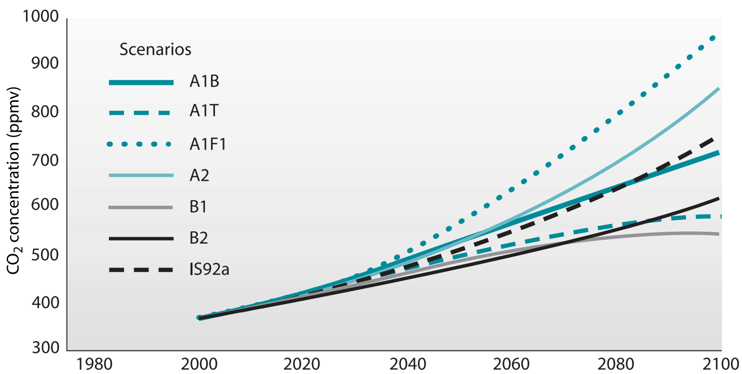

FIGURE 5. Atmospheric CO_2 concentrations resulting from the IPCC's scenarios of future emissions in which no explicit action is taken to curb emissions.[80]

None of the scenarios depicted in Figure 5 is intended to be considered more likely than the others.[79] It would clearly be desirable for the world to strive to follow a development path resembling one of the lowest two scenarios (B1 and A1T), in order to reduce the magnitude of the explicit action that will be needed to curb GHG emissions.[81] The B1 scenario has an emphasis on "global solutions to economic, social and environmental sustainability," and the A1T scenario emphasizes the rapid introduction of new and more efficient non-fossil energy sources.[82]

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68. Den Elzen, M. and M. Meinshausen. 2005. *Meeting the EU 2˚C climate target: global and regional emission implications*, p.15,41. Netherlands Environmental Assessment Agency, http://www.rivm.nl/bibliotheek/rapporten/728001031.pdf.
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72. *Ibid.*
73. German Advisory Council on Global Change. 2003. *Climate Protection Strategies for the 21st Century: Kyoto and beyond*, p.23, http://www.wbgu.de/wbgu_sn2003_engl.html.
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79. Intergovernmental Panel on Climate Change. 2000. *Special Report, Emission Scenarios, Summary for Policymakers*, p.11, http://www.ipcc.ch.
80. Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: The Scientific Basis, Summary for Policymakers and Technical Summary of the Working Group I Report*, p.65, http://www.ipcc.ch.
81. Robinson, J. et al. 2005. "Climate Change and Sustainable Development: Realizing the Opportunity," *Ambio*, forthcoming.
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3. By how much and by when must emissions be reduced?

3.1 Reductions in global emissions

It is essential to distinguish atmospheric *concentrations* of GHGs from annual *emissions* of GHGs. Global emissions of GHGs are rising, but simply halting the rise by stabilizing *emissions* will not be sufficient to stabilize *concentrations*. This is because, as shown in Figure 6, about half the amount of GHGs emitted in recent years has simply accumulated in the atmosphere. This implies that to halt the buildup in concentrations, we not only need to reverse the current rise in emissions but also then go on to cut emissions by at least half.[1]

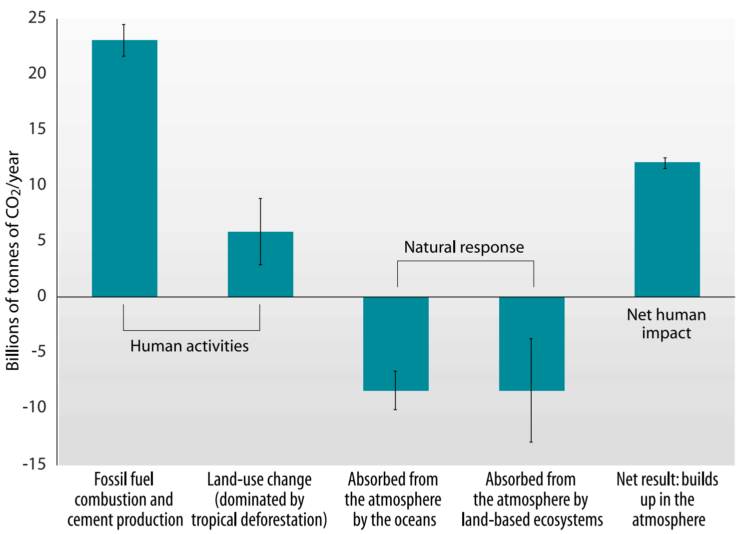

FIGURE 6. Global atmospheric CO_2 budget for 1989–98, showing the addition of CO_2 to the atmosphere by human activities, natural absorption of CO_2 by land and oceans, and the net CO_2 build-up in the atmosphere. Vertical bars show uncertainties.[3]

Models of the global "carbon cycle" can be used to predict detailed trajectories of annual emissions over time that can stabilize atmospheric concentrations at particular levels (this is the third step depicted in Figure 3). Figure 7 depicts trajectories reported by the IPCC and shows clearly that stabilization of concentrations at any level requires emissions to be reduced eventually to a small fraction of the current level;[2] and that the longer it takes to achieve those reductions, the higher the level at which GHG concentrations will stabilize.

Figure 7 shows only one possible set of emissions trajectories that would allow concentrations to be stabilized at different levels. Different assumptions about the way the emission reduction effort is to be distributed over time and uncertainties in modelling of the carbon cycle will lead to variations in the trajectories computed for a given stabilization level. Table 1 shows this variation among three illustrative sets of trajectories calculated more recently than those shown in Figure 7.[4]

Despite significant variation among the three sets of trajectories, Table 1 suggests that to stabilize the atmospheric GHG concentration at 400 ppmv CO_2e, an objective necessary to stay with reasonable confidence within a 2°C global warming limit (Section 2.3.2), global GHG emissions must be limited to no more than about 15% above the 1990 level by 2020 and fall to at least 30–50% below the 1990 level by 2050. To stabilize at 450 ppmv CO_2e, with only about a 50–50 chance of staying within the 2°C limit (Section 2.3.2), global emissions must be kept between 1–27% above the 1990 level in 2020, while estimates of where global emissions must be in 2050 vary wildly between 60% below the 1990 level and 20% above.

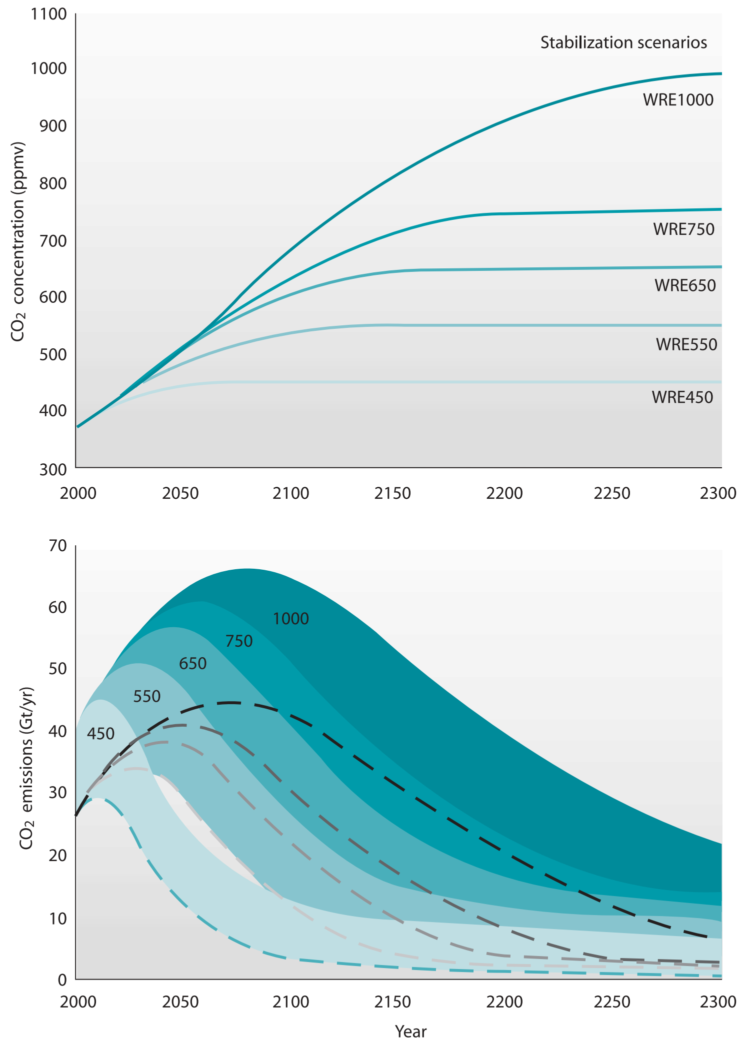

FIGURE 7. Scenarios for stabilizing atmospheric CO_2 concentrations (top) and trajectories of annual emissions (bottom) corresponding to each stabilization scenario, showing uncertainties. The dashed lines indicate lower uncertainty limits.[5]

Global emissions reach a peak around 2015 in all four trajectories in the Netherlands Environmental Assessment Agency study and peak around 2020 in the three trajectories in the German Federal Environment Agency study. Dates for peak emissions are not given in the Potsdam Institute study. But Table 1 suggests that even when the atmospheric GHG concentration is stabilized at levels as high as 500 or 550 ppmv CO_2e, global GHG emissions must peak and begin to fall well before 2050.

