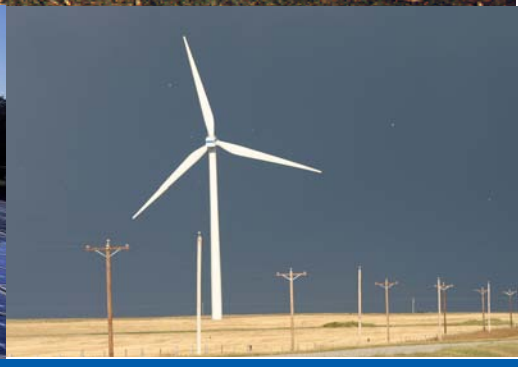
Choosing Greenhouse Gas Emission Reduction Policies in Canada

Prepared for Don Drummond, TD Bank Financial Group



Clare Demerse • Matthew Bramley

October 2008

the PEMBINA institute
Sustainable Energy Solutions

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The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org.

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The Pembina Foundation for Environmental Research and Education is a federally registered charitable organization. The foundation supports innovative environmental research and education initiatives that help people understand the way we produce and consume energy, the impact of energy generation and use on the environment and human communities, and options for more sustainable use of natural resources. The Pembina Foundation contracts the Pembina Institute to deliver on this work. More information about the Pembina Foundation is available at www.pembinafoundation.org or by contacting info@pembinafoundation.org.

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Preface

There is a growing consensus in Canada that action is required to address climate change. Concerns over economic costs, in aggregate and to certain sectors and regions, have no doubt impeded the implementation of policies. Yet uncertainty over the course of policy poses a cost because businesses have little idea how to factor future environmental policies into their planning. Despite years of debate, there is limited Canadian analysis available on the most efficient policies from environmental and economic perspectives. It is not surprising then that consensus has not been formed on how policy should move forward. Confusion reigns as various factions argue the relative merits of key policy options, such as regulation, cap-and-trade and carbon taxation.

TD Bank Financial Group engaged the Pembina Institute to conduct a survey of existing studies and international experience to better understand the state of knowledge of environmental policy, especially as it relates to the economy. The purposes of the study are first to document which policies have been found to be most environmentally and economically efficient and second to identify the gaps in current understanding. The hope is that future research can fill these gaps and enable policy to achieve appropriate environmental objectives with minimal economic cost.

Don Drummond
Senior Vice President and Chief Economist

TD Bank Financial Group

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Choosing Greenhouse Gas Emission Reduction Policies in Canada

This study examines the policy tools that federal and provincial governments have at their disposal to reduce greenhouse gas (GHG) emissions, including "carbon"[1] pricing (through cap-and-trade systems or carbon taxes), regulated standards, subsidies, infrastructure spending, research and development, and voluntary initiatives.

To understand the strengths and weaknesses of these policy options, our study assesses them against a set of criteria that includes environmental effectiveness, economic efficiency, fairness and cost-effectiveness. We also review the real-world experience with the implementation of these policy options in Canada and internationally. That policy review is presented as Appendix B to this report.

To date, Canada's governments have been relatively timid in their implementation of climate policies. The history of climate policy implementation in Canada (since the mid-1990s) reveals a preference for voluntary policies and subsidies instead of mandatory carbon pricing or regulatory options. During this time, Canada's emissions grew quickly. That growth is projected to continue in the absence of stronger policies to reduce emissions.

In light of Canada's and other countries' experiences, it is clear that financial incentives, voluntary measures and public information policies, while useful in limited "niches," are not adequate to reduce Canada's total national emissions on their own. This past experience strongly suggests that Canadian governments must implement policy options closer to the mandatory end of the policy spectrum. As approximately 50% of Canadian emissions come from heavy industry, a portion of the economy that has shown itself responsive to price signals, carbon pricing appears to be a crucial piece of the puzzle in cutting Canada's emissions.

Given the recent focus on carbon pricing among Canadian policymakers, this report examines carbon pricing mechanisms in detail. In particular, it explores the best ways to use revenues raised through carbon pricing, and the best options to mitigate any reduced international competitiveness that Canadian industries may encounter.

Despite the importance of carbon pricing policies, international experience suggests that they function more effectively when complemented with regulations and financial incentives to

[1] In this context, the word "carbon" is shorthand for the six greenhouse gases covered by the Kyoto Protocol (of which carbon dioxide is the most important). "Carbon dioxide equivalent" is a standard measure that incorporates emissions of all six gases into a single number.

overcome the market barriers and market failures that block the take-up of energy efficiency opportunities. In other words, carbon pricing is necessary but not sufficient. A comprehensive suite of policies — so-called "silver buckshot" rather than a silver bullet — is likely needed to capture cost-effective emission reduction opportunities that would go unrealized with carbon pricing alone.

In Canada, the right policy mix will necessarily span numerous jurisdictions: no one government controls all the levers. The level of ambition that governments set — both for overall emission reductions and individual policies — also matters, although recommending appropriate emissions targets for Canada is beyond the scope of this report.