TABLE 1. Global GHG emissions levels in 2020 and 2050 consistent with stabilizing atmospheric GHG concentrations at various levels.

	POTSDAM INSTITUTE[6]			NETHERLANDS ENVIRONMENTAL ASSESSMENT AGENCY[7]				GERMAN FEDERAL ENVIRONMENT AGENCY[8]		
Stabilized CO_2e concentration (ppmv)[9]	350	400	450	400	450	500	550	450*	550*	650*
% change in emissions 1990–2020 (low/high)	–20 / +7	+10 / +11	+1 / +27	+15	+20 / +25	+25 / +35	+25 / +35	+10	+30	+50
% change in emissions 1990–2050 (low/high)	–51 / –22	–34 / –31	0 / +20	–55 / –50	–40 / –30	–25 / –15	–10 / –5	–60	–25	+45

* These are approximations, suggested in the study, to the latter's target concentrations of 350/400, 450 and 550 ppmv CO_2 (not CO_2e) respectively.

3.2 Reductions in industrialized-country emissions

Even if there is agreement on the amount by which global emissions should be reduced, it remains challenging to agree on an allocation of global emission reductions among countries, a necessary step towards determining national emissions targets (this is the fourth step depicted in Figure 3). This may well be the most difficult aspect of the climate change issue because there are so many divergent views on what is a "fair" way to share responsibility for reducing emissions. In formal terms, there are a variety of possible equity principles that can be used to settle the question, and different parties place different amounts of emphasis on each principle.[10]

The UNFCCC, which has been almost universally endorsed by the international community (as noted in Section 2.1.2), provides significant guidance on the matter, notably:

> *Noting that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs.*[11]
>
> *The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the negative effects thereof.*[12]

At least five different equity principles are evoked in these two paragraphs alone: polluter-pays ("largest share of ... current global emissions"), historical responsibility ("largest share of historical ... emissions"), equal per capita rights to emit ("per capita emissions ... are still relatively low"), intergenerational equity ("future generations of humankind") and ability-to-pay ("in accordance with their ... respective capabilities").

3.2.1 REDUCTIONS DERIVED FROM GLOBAL EMISSIONS TRAJECTORIES

A first approach to deriving national emissions trajectories and targets is to apply schemes for allocating responsibility among categories of countries – generally the two categories of industrialized and developing countries – to the global emissions trajectories discussed in Section 3.1. This approach was taken in the recent Dutch and German government studies cited there; the results are summarized in Table 2.

TABLE 2. Reductions in the GHG emissions of industrialized countries by 2020 and 2050 consistent with stabilizing atmospheric GHG concentrations at various levels.

	NETHERLANDS ENVIRONMENTAL ASSESSMENT AGENCY[13]				GERMAN FEDERAL ENVIRONMENT AGENCY[14]		
Stabilized CO_2e concentration (ppmv)	400	450	500	550	450*	550*	650*
% reduction in emissions 1990–2020	25–30	10–20	5–15	0–15	25–50	10–30	5–25
% reduction in emissions 1990–2050	85–90	75–85	65–70	55–60	80–90	70–90	40–80

* These are approximations, suggested in the study, to the latter's target concentrations of 350/400, 450 and 550 ppmv CO_2 (not CO_2e) respectively.

The results of the Netherlands Environmental Assessment Agency study shown in Table 2 apply to the US, Canada, enlarged EU, former Soviet Union and Japan (but not Oceania, for which the reductions are less stringent). The results presented are those for a "multi-stage approach" that assumes a gradual increase in the number of countries that pass from having no targets (stage 1) to emissions intensity[15] targets (stage 2), and then to absolute emissions targets (stage 3). Passage from stage 1 to 2 and from stage 2 to 3 is triggered by the value of a "capability-responsibility index" that combines the ability-to-pay and polluter-pays principles.

The same study also calculated emissions trajectories for industrialized countries based on the "contraction and convergence" scheme, in which national per capita emissions converge starting in 2012 until they are equal in 2050. This scheme is based on the equity principle of equal per capita rights to emit. Industrialized countries' emission reductions by 2020 are quite similar to those in the "multi-stage approach," but the reductions by 2050 are significantly more stringent.

The results of the German Federal Environment Agency study shown in Table 2 apply generally to industrialized countries and cover four allocation schemes, although a few outlying results fall outside the ranges given in the table. The four schemes are contraction and convergence, "common but differentiated convergence" (a variant of contraction and convergence), a "multi-stage" approach somewhat similar to the one used in the Netherlands Environmental Assessment Agency study and a "triptych" scheme in which common rules are applied to the sectoral emissions of all countries.

The UK's target to reduce national CO_2 emissions by 60% by 2050 (see Section 3.2.2) was originally derived by the Royal Commission on Environmental Pollution, which applied the contraction and convergence approach to stabilization of the atmospheric

CO_2 concentration at 550 ppmv.[16] The Energy White Paper that established the target was accompanied by a study[17] that presented an alternative derivation of the 60% reduction. The study considered low- and high-growth global emissions trajectories, consistent with the same 550 ppmv CO_2 stabilization level, but in which developing countries begin to limit their emissions at different dates. The study found that a 60% emissions reduction by industrialized countries by 2050 would require developing countries to begin limiting their emissions as early as 2010 if the absorption of CO_2 by natural carbon sinks[18] is low and developing countries' emissions would otherwise grow rapidly. A 60% emissions reduction by industrialized countries by 2050 could, on the other hand, allow developing countries to begin limiting their emissions as late as 2100 if the absorption of CO_2 by natural carbon sinks is high and developing countries' emissions grow relatively slowly. The study concluded that "a precautionary approach would suggest that a 60% cut by [industrialized country] parties is not an unreasonable target," but cautioned that "should the sensitivity of the climate system to CO_2 be at the higher end of the current range of estimates, greater reductions than 60% by 2050 will be needed if the more severe impacts are to be avoided."

3.2.2 POST-2012 REDUCTION COMMITMENTS BY GOVERNMENTS

Another approach to assessing what might be appropriate national emissions targets for industrialized countries such as Canada is to examine the targets to which some governments have already committed. Commitments regarding post-2012 GHG emissions targets include the following, summarized in Table 3:

- In 2003, the UK government published its Energy White Paper that "accept[s] the Royal Commission on Environmental Pollution's recommendation [Section 2.3.2] that the UK should put itself on a path towards a reduction in carbon dioxide emissions of some 60% from current levels by about 2050."[19] (The UK's CO_2 emissions were 5% below the 1990 level in 2001.[20]) The White Paper also "aims" to reduce CO_2 emissions to about 27–33% below the 1990 level by 2020.[21]
- The French government's Climate Plan (2004) states: "France considers that the atmospheric concentration of CO_2 should not exceed 450 ppm[v], in order to avoid an increase in global average temperature of more than 2°C, and that global GHG emissions should therefore be cut in half by 2050, which should lead industrialized countries to reduce their emissions by a factor of four to five over the same period. In this context, France's long-term objective is therefore to reduce its GHG emissions by 75–80% by 2050."[22] (France's emissions in 2004 were expected to be almost equal to the 1990 level.[23])
- In March 2005, the European Council (comprising the heads of state or government

TABLE 3. Post-2012 GHG emission reduction commitments by governments in industrialized countries (relative to 1990 levels except where noted).

	% REDUCTION IN EMISSIONS 1990–2020	% REDUCTION IN EMISSIONS 1990–2050
California	0[a]	80
EU (25 countries)	15–30[b]	60–80[c]
France	–	75–80[d]
Germany	40[e]	–
New England states/ Eastern Canadian provinces	at least 10	75–85[f]
New South Wales	0[a,g,h]	60[h]
Sweden	–	43[i]
UK	ca. 27–33[j]	60[j]

a This does not imply zero effort but rather that emissions will be brought down after having risen.
b Government leaders' recommendation for developed countries, rather than a commitment.
c Environment ministers' recommendation for developed countries, rather than a commitment.
d Reduction below "current" level in 2004.
e Offer conditional on the EU committing to a 30% reduction by same date.
f Suggestion based on "current science"; reduction below "current" level in 2001.
g Reduction by 2025.
h Reductions below 2000 level.
i Reductions in per capita emissions below "current" level in 2001.
j Reductions apply to CO_2 only. The emission levels (MtC) used in the White Paper are 164.5 (1990), 110–120 (2020) and "around 65" (2050).

of all EU member states) stated its belief that "reduction pathways for the group of developed countries in the order of 15–30% by 2020, compared to the baseline envisaged in the Kyoto Protocol [i.e., emissions in 1990] ... should be considered," based on the Council's position (Section 2.3.1) that "with a view to achieving the ultimate objective of the UN Framework Convention on Climate Change, the global annual mean surface temperature increase should not exceed 2°C above pre-industrial levels."[24] The Environment Council (comprising the environment ministers of all member states) had earlier recommended that "reduction pathways by the group of developed countries in the order of 15–30% by 2020 *and 60–80% by 2050* compared to the baseline envisaged in the Kyoto Protocol should be considered."[25] (our emphasis)

- Germany's federal government previously offered to take on a target to reduce the country's GHG emissions to 40% below the 1990 level by 2020 if the EU committed to a 30% reduction over the same timeframe.[26]
- On June 1, 2005, California's Governor Schwarzenegger issued an Executive Order setting targets to limit statewide GHG emissions to the 2000 level in 2010, the 1990 level in 2020 and 80% below the 1990 level by 2050.[27]
- In 2001, the Conference of New England Governors and Eastern Canadian Premiers (of Québec and the four Atlantic provinces) adopted a "mid-term goal [to] reduce regional GHG emissions by at least 10% below the 1990 level by 2020," and

a "long-term goal [to] reduce regional GHG emissions sufficiently to eliminate any dangerous threat to the climate; current science suggests this will require reductions of 75–85% below current levels."[28]

- In Australia, the former premier of New South Wales, Bob Carr, recently committed the state to capping its emissions at 2000 levels by 2025 and achieving a 60% cut by 2050.[29] (The state's emissions were 3% lower in 2002 than in 1990, including land-use, land-use change and forestry (LULUCF), and 6% higher in 2002 than in 1990 excluding LULUCF.[30])
- In 2001 the government of Sweden established the objective of reducing Sweden's per capita GHG emissions to 43% below the "current" level (almost equal to the 1990 level) by 2050.[31]

3.2.3 VIEWS OF BUSINESS ORGANIZATIONS

Deep reductions of the same order as those to which governments are now committing are beginning to find support among business organizations, including some of the world's largest GHG-emitting companies:

- As noted in Section 2.3.2, BP believes "it is necessary to stabilise atmospheric concentrations of greenhouse gases at around 500–550 parts per million" (without specifying CO_2 or CO_2e), and Shell has also put forward scenarios that allow the atmospheric CO_2 concentration to stabilize below 550 ppmv. According to the studies cited in Section 3.2.1, stabilization at these levels requires industrialized countries' GHG emissions to be reduced to 40–80% below 1990 levels by 2050.
- In May 2005, the leaders of 13 major British-based companies, including BP and Shell, wrote to Prime Minister Tony Blair on the need to develop long-term policies to achieve the government's 60% CO_2 emission reduction target (see Section 3.2.2). The companies wrote: "We welcome the UK Government's commitment to a reduction of this order of magnitude."[32]
- Insurance companies have often been prominent in expressions of concern about climate change. Australia's largest general insurer, Insurance Australia Group, has joined calls for the country to adopt a target to reduce GHG emissions by 60% by 2050.[33] Munich Re, one of the world's largest reinsurers, recently called for "a strong commitment on the post Kyoto period."[34]

3.3 No time for delay

Climate change is a long-term problem: the impacts are (for now) appearing gradually, and the emission reductions needed to limit the impacts will take a few decades to achieve. This is because the reductions are very large and are constrained by feasible turnover rates of capital stock such as industrial facilities and transport infrastructure.

The long-term nature of the problem, combined with the scale of the efforts needed to solve it and a perception of little immediate electoral benefit from taking action, can deceive decision makers into thinking there is little or no urgency about initiating deep emission reductions. This is a grave error, as well as a failure of leadership.

First, more attention needs to be paid to the wide range of climate change impacts that are already being observed. Some of these are already spectacular, especially in the Arctic (see Section 2.2).

Second, the reality is that the emission reductions needed are so large that if they are not initiated immediately by enough countries, the lower levels of stabilization of GHG concentrations will become, for practical purposes, impossible to achieve. The Netherlands Environmental Assessment Agency study cited in Sections 3.1 and 3.2.1 examined this question[35] and found that if the US and developing countries take no action for two decades after 2012, stabilization at even the highest level considered in the study – 550 ppmv CO_2e – would require the other industrialized countries to reduce their emissions by about 90% between 1990 and 2025.[36] Even if unlimited international emissions trading allowed such countries to meet a 90% emission reduction target by paying for reductions outside their borders, this would clearly not be politically feasible, even if it were economically feasible.

The same study considered another case where the US merely limits its emissions to the 2000 level by 2025 and where developing countries take on emissions intensity and then absolute emissions targets much more slowly than for the results reported in Sections 3.1 and 3.2.1. In this case, the other industrialized countries have to reduce their emissions by about 50% between 1990 and 2025 for stabilization at 550 ppmv CO_2e, by about 60% between 1990 and 2025 for 500 ppmv CO_2e, and by almost 100% between 1990 and 2025 for 450 ppmv CO_2e or lower. Again, emissions targets such as these are not politically feasible.

Given the scale of the required reductions in emissions below 1990 levels – let alone below business-as-usual levels – any economically rational (cost minimizing) strategy will *immediately* initiate an emissions trajectory that leads to deep reductions. A key finding of the International Symposium on the Stabilisation of GHG Concentrations, convened by the UK government in February 2005, was that "even a delay of just five years could be significant. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be three to seven times greater to meet the same [global average] temperature target."[37] It is virtually certain that such dramatically increased rates of emission reduction will carry a high price tag.

As noted in Section 2.1.1, the national science academies of the G8 countries plus China, India and Brazil, have made the same point: "Failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future.... We urge all nations ... to take prompt action to reduce the causes of climate change."

If, on the other hand, decisive action is not initiated immediately, as capital stock turns over decisions will continue to be made to invest in infrastructure with potentially enormous GHG emissions and operational lifetimes of decades. Abandoning such infrastructure before the end of its normal lifetime is then very difficult as it leads to large capital losses for investors.

It is also pertinent to recall here the argument presented in Section 2.3.2, that optimal (cost minimizing) behaviour in light of the uncertainty in "climate sensitivity" is to pursue lower concentration objectives than would be optimal if there were no uncertainty because the risk of incurring the high costs of delayed action to correct to a lower target, after the uncertainty is removed, outweighs the costs of early action. Or, as it was put in the UK government study accompanying the Energy White Paper (Section 3.2.1), "'burn now, pay later' is a high risk approach."[38] This only further reinforces the urgency of initiating deep emission reductions immediately.

NOTES TO SECTION 3

1. This observation applies to atmospheric concentrations only; it does not address the potential negative impacts of ocean absorption of CO_2, notably ocean acidification.
2. Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: Synthesis Report*, p.90, http://www.ipcc.ch/pub/syreng.htm.
3. Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: The Scientific Basis*, Table 3.3, http://www.grida.no/climate/ipcc_tar/wg1/110.htm.
4. For example, the emissions trajectories shown in Figure 7 assume that CO_2 concentrations cannot peak and fall before stabilizing. In the Potsdam Institute and Netherlands Environmental Assessment Agency trajectories shown in Table 1, concentrations peak before stabilizing for the lower concentration levels.
5. Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: The Scientific Basis, Summary for Policymakers and Technical Summary of the Working Group I Report*, p.76, http://www.ipcc.ch.
6. Hare, B. and M. Meinshausen. 2004. *How Much Warming Are We Committed To And How Much Can Be Avoided?*, p.34. PIK Report No.93, http://www.pik-potsdam.de/pik_web/publications/pik_reports/reports/pr.93/pr93.pdf. *Climatic Change*, in press.
7. Den Elzen, M. and M. Meinshausen. 2005. *Meeting the EU 2°C climate target: global and regional emission implications*, p.18–19. Netherlands Environmental Assessment Agency, http://www.rivm.nl/bibliotheek/rapporten/728001031.pdf. The emission changes shown in Table 1 are changes to total emissions including land-use change and forestry.
8. Höhne, N. et al. 2005. *Options for the second commitment period of the Kyoto Protocol*, p.147,155. Umweltbundesamt, http://www.umweltbundesamt.org/fpdf-l/2847.pdf.
9. The Potsdam Institute study (p.13) and the Netherlands Environmental Assessment Agency study (p.15) include aerosols in their CO_2e concentration values. The German Federal Environment Agency study deals only with CO_2, but (p.109) does not include aerosols in its suggestion of CO_2e concentrations approximately equivalent to the CO_2 concentrations. However, as noted in Section 2.3.2, SO_2 emissions are

anticipated to fall to a small fraction of their current level by the end of this century, and so including aerosols in the definition of CO_2e concentration does not have much effect on the numerical value of CO_2e stabilization objectives.