As governments move to implement climate policies in Canada, our assessment found several areas where further research would be beneficial. These include:

- Jurisdictional questions, including the interaction between federal and provincial carbon pricing policy proposals.
- The specific policies and price levels needed to overcome market barriers that can prevent consumers and businesses from taking up cost-effective options to reduce emissions.
- An independent assessment of the vulnerability of various Canadian industrial sectors to international competitiveness impacts from carbon pricing, and, if vulnerability is found, the policies best suited to mitigate that vulnerability
- A comprehensive economic modelling study of the package of policies needed to reach a range of climate targets in Canada, from Canada's current medium- and long-term targets to the science-based target ranges being considered in global climate negotiations. This modelling would examine the economic costs and benefits involved in reaching the selected targets, both in aggregate and broken down by sector and region.

Despite the ongoing need for Canadian climate policy research, our review uncovered far more areas of consensus than of disagreement among experts. Theory and practice confirm that reducing emissions in a cost-effective way starts with a clear price signal that reflects the costs of GHG pollution. Complementing that price signal with targeted regulations and spending can increase its effectiveness, and governments have a number of proven policy options to choose from to do this. Economic modelling suggests that delay in implementing policies will serve to increase the cost of meeting emission reduction targets.

The most recent climate science strongly suggests that there is no time for delay. Fortunately, Canadian governments have more than enough information to take action by implementing climate policies that work for both the environment and the economy.

A. Introduction

Any Canadian interested in public policy will have found it nearly impossible to avoid discussion about climate change over the past couple of years. Global warming has become a very high-profile political issue in Canada, and recent surveys have placed it at the top of voters' list of concerns as well.

In Canada, all major federal political parties now agree that climate change is real and must be treated as a political priority. It seems likely that pressure on Canadian governments to implement a credible and effective strategy to address climate change will only increase over time, given the growing weight of scientific evidence, the prominence of climate change on the international agenda over the next two years[2] and the business community's desire for policy certainty. But despite the unanimous concern about global warming, the appropriate policy solutions have become a hotly contested area of discussion.

This study examines the policy tools that federal and provincial governments have at their disposal to reduce greenhouse gas (GHG) emissions, including "carbon"[3] pricing, regulated standards, subsidies, infrastructure spending, research and development, and voluntary initiatives. The report compares the available policy approaches and draws some initial conclusions about how those policies can be used and combined to achieve GHG emission reductions.[4] The conclusions aim to identify areas of strong consensus, areas of ongoing debate and areas where further research would be useful as a step toward more specific policy conclusions.

The policy assessment presented here has been informed by both a review of the literature, including economic modelling studies and qualitative policy assessments, and by a review of relevant policy experience in Canada and internationally. That review is summarized and presented in Appendix B, entitled *Review of Experience of and Research on Greenhouse Gas Emissions Reduction Policies in Canada and Internationally*. Although the review is far from exhaustive, it does provide an illustration of the range of climate policy initiatives currently underway and some key economic modelling results.

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[2] Climate change was one of the top agenda items at the 2008 G8 Leaders' Summit in Hokkaido, Japan, on July 7–9. Nations have also agreed to negotiate a second (post-2012) phase of the Kyoto Protocol over the next 14 months. This process is scheduled to conclude at the UN climate conference in Copenhagen, Denmark, in December 2009.

[3] In this context, the word "carbon" is shorthand for the six greenhouse gases covered by the Kyoto Protocol (of which carbon dioxide is the most important). "Carbon dioxide equivalent" is a standard measure that incorporates emissions of all six gases into a single number.

[4] This report focuses on emission reductions, but the authors recognize that a comprehensive climate policy would cover additional areas, notably adaptation to climate impacts as well as research on the science, impacts and economics of climate change.

In considering the policy tools available to reduce GHG emissions, this report took the following points as given:

- Climate change represents a significant threat to Canadians and the world and needs to be addressed with urgency.
- The development of climate policy should be guided by scientific assessments of the amount of emission reductions needed to avoid dangerous climate change.
- Through international agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC), developed countries like Canada have committed to play a leadership role in facing this global challenge.

However, recommendation of a specific emission reduction goal or a level of ambition for emission reduction policies is beyond the scope of this report, and it is addressed in other Pembina Institute publications.[5] The policies described here could be used to meet a range of environmental or economic goals, depending on the manner in which they are combined and the stringency with which they are applied.

[5] See, in particular, Matthew Bramley, *The Case for Deep Reductions: Canada's Role in Preventing Dangerous Climate Change* (Vancouver, BC, and Drayton Valley, AB: The Pembina Institute and David Suzuki Foundation, 2005). Also available online at climate.pembina.org/pub/536.

B. Criteria for Policy Evaluation

An effective assessment of policy options requires (i) deciding on a list of evaluation criteria and (ii) deciding how best to apply those criteria.