10. Banuri, T. et al. 1996. Equity and Social Considerations. In *Climate Change 1995: Economic and Social Dimensions of Climate Change*. Edited by J. Bruce et al. Cambridge University Press.
11. Preamble, http://unfccc.int/essential_background/convention/background/items/1349.php.
12. Article 3.1, http://unfccc.int/essential_background/convention/background/items/1349.php.
13. Den Elzen, M. and M. Meinshausen. 2005. *Meeting the EU 2˚C climate target: global and regional emission implications*, Figure 9a,c (p.24). Netherlands Environmental Assessment Agency, http://www.rivm.nl/bibliotheek/rapporten/728001031.pdf. The emission changes shown in Table 2 do not include land-use change and forestry.
14. Höhne, N. et al. 2005. *Options for the second commitment period of the Kyoto Protocol*, p.148–155. Umweltbundesamt, http://www.umweltbundesamt.org/fpdf-l/2847.pdf.
15. Emissions intensity is emissions per unit of production or GDP.
16. Royal Commission on Environmental Pollution. 2000. *Energy – The Changing Climate Summary of The Royal Commission on Environmental Pollution's Report*, p.28, http://www.rcep.org.uk/newenergy.htm.
17. Department for Environment, Food and Rural Affairs. 2003. *The Scientific Case for Setting a Long-Term Emission Reduction Target*, p.6–8, http://www.defra.gov.uk/environment/climatechange/ewpscience.
18. Carbon sinks are processes in which CO_2 is absorbed in growing vegetation, soils or oceans (see Figure 6).
19. Department of Trade and Industry. *Our energy future – creating a low carbon economy*, p.8, http://www.dti.gov.uk/energy/whitepaper.
20. *Ibid.*, p.25.
21. *Ibid.*, p.25–26.
22. Ministère de l'écologie et du développement durable. 2004. *Plan Climat 2004*, p.68, http://www.ecologie.gouv.fr/IMG/pdf/PLAN-CLIMAT-2004-2.pdf.
23. *Ibid.*, p.5.
24. Council of the European Union. 2005. *22 and 23 March 2005 Presidency Conclusions*. 7619/1/05 REV, p.15–16, http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf.
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26. See http://www.bmu.de/english/climate/current/doc/35129.php.
27. See http://www.governor.ca.gov/state/govsite/gov_pressroom_main.jsp.
28. The Committee on the Environment and the Northeast International Committee on Energy of the Conference of New England Governors and Eastern Canadian Premiers. 2001. *Climate Change Action Plan 2001*, p.7, http://www.negc.org/documents/NEG-ECP%20CCAP.PDF.
29. Australia kicks off two major funding schemes for GHG abatement. *Carbon Finance*, June 2005, http://www.carbon-financeonline.com/issue/18/story/632.html (subscription required).
30. Australian Greenhouse Office. Undated. *State and Territory Greenhouse Gas Emissions – An Overview*, P.17–18, http://www.greenhouse.gov.au/inventory/stateinv/pubs/stateoverview.pdf.
31. Swedish Ministry of the Environment. 2001. *The Swedish Climate Strategy, Summary Gov. Bill 2001/02:55*, p.7,15, http://www.sweden.gov.se/content/1/c6/02/05/22/bb5baf61.pdf.
32. HRH The Prince of Wales's Business & the Environment Programme. 2005. *Corporate Leaders Call for UK Leadership on Climate Change*. News release, 27 May, http://www.cpi.cam.ac.uk/bep/downloads/CLG_pressrelease_letter.pdf.
33. Insurer joins call for Australia to make 60% GHG cut by 2050. *Carbon Finance*, July 2004, http://www.carbon-financeonline.com/issue/8/story/273.html (subscription required).
34. Munich Re calls for post-2012 certainty as cat costs soar. *Carbon Finance*, December 2004, http://www.carbon-financeonline.com/issue/12/story/427.html (subscription required).
35. Den Elzen, M. and M. Meinshausen. 2005. *Meeting the EU 2˚C climate target: global and regional emission implications*, p.27–29. Netherlands Environmental Assessment Agency, http://www.rivm.nl/bibliotheek/rapporten/728001031.pdf.
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4. Post-2012 GHG targets for Canada

4.1 Why longer-term targets?

The Government of Canada recognizes that "meeting the long-term objective of the UNFCCC will require reducing net GHG emissions to near zero,"[1] as the IPCC has shown (Section 3.1), and Environment Minister Stéphane Dion has emphasized that "deep reductions in global emissions are essential." (Section 2.1.1) The Government's current climate change plan, however, is focused on the Kyoto Protocol. Although the plan states that the Government is "committed to the transformative, long-term change required to make deep reductions in GHG emissions,"[2] it proposes no targets or policy details for the post-2012 period. As noted in Section 1, the Government has not yet made any commitments regarding the far deeper reduction targets that will be needed post-2012.

There are five reasons why this is a serious problem requiring urgent attention:

- Given that successfully solving the climate change problem requires a multi-decade effort, it is not responsible for Canada to be silent on the part it intends to play in that effort beyond the near term.
- Without knowing where we want to be five decades from now, governments cannot make the right policy decisions about where we need to go over the next one or two decades. Canada cannot responsibly enter international negotiations on GHG targets for the immediate post-2012 period without a clear idea of how such targets fit into its longer-term strategy.
- Canada's energy policies, which include support for rapid expansion of highly GHG-intensive activities such as oil sands development,[3] are sharply at odds with our climate policy, which aims for reductions in absolute GHG emissions levels. Our energy policy needs to be overhauled to make it consistent with our climate policy, but this cannot be achieved if our climate policy is limited to the near term.
- Canadian energy producers are contemplating investments in the order of $200 billion over the next 20 years[4] in infrastructure with potentially enormous

GHG emissions and operational lifetimes of 40 years or longer. Decisions on these investments that are inconsistent with deep long-term GHG emission reductions would lead either to large capital losses for investors (if such infrastructure is later abandoned) or an inability for Canada to come even close to shouldering its responsibility to address climate change.

- Without clarity on medium- and long-term GHG objectives, the private sector does not have the necessary incentive to invest in the development and deployment of the technologies needed for deep GHG reductions. As British industry leaders wrote in May 2005 to Prime Minister Tony Blair: "Climate change policy needs to ... create greater certainty about the long-term value of emissions reductions by setting targets for emissions trading and other related policies beyond 2012. We believe that in order to ensure that the long-term investments that our companies make are consistent with a shift to a low-carbon economy, these policies should set targets now for the year 2025."[5]

It could not be clearer that Canada needs to emulate the governments that have already made post-2012 reduction commitments (Section 3.2.2). It is, therefore, very welcome that the National Round Table on the Environment and the Economy (NRTEE) has been mandated by the Prime Minister to provide, by April 2006,[6] "advice and recommendations on the development of a long-term energy and climate change strategy for Canada," including "options for post-2012 greenhouse gas reduction targets, including second commitment period [i.e., immediately post-2012] and 2050–2080 in keeping with objectives aimed at stabilizing concentrations of greenhouse gases in the atmosphere and minimizing temperature increases."[7] For illustrative purposes, the NRTEE is undertaking economic modelling of a reduction in Canada's GHG emissions to 60% below the current level by 2050.[8]

It is important to stress that long-term GHG targets alone are insufficient. Near- and medium-term targets are also essential to keep the issue high on the political agenda and to concentrate the minds of governments, corporate leaders and citizens on the urgency of initiating deep emission reductions now.

4.2 A proposal for responsible Canadian leadership

The David Suzuki Foundation and the Pembina Institute believe that the Government of Canada must move quickly to adopt medium- and long-term emission reduction targets that will ensure Canada plays a responsible part in achieving deep reductions in the world's GHG emissions. We believe that the scale and urgency of the problem, as demonstrated in this paper, demand bold, imaginative leadership that takes as its starting point the essential need to avert the human, economic and environmental catastrophe of uncontrolled climate change.

At the same time, there is strong evidence[9] that targets along the lines we are proposing are technologically and economically feasible.

RECOMMENDATION > **We propose that the Government of Canada adopt the following targets:**

- **a reduction in Canada's GHG emissions to 25% below the 1990 level by 2020**
- **a reduction in Canada's GHG emissions to 80% below the 1990 level by 2050**

Our targets have been developed as follows:

- In light of the current scientific understanding of the impacts of climate change (Section 2.2) and climate sensitivity (Section 2.3.2), we believe the atmospheric GHG concentration must be stabilized at no more than 400 ppmv CO_2e.[10]
- Emission reductions need to be realized in a context where developing countries gradually take on more stringent targets in stages, in accordance with widely accepted equity principles, especially polluter-pays, historical responsibility and ability-to-pay (Section 3.2). Under these conditions, industrialized countries must reduce emissions by 85–90% between 1990 and 2050 (Table 2).
- Given that Canada's emissions of GHGs are, on a per-capita basis, among the highest in the world,[11] that relative to GDP they are 25% higher than for the industrialized world as a whole,[12] and that Canada is one of the world's wealthiest countries in terms of GDP, natural resources and technological know-how, we believe that Canada cannot justify making emission reductions by 2050 that are much smaller than those required by industrialized countries as a whole.
- We make some adjustment to take account of the fact Canada has faced greater upward pressure on emissions since 1990 than many other industrialized countries due, in part, to our relatively rapid GDP and population growth.[13] This leads us to an 80% reduction target for 2050.
- We choose a reduction target for 2020 that lies on a straight line between our Kyoto target (2008–12; 2010 as a proxy) and the target for 2050. As explained below, this straight line path recognizes that greater year-on-year percentage emission reductions may be feasible at the end of the period than at the beginning. It produces a 25% reduction target for 2020.
- We take account of strong evidence that targets along these lines are technologically and economically feasible. This evidence is discussed in Sections 4.3.1–4.3.4 below.

Figure 8 illustrates the derivation of these targets and compares them to other possible deep emission reduction trajectories.

Canada's GHG emissions were 24% above the 1990 level in 2003,[14] the latest year for which data is available. If we estimate that they rose between 2003 and 2004 at the same annual percentage rate as they rose, on average, between 1990 and 2003, then Canada's emissions in 2004 were 26% above the 1990 level. This is the starting point shown in Figure 8. The figure also shows Canada's Kyoto target to reduce emissions to 6% below the 1990 level by 2008–12.

Figure 8 then shows four possible trajectories for deep emission reductions:

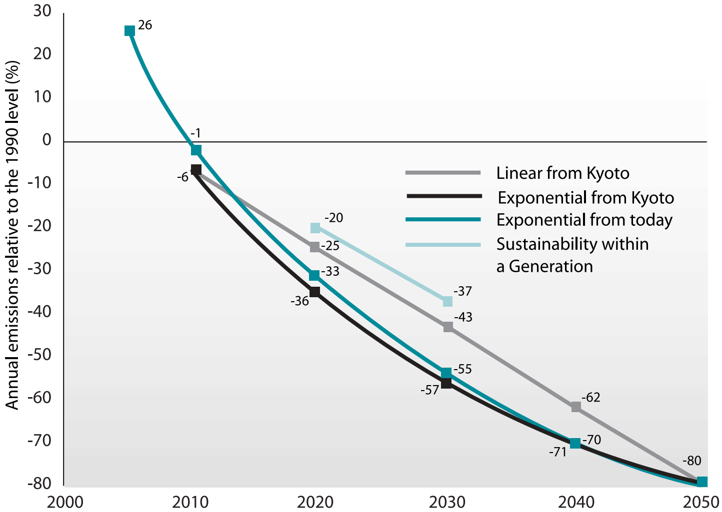

FIGURE 8. Deep reduction trajectories for Canada's GHG emissions. Our proposed targets lie on the "Linear from Kyoto" trajectory.

- The "Linear from Kyoto" trajectory is a straight line path from our Kyoto target in 2010 to our 80% target for 2050. This is the trajectory used to produce our proposed 25% reduction target for 2020. Although this trajectory is a straight line in the figure, it actually implies greater year-on-year percentage emission reductions at the end of the period than at the beginning because the overall emissions level is falling. Thus, emissions are reduced by 2.0% between 2010 and 2011, but by 8.5% between 2049 and 2050.
- The "Exponential from Kyoto" trajectory also links the Kyoto target in 2010 to our 80% target for 2050, but such that year-on-year percentage emission reductions stay the same (3.8%) throughout the period. Although this may seem a reasonable approach, we reject this trajectory as too draconian in the early years.
- The "Exponential from today" trajectory links our actual emissions in 2004 to our 80% target for 2050 such that year-on-year percentage emission reductions stay the same (3.9%) throughout the period. This shows that using actual emissions in 2004, rather than the Kyoto target, as a starting point makes virtually no difference to the average year-on-year percentage emission reduction. This trajectory is also rejected as too draconian between 2010 and 2030.
- The "Sustainability within a Generation" trajectory shows GHG emissions targets consistent with the David Suzuki Foundation's 2004 publication. *Sustainability within a Generation* (SWAG) suggested that to achieve sustainability by 2030, Canada's energy use needed to be reduced by 30% between 2004 and 2020, that Canada needed to be generating at least 25% of its electricity from low-impact renewable sources by 2020 and that Canada's GHG emissions needed to be reduced by 50% between 2004 and 2030.[15] The 2020 SWAG objectives are approximately

equivalent to a 20% GHG emission reduction between 1990 and 2020,[16] and the 2030 SWAG objective is equivalent to a 37% emission reduction between 1990 and 2030. The figure shows that the targets we propose in this paper are well aligned with *Sustainability within a Generation*.

Our proposed targets are also well aligned with, and fall within the ranges of, those to which governments in other industrialized countries have committed (see Table 3).

Deep emission reduction trajectories to take Canada to an 80% emission reduction target by 2050 could alternatively be derived using cost-minimizing economic models. Such an exercise is unlikely to produce an interim reduction target for 2020 that differs dramatically from our proposed 25%. However, economic modelling over a 50-year timeframe is of questionable value since models cannot "know" the availability and costs of technologies far in the future (see Section 4.3.2).

We assume that international trading of emission credits, as provided for by the Kyoto Protocol, will continue after 2012. Our proposed targets are derived from an assessment of Canada's responsibility for contributing to deep reductions in the world's GHG emissions. Purchasing emission credits that correspond to genuine emission reductions in other countries is one way for Canada to assume that responsibility. Our targets should therefore apply to Canada's emissions net of purchases or sales of emission credits. However, it is important that:

- Canada should only purchase credits that correspond to genuine emission reductions. Canada should not purchase, and the international GHG reduction regime should seek to exclude,
  - "hot air" credits that countries can sell only because their emission targets are higher than their business-as-usual emissions and
  - credits from business-as-usual projects that would have occurred anyway in the absence of the crediting system.

- Canada must ensure that it is exhausting all opportunities to reduce emissions domestically at a reasonable cost before purchasing foreign credits. This is necessary to
  - maximize the co-benefits of reductions in GHGs – notably, health benefits from reductions in regional air pollution,
  - ensure Canada is taking sufficient early action to prepare its economy to prosper under future, tighter GHG constraints and
  - narrow, not widen, the differences in per capita emissions between developed and developing countries, an objective derived from the equity principle of equal rights to emit and enshrined in the Marrakech Accords.

The availability of international emissions trading means that there need not be excessive concern about whether the emissions targets that Canada adopts are exactly the right ones. Surpassing or missing targets domestically by relatively modest amounts is "smoothed out" by emissions trading.

4.3 Objections to the proposal and why they should be rejected

Our proposed targets are ambitious. They could hardly be otherwise, given the scale and urgency of the problem of climate change. But they can be expected to be controversial. The most obvious objections include the following:

- We don't have the technology yet.
- It will cost too much.
- We're a special case because of our energy exports.
- Canada can't act without the US.
- We need more time because we've started late.

The following sections address each of these objections in turn and present arguments as to why they should be rejected.

4.3.1 WE DON'T HAVE THE TECHNOLOGY YET

In addressing this objection it may be useful to begin by recalling that about three-quarters of GHG emissions come from the combustion of fossil fuels for energy (Section 2.1.1). Clearly, there are many options available for using less energy, using energy more efficiently and producing energy without fossil fuels. For example, the International Energy Agency (IEA) has projected that 32% of the world's electricity could come from renewable sources by 2050, and IEA staff have suggested that this figure could increase to as much as 53% if aggressive policies to cut GHG emissions are implemented.[17] The European Renewable Energy Council, an industry association, has outlined how 82% of the world's electricity, and 48% of the world's total primary energy, could come from renewable sources by 2040.[18]

The IPCC, in its Third Assessment Report (2001), conducted a detailed review of the technical and economic potential of emission reduction opportunities, taking into account normal capital stock turnover, for energy conservation and efficiency in industry, transportation and buildings; less carbon-intensive options for energy production; and opportunities unrelated to energy in agriculture and waste management.[19] The conclusion was this:

> *Most model results indicate that known technological options could achieve a broad range of atmospheric CO_2 stabilization levels, such as 550 ppmv, 450 ppmv or below*[20] *over the next 100 years or more, but implementation would require associated socio-economic and institutional changes.... 'Known technological options' refer to technologies that exist in operation or pilot plant stage today ... It does not include any new technologies that will require drastic technological breakthroughs. In this way it can be considered to be a conservative estimate, considering the length of the scenario period.*[21]

More recently, researchers at Princeton University have put forward 15 technology options, each of which would reduce annual CO_2 emissions in 2050 by 3.7 billion tonnes (1 billion tonnes of carbon) or about 7% relative to business-as-usual levels. Only about seven of these options, called "stabilization wedges," would need to be implemented to be on track to stabilize the atmospheric CO_2 concentration at 500 ppmv.[22] The "wedges" cover familiar ground of energy conservation and efficiency in transportation and buildings, less carbon-intensive options for energy production (including underground storage of CO_2), and changes to forestry and agricultural practices. The authors reject any need for "revolutionary" technologies over the next few decades (although they do believe that these will be needed later):

> *Humanity can solve the carbon and climate problem in the first half of this century simply by scaling up what we already know how to do.... Every one of these options is already implemented at an industrial scale.*[23]

The authors of the "stabilization wedges" concept cite three key "reasons for optimism that global emissions in 2030 need not exceed today's emissions":

- "the world today has a terribly inefficient energy system;"
- GHG emissions today have zero economic cost (i.e., there is no price signal to drive them down, although the Kyoto Protocol has now begun to change this outside the US); and
- much of the capital stock that will be in place in 2030 has not yet been built.[24]

In a groundbreaking study published in 2002, prominent Canadian energy expert Ralph Torrie demonstrated the feasibility of reducing Canada's GHG emissions to almost 50% below the 2004 level by 2030, using existing technologies and within current economic assumptions. Annual savings to consumers were estimated at $30 billion by 2030.[25] The 50% reduction target was later included in the David Suzuki Foundation's *Sustainability within a Generation* and, as shown in Section 4.2, is close to the emissions target that this paper proposes for 2030.

While it is possible to agree with the common assertion that "climate change is a technology problem," the reality is that it is primarily a problem of deploying existing technologies and only secondarily one of reducing their costs and developing new ones. Once it is recognized that the problem is, above all, one of deployment, then solving it becomes much more a question of political will and "who pays?" than of technology. "Climate change is a technology problem" is not a valid excuse for delaying the initiation of deep emission reductions.

4.3.2 IT WILL COST TOO MUCH

A partial answer to this objection has already been provided in the previous section. Deep emission reductions can be achieved by 2050 with technologies that are already being used on an industrial or at least pilot plant scale. Clearly, they would not already be in use on those scales if they were grossly more expensive than alternatives. In addition, if the past 50 years are any guide we should expect enormous innovation over the next 50 years, further reducing the costs of existing GHG-reducing technologies, perhaps dramatically so.

It is also a mistake to assume GHG emissions reduction necessarily has a net cost. While the implementation of energy conservation, efficiency and renewable energy generation may involve significant capital costs, it will reduce operating costs. Emissions reduction can therefore translate into cost savings for energy consumers (although regulated requirements, significant additional financial incentives and/or education may be required to ensure consumers take cost-saving actions).

Economic models can be used to estimate the costs associated with deep emission reduction scenarios. The results are far from conclusive since models cannot "know" the availability and costs of technologies far in the future.[26] However, economic modelling of deep GHG emission reduction targets for Canada would likely provide some useful insights. At the time of writing, both Environment Canada and the NRTEE are undertaking such modelling. Earlier modelling of Canada's Kyoto efforts showed that they could be undertaken with little effect (slightly positive or slightly negative) on GDP.[27]

As might be expected, the UK government has undertaken extensive economic modelling of its 60% emission reduction target (see Section 3.2.2). The modelling suggests that in achieving the 60% target, the UK's GDP in 2050 will be "of the order of 0.5 to 2%" lower than in a business-as-usual scenario[28] – representing, at worst, a delay in economic growth of about one year.

Relevant illustrative results obtained with models of the world economy include the following. The wide range of results is a consequence of variations both in the assumptions inherent in the models themselves and in the scenarios modelled:

- Carbon tax levels needed to reach a stabilized atmospheric concentration of 550 ppmv (it is not clear whether this is CO_2 or CO_2e) by 2100 varied from $1.40 to $34 per tonne CO_2 in 2020 and from $11 to $85 in 2040/2050 (in constant 2001 Canadian dollars) across eight different models.[29] To place these numbers in context, $50/tonne CO_2 corresponds to 12.2¢ per litre of gasoline.[30]
- In modelling commissioned by the German Advisory Council on Global Change, carbon permit prices (equivalent to carbon tax levels) needed to reach a stabilized atmospheric concentration of 400 to 450 ppmv CO_2e were about $12 to $45 per tonne CO_2 in 2020 and about $90 to $210 in 2050 (in constant 1990 Canadian dollars). In the stabilization scenarios, the world's GDP in 2050 was between 0.3 and 2.3% lower than in business-as-usual scenarios. As above, this represents at worst a delay in economic growth of about one year.[31]

Beyond the question of impacts on the economy as a whole, particular sectors will face genuine threats to their competitiveness if there is a sufficiently large imbalance between GHG constraints imposed on those sectors in Canada and in countries with which those sectors are competing. Some sub-sectors of the economy (e.g., oil sands production with no CO_2 capture, coal-fired electricity with no CO_2 capture) are likely simply to be incompatible with deep emission reductions and will be eliminated. But in other cases governments have the tools to manage unwelcome competitiveness threats, for instance by adapting GHG emission constraints – such as mandatory sectoral targets – to sectors' particular circumstances. This must, however, be based on defensible economic analysis that is open to public debate, not unfounded claims and private lobbying.

It must, of course, be remembered that if insufficient action is taken to curb GHG emissions, climate change impacts (Section 2.2) are likely to result in very large financial costs, especially in sectors like water management, agriculture, forestry and insurance. It is also essential to consider non-financial costs to people and ecosystems. Considering the costs of reducing GHG emissions, but not the costs of failing to reduce GHG emissions, is highly misleading.

4.3.3 WE'RE A SPECIAL CASE BECAUSE OF OUR ENERGY EXPORTS

Canada exports large amounts of oil and natural gas. Oil and gas extraction, processing and transportation[32] are responsible for 16% of Canada's GHG emissions. These emissions increased by 56% between 1990 and 2002 and are projected to increase by 99% between 1990 and 2010,[33] in large part because of increased exports from Alberta's oil sands. Some argue that Canada is not really responsible for the emissions from the production of oil and gas for export because we cannot control the market's demand. The logical extension of this is that Canada must adjust any long-term GHG emission targets to account for unlimited additional emissions from rapidly expanding exports.

This argument cannot be accepted for the following reasons:

- It contravenes the polluter-pays principle, looking both narrowly at the responsibility of the emitters and broadly at the fact oil consumption is one of the largest causes of the climate change problem.
- Canada cannot justify abandoning responsibility for these emissions unless the foreign buyers of the oil and gas agree to accept it instead. There is no prospect of this ever happening, especially as 80% or more of the emissions from the lifecycle of oil and gas come from combustion of the product and so are already the responsibility of the buyers.
- Canadian producers could require that foreign buyers provide, as part of their purchase, emission credits to cover the emissions from production in Canada. Emissions trading of this kind would provide some flexibility to allow Canada to continue these emissions while meeting deep reduction targets net of acquired credits (see Section 4.2).
- Equivalently, Canadian producers could offset emissions from production by purchasing emission credits from any source. This need not be prohibitively costly. Taking the example of oil sands production, with an emissions intensity of 65 kg CO_2e per barrel,[34] it would cost producers $0.98 per barrel to offset 100% of the emissions by purchasing credits at $15/tonne CO_2e (the price that the Government of Canada has guaranteed during 2008–12) and still only $3.25 per barrel if credits cost $50/tonne.[35] At the time of writing, oil prices are in the vicinity of $70/barrel (Canadian dollars).

4.3.4 CANADA CAN'T ACT WITHOUT THE US

Canada's economy is strongly integrated with that of the US. Clearly, if the US took no action to control GHG emissions, it would be difficult for Canada to pursue deep emission reductions without suffering damage to its competitiveness. However, it is a mistake to look solely at the position of the Bush administration, which has withdrawn from the Kyoto Protocol, and conclude that the US is taking no action. In 2002, the Pembina Institute conducted a comparison of government implementation of GHG-reducing policies in Canada and the US, including both federal and provincial/state levels. The study found that governments in the US had taken far more significant action to reduce GHG emissions than governments in Canada. In particular, state governments in the US were far ahead of provincial governments in Canada, and there was not a single category of measures in which Canada was ahead of the US.[36]

Many states continue to forge ahead with policies addressing GHG emissions.[37] In addition, there is now both in Congress and the private sector considerable interest in and support for legislation to cap GHG emissions. Key illustrative examples of these developments include the following:

- The states of Oregon,[38] Massachusetts,[39] New Hampshire[40] and Washington[41] have enacted regulated limits on CO_2 emissions from fossil-fuelled electricity generation beginning in 1997, 2006–08, 2006 and 2004 respectively.
- In 2003, the governors of Connecticut, Delaware, Massachusetts, New Hampshire, New Jersey, New York, Maine, Rhode Island and Vermont formed the Regional Greenhouse Gas Initiative to develop a regional CO_2 emissions targets-and-trading system for the electricity generation sector.[42] Details of the proposed system are due to be published in the fall of 2005.[43] The system is expected to start in 2009 and cover more than 600 facilities.[44]
- California has enacted regulated limits on GHG emissions from automobiles. The limits are due to take effect in 2009 and achieve a reduction in emissions of approximately 30% below projected 2009 levels by 2016.[45]
- To date, 18 states plus the District of Columbia have implemented renewable electricity standards – also called renewable portfolio standards – that require electric utilities to gradually increase the amount of renewable energy resources in their electricity supplies. Combined, these standards are projected to result in the installation of 25,550 megawatts of new renewable electricity generation capacity by 2017.[46]
- In June 2005, 38 senators voted in favour of the McCain-Lieberman bill[47] that seeks to cap the GHG emissions of the electricity, manufacturing, commercial and transportation sectors (representing 85% of national emissions) at their 2000 level by 2010.[48] While 60 senators voted to defeat the bill, the Senate approved, by a vote of 53 to 44, a non-binding resolution[49] expressing “the sense of the Senate that Congress should enact a comprehensive and effective national program of mandatory, market-based limits and incentives on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions at a rate and in a manner that (1) will not significantly harm the US economy; and (2) will encourage comparable action by other nations that are major trading partners and key contributors to global emissions.”

- Major American GHG emitters Cinergy,[50] Duke Energy,[51] Exelon[52] and PG&E,[53] as well as JPMorgan Chase,[54] the country's second largest financial services group, have all stated that they support federal regulation of CO_2 emissions.
- According to a survey of 19 US utilities undertaken in early 2004, 47% of respondents expected Congress to enact mandatory regulation of CO_2 emissions within five years and 58% expected it within ten years.[55]

In summary, given the significant moves towards GHG reductions in the US, Canada does not need to delay starting to pursue a trajectory of deep GHG emission reductions while efforts continue to bring the US formally into the international regime for GHG reduction.

4.3.5 WE NEED MORE TIME BECAUSE WE'VE STARTED LATE

Objections may be made to our use of Canada's Kyoto emissions target as the starting point for a trajectory of deep emission reductions. In the absence of strong government policy implementation during most of the eight years that have passed since the Kyoto conference, Canada's emissions had risen to 24% above the 1990 level by 2003, the latest year for which data is available (see Section 4.2). Use of a starting point 6% below the 1990 level just seven years later (in 2010) may be seen as unrealistic.

This argument cannot be accepted for the following reasons:

- Canada's failure to take meaningful action until very recently is Canada's responsibility, and it is ours to remedy. Using, for example, the 2004 emissions level as the starting point for a deep emission reduction trajectory would mean absolving Canada, for years to come, of full responsibility for the extra emissions resulting from our inaction between 1997 and 2005. Other countries would need to compensate with even greater reductions. This is not defensible.
- Emissions trading provides Canada with flexibility to meet targets that are missed through domestic reductions and flexibility to get back on track after our late start.
- Our proposed deep emission reduction trajectory does, in any case, include some adjustment to take account of the fact Canada has faced greater upward pressure on emissions since 1990 than many other industrialized countries because of our relatively rapid GDP and population growth (see Section 4.2).

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5. How should Canada approach the negotiations on the post-2012 international regime?

How can Canada play a leading role in the long-term, global effort to cut GHG emissions? Adopting responsible medium- and long-term emission reduction targets consistent with preventing dangerous climate change is the first part of the answer. But it is also critical for Canada to approach negotiations on the international regime for longer-term GHG reductions with appropriate ambitions.

This is all the more important as Canada is chairing the annual session of United Nations climate change negotiations at which the countries that have ratified the Kyoto Protocol have agreed to "initiate the consideration of" GHG targets for the post-2012 period.[1] This United Nations climate change conference, known in short as COP-11,[2] takes place in Montreal between November 28 and December 9, 2005. Canada will hold the presidency of the negotiations for approximately one year, until the next annual conference.

5.1 The urgency of international agreement on post-2012 GHG targets

Broad international agreement on coordinated action to reduce GHG emissions is essential because the global emission reductions needed are very large, and the reductions that industrialized countries need to make are larger still. A scenario in which as many countries as possible act together to achieve such reductions, in a manner that takes reasonable account of the legitimate concerns of all, will be far more politically and economically feasible than a scenario in which a few act unilaterally. Scattered unilateral action will inevitably be hindered by concerns about fairness and competitiveness, both real and imagined.

The Kyoto Protocol, which became international law in February 2005, currently sets GHG targets for the period 2008–12 and only for industrialized countries. If fully implemented, the protocol would reduce those countries' emissions only by about 5% overall, relative to the 1990 level[3] – just a small first step towards the deep long-term reductions required. Furthermore, two of the countries – the US and Australia – for which the protocol sets emissions targets have refused to ratify it, and the current US administration has made clear that it has no intention of meeting its Kyoto target (although, as documented in Section 4.3.4, there is in considerable support in the US for capping GHG emissions, and many state governments are taking major action).

It remains essential for the industrialized countries that have ratified the Kyoto Protocol, including Canada, to comply with their obligations. But it is also essential to reach a broad international agreement that will result in much larger GHG reductions for the period post-2012. Successful implementation of the Kyoto Protocol by the countries that have ratified it is key to increasing the chances of achieving the necessary post-2012 agreement.

It is urgent that the international community agree on post-2012 GHG reductions for the same reasons for which it is urgent that Canada do so (Section 4.1):

- to allow countries to be able to make the right domestic climate policy decisions now;
- to help ensure that countries' energy policies become consistent with their climate policies;
- to prevent the wrong investment decisions being made on infrastructure with potentially enormous and prolonged GHG emissions; and
- to provide the necessary incentive to the private sector to invest in the development and deployment of the technologies needed for deep GHG reductions.

An additional reason for urgency is that the Kyoto Protocol has created an international GHG emissions trading market, commonly referred to as the "carbon market," which is now creating a price signal for emission reductions around the world.[4] This market is not small: at the Carbon Expo held in Cologne in May 2005, funds seeking to purchase emission credits totalled more than $1.6 billion.[5] If there is no agreement by 2008 on GHG targets for the immediate post-2012 period, the resulting uncertainty in the value of post-2012 reductions will likely cause a collapse of the market.

The analysis cited in Section 3.3 shows that an international agreement on GHG reductions post-2012 must involve major reductions by the US and place meaningful constraints on the emissions of major developing countries, while respecting the equity principles evoked in the UNFCCC. In 2000, the US accounted for 21% of the world's GHG emissions and China 15%.[6] Under a business-as-usual scenario, between 2002 and 2020 CO_2 emissions from energy use (accounting for the bulk of GHG emissions) are projected to increase by 30% in the US and by 122% in China. By 2020 the two countries' emissions totals are projected to be almost equal and jointly make up 41% of global emissions.[7]

As noted in Section 3.2, agreement on an allocation of global emission reductions among countries is challenging because there are so many divergent views on what is a "fair" way to share responsibility for reductions. Under the UNFCCC, almost all decisions must be adopted by consensus among close to 200 countries,[8] a process that is often unwieldy. This has led to proposals that no attempt be made to reach a global agreement and that emission reduction agreements be pieced together instead among various groupings of like-minded countries, outside the framework of the UNFCCC.[9] However tempting this approach may be, it seems very unlikely to succeed. Deadlocks under the UNFCCC process result, in the most part, not from the number of countries involved, but from conflicts between the interests of a few major countries or blocs of countries. Pursuing agreements outside the UNFCCC will not make these conflicts disappear. Instead, they must be resolved.

5.2 Canada's objectives for the negotiations

5.2.1 STARTING THE PROCESS

In September 2005, Prime Minister Paul Martin stated: "We will initiate discussions to achieve a truly global and inclusive regime to achieve deep and genuine reductions of greenhouse gas emissions."[10]

RECOMMENDATION >

The David Suzuki Foundation and the Pembina Institute believe that Canada's initial objective must be to achieve agreement, during the Canadian presidency, on a process to negotiate, by 2008, a broad international regime for post-2012 GHG reductions consistent with preventing dangerous climate change. This process must be rooted in both the Kyoto Protocol and the UNFCCC and must not be allowed to be hindered by any one country.

This recommendation is based on the following key considerations:

- The Kyoto Protocol requires[11] participating countries to "initiate the consideration of" GHG targets for the post-2012 period in 2005.
- Significant time is required for difficult negotiations, but a deadline is essential to clarify expectations and focus efforts. Time is also needed for countries to ratify the agreement on the post-2012 regime well before it starts to apply. Yet there are compelling reasons for urgency. A negotiation process lasting three years would be longer than the two-year process that resulted in the Kyoto Protocol.[12]
- It is critical to retain the Kyoto Protocol as a legal platform for the negotiations

- because of its emphasis on mandatory emissions targets combined with emissions trading – a proven, effective approach that must remain at the heart of the international regime;[13]
- because moving away from the protocol would result in wasting years of effort that have been devoted to elaborating its detailed operational rules since it was negotiated in 1997; and
- because the protocol provides the legal basis and operational mechanisms of the international carbon market.

- The current US administration has shown no interest in developing an effective international regime for GHG reduction. This position cannot be reconciled with the reductions needed. An attempt to accommodate it at the start of the negotiation process can only lead to failure. Instead, the process should take careful account of the anticipated views of a future US administration committed to effective action on climate change, based on the considerable support for capping GHG emissions that already exists in the US.

5.2.2 THE RIGHT KIND OF REGIME

Once the negotiation process has been agreed upon and is underway, which should be the case early in 2006, countries will begin in earnest to develop the detailed framework of the post-2012 regime.

The David Suzuki Foundation and the Pembina Institute urge the Government of Canada to endorse the three-track framework that the Climate Action Network (CAN) International proposes for the post-2012 international regime.

< RECOMMENDATION

The CAN International framework involves three parallel tracks:[14]

- A **Kyoto Track** for industrialized countries, with legally binding absolute emissions targets that are progressively reduced in successive time periods.[15] The Kyoto Track is needed to provide the essential driving force for the development and deployment of the technologies needed for deep GHG reductions by the richer countries.
- A **Greening** or **Decarbonization Track** for the majority of developing countries, where emissions growth is slowed using instruments such as "sustainable development policies and measures," targets applying to specific economic sectors, emissions intensity[16] targets, and, where required, assistance by industrialized countries. The Decarbonization Track is intended to enable developing countries to "leapfrog" polluting technologies and follow a low GHG path to development via rapid adoption of energy conservation, energy efficiency and low-impact renewable energy.

- An **Adaptation Track** for the most vulnerable countries and regions, involving assistance and compensation funded by industrialized countries, to deal with unavoidable impacts of climate change.

In the immediate post-2012 period, the Kyoto Track would include the countries that already face targets under the Kyoto Protocol, plus a relatively small number of countries currently classified as "developing" but whose per capita emissions, cumulative historical emissions and per capita GDP are sufficiently high. Countries would progressively move from the Decarbonization Track to the Kyoto Track according to these same criteria, also taking into account the progress made by existing Kyoto Track countries. Countries could fall simultaneously under the Decarbonization and Adaptation tracks.

The CAN International three-track framework accommodates well the equity principles evoked in the UNFCCC (Section 3.2). It also resembles the "multi-stage approach" described in Section 3.2.1. In light of the major contribution of deforestation to global GHG emissions (Section 2.1.1), it may be necessary to implement a fourth track to specifically curtail these emissions.[17]

Although the Government of Canada is not currently advocating a particular framework for the post-2012 international regime, it has laid out six "elements of an effective international approach." These are Environmental Effectiveness, Advancing Development Goals in a Sustainable Manner, Broad Participation, Building a Strong Global [Carbon] Market, Realizing the Full Potential of Technology and Tackling Adaptation.[18] We offer the following initial comments in response to the Government's discussion of these elements (with reference to numbered paragraphs in the Government's discussion paper):

Environmental Effectiveness. The Government must recognize that keeping global warming as far below 2°C as possible relative to the pre-industrial level is the ultimate measure of environmental effectiveness and that limiting the atmospheric CO_2 concentrations to 550 ppmv (para. 14) is therefore not sufficient (Section 2.3.2).

Broad Participation. Commitments such as technology agreements, policies and measures, or sectoral goals (paras 58–59) can complement absolute emissions targets and be explored for use in the Decarbonization Track, but they cannot replace absolute emission targets for countries that meet the criteria for the Kyoto Track. It is very unlikely that commitments other than binding absolute emissions targets will deliver the necessary emission reductions. For example, targets for global industry sectors (paras 66, 79) will give prominence to narrow sectoral interests and focus on each sector's self-interested view of what is economically achievable instead of what is environmentally necessary and objectively feasible for the economy as a whole.

Building a Strong Global Carbon Market. The Government must recognize that a strong carbon market requires agreement to be reached by 2008 on GHG targets for the immediate post-2012 period. Without this, the resulting uncertainty in the value of post-2012 reductions will likely cause the market to collapse.

Realizing the Full Potential of Technology. The Government must recognize that while it can be said that a "technological revolution" is needed (paras 44, 76), the problem is primarily one of deploying existing technologies and only secondarily one of reducing their costs and developing new ones (para. 77). The need for technological innovation must be not be used as an excuse to avoid, delay or weaken binding emissions targets – which, if sufficiently strong, will be highly effective in driving the necessary technology deployment and development. Driving technology deployment and development through binding targets versus government expenditure (para. 78) is largely a question of "who pays?" – the answer to which must be adequately informed by the polluter-pays principle (see Section 4.3.1).

5.2.3 AVOIDING PAST MISTAKES

Finally, the David Suzuki Foundation and the Pembina Institute call on the Government of Canada to desist from seeking operational rules for the post-2012 regime that threaten the environmental integrity of emissions targets.

< RECOMMENDATION

In the Kyoto negotiations, Canada sought at various times, and with varying success, to:

- weaken "supplementarity" requirements to prioritize domestic emission reductions over purchases of foreign emission credits;
- weaken provisions to ensure "additionality" i.e., the requirement that credits be granted only for emission reduction projects that go beyond a business-as-usual scenario;
- obtain credits for absorption of CO_2 as a result of natural forest growth not resulting from any human intervention;
- obtain special credits for export of "clean energy" to the US; and
- obtain credits for export of nuclear technology to developing countries.

Although Canada did ratify the Kyoto Protocol, these positions significantly damaged our reputation and are not consistent with playing a responsible and leading role in the global effort to cut GHG emissions.

With Canada presiding at the international climate change negotiations and the Government now clearly stating the necessity of both deep reductions in GHG emissions and a strategy to achieve them, there could be no better moment for Canada to move to a position of real leadership at the global level – both by adopting responsible GHG targets consistent with preventing dangerous climate change and by approaching the negotiations on the international regime for post-2012 GHG reductions with ambitions and positions commensurate with the challenge.

NOTES TO SECTION 5

1. Kyoto Protocol article 3.9, http://unfccc.int/essential_background/kyoto_protocol/items/1678.php.
2. The eleventh session of the Conference of Parties to the United Nations Framework Convention on Climate Change.
3. See http://unfccc.int/essential_background/kyoto_protocol/items/2830.php.
4. Although the Kyoto Protocol sets GHG targets only for industrialized countries, developing countries can create and sell emission reduction credits valid for use by industrialized countries in meeting their targets.
5. World Bank supports CDM sellers at Carbon Expo. *Carbon Finance*, March 2005, http://www.carbon-financeonline.com/issue/15/story/531.html (subscription required). Euros have been converted to Canadian dollars using an exchange rate of €1=$1.6.
6. World Resources Institute. 2005. *Climate Analysis Indicators Tool (CAIT)* Version 2.0, http://cait.wri.org/cait.php.
7. Energy Information Administration. 2005. *International Energy Outlook 2005*, Table A10, http://www.eia.doe.gov/oiaf/ieo/pdf/ieoreftab_10.pdf.
8. Climate Change Secretariat. 2002. *A Guide to the Climate Change Convention Process*, preliminary 2nd edition, p.33, http://unfccc.int/essential_background/background_publications_htmlpdf/items/2625.php.
9. Bodansky, D. 2004. *International Climate Efforts Beyond 2012: A Survey of Approaches*, p.7–8. Pew Center on Global Climate Change, http://www.pewclimate.org/global-warming-in-depth/all_reports/international_climate_efforts/.
10. Office of the Prime Minister. 2005. *Address by Prime Minister Paul Martin at the United Nations General Assembly*. Speech, 16 September, http://www.pm.gc.ca/eng/news.asp?id=584.
11. Article 3.9, http://unfccc.int/essential_background/kyoto_protocol/items/1678.php.
12. The negotiation process for the Kyoto Protocol began at COP-1 in 1995 and concluded at COP-3 in 1997.
13. Parties to the UNFCCC (i.e., the countries that had ratified it) agreed ten years ago, in the "Berlin Mandate" (1995), on the need "to set quantified limitation and reduction objectives within specified time-frames, such as 2005, 2010 and 2020," for the GHG emissions of industrialized countries. See http://unfccc.int/resource/docs/cop1/07a01.pdf.
14. Climate Action Network International. 2003. *A Viable Global Framework for Preventing Dangerous Climate Change*, p.3–7, http://www.climatenetwork.org/docs/CAN-DP_Framework.pdf.
15. Targets must include all of the emission sources and GHGs currently covered by the Kyoto Protocol as well as the emissions from international aviation and marine bunker fuels, not currently included in the Kyoto system.
16. Emissions intensity is emissions per unit of production or GDP.
17. See, for example, http://www.environmentaldefense.org/go/CR.
18. Environment Canada and Foreign Affairs Canada. 2005. *Action on Climate Change: Considerations for an Effective International Approach*, p.7–14, http://www.montreal2005.gc.ca/Preliminary_Activities-WS96A244AE-1_En.htm.

The Case for Deep Reductions shows that Canada – and the world – needs to make deep, long-term greenhouse gas emission cuts to meaningfully address climate change.

The report calls on Canada to move quickly to adopt medium- and long-term emission reduction targets. The scale and urgency of the problem, as demonstrated in this report, demands bold, imaginative leadership that takes as its starting point the essential need to avert the human, economic and environmental catastrophe of uncontrolled climate change.

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