List of Policy Evaluation Criteria

One possible starting point is a list of five criteria published by the Government of Canada in the 2005 federal budget. (The government's list was intended to be used for the evaluation of environmental tax proposals.) The Budget 2005 criteria are:

- environmental effectiveness
- fiscal impact
- economic efficiency
- fairness
- simplicity of administration.[6]

We believe that three other evaluation criteria are relevant to our analysis: cost-effectiveness, avoidance of international competitiveness impacts and political feasibility. A brief description of each of the criteria follows.

Environmental Effectiveness. This criterion is intended to determine whether and to what extent a policy will contribute to environmental improvement objectives. Environmental effectiveness can be measured directly through expected changes in environmental outcomes (e.g., levels of GHG emissions), or it can be measured indirectly through a shift in behaviour that is expected to lead to environmental improvements (e.g., increased use of public transit, increased deployment of renewable energy). Given that the end goal of emission reduction policies is an environmental one, this is clearly a crucial criterion.

Fiscal Impact. This criterion considers the impact of an environmental policy on a government's fiscal position. This could include, for example, the impact of the policy on commitments to a balanced budget, on the ability to adjust fiscal policy over time, on sound fiscal management and on an efficient tax system. The potential for a policy to raise revenue and how the revenue is subsequently used is also important.

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[6] The five criteria are found in "Annex 4: A Framework for Evaluation of Environmental Tax Proposals" in Department of Finance Canada, *The Budget Plan 2005* (Ottawa, ON: Department of Finance Canada, 2005). Also available online at www.fin.gc.ca/budget05/bp/bpa4e.htm.

Economic Efficiency. Economic efficiency refers to the optimal allocation of resources among alternative uses. A decrease in economic efficiency — or market failure — occurs when prices do not reflect true and complete costs. The relevant example of market failure in this context is the existence of "environmental externalities," which occur when environmental costs are not fully incorporated into prices but are instead borne by society as a whole. A policy change that adjusts prices to be a better reflection of true costs should correct market failures that would lead to a sub-optimal allocation of resources. This correction will result in an increase in economic efficiency as the allocation of resources among alternative uses improves.

Fairness. Fairness concerns the distribution of the burden or benefit of an environmental policy. In general, it is considered fair that polluters pay the costs associated with the pollution that they are responsible for,[7] and that those who invest in environmental improvements should receive the benefits associated with their investment. Other important fairness principles include ability to pay and historical responsibility for pollution (and its converse — recognition of early action in making environmental improvements).

In Budget 2005, the government defined "polluter pays" as meaning that "the polluter should bear the costs of activities that directly or indirectly damage the environment. This cost, in turn, is then factored into market prices."[8] Environment Minister John Baird reaffirmed the government's commitment to this principle in 2007.[9]

Administrative Simplicity. Environmental policies should be designed to be relatively simple and easily understood by the affected parties. Policies that leave the decision making and responsiveness associated with the policy with the affected parties and are harmonized across different levels of government will tend to be associated with relatively lower administrative costs than those that are highly prescriptive and not harmonized. New policies that can be "piggy-backed" on existing monitoring or administrative structures will be relatively simpler than those that require new administrative or monitoring systems or complex rules that change frequently over time. Simplicity limits opportunities to "game the system" and helps increase transparency.

Cost-Effectiveness. This criterion concerns the economic costs associated with a particular environmental policy per unit of effect achieved. A cost-effective environmental policy is one that achieves a greater environmental improvement for a given financial investment than an alternative policy (for example, a policy capable of reducing emissions for $50/tonne is more cost-effective than a policy costing $100/tonne reduced). An assessment of cost-effectiveness is often combined with the environmental benefits achieved by the policy in a cost-benefit analysis, where the key question is whether the costs of the policy are justified on the basis of the expected environmental gains and the economic costs of environmental inaction. In this kind of

[7] Examples of the polluter pay principle include "extended polluter responsibility" policies, where manufacturers accept responsibility for the upstream and downstream impacts of their products; requirements for polluters to remediate contaminated sites; and road tolling or "congestion charge" policies that require road users to pay for the use or construction of a road.

[8] Department of Finance Canada, *The Budget Plan 2005*, 319.

[9] See, for example, Minister Baird's testimony to the House of Commons Standing Committee on the Environment and Sustainable Development on May 29, 2007.

assessment, an effective policy is one where the benefits of environmental improvements or the costs of environmental inaction outweigh the cost of implementing the policy.

Avoidance of International Competitiveness Impacts. The application of emission reduction policies may have real or perceived impacts on industries' ability to compete internationally in cases where other jurisdictions do not implement comparable policies. One approach to mitigating these impacts is to coordinate domestic environmental policies with global or international policy regimes. In addition to helping to protect the competitive position of affected industries, this approach can serve to reduce domestic adjustment costs and lead to greater economic efficiency. Addressing genuine competitiveness concerns could also produce environmental improvement by reducing the "carbon leakage" that could result if high-emitting industries relocate to another jurisdiction rather than improve their performance.

Political Feasibility. An important consideration is the political feasibility of pursuing a particular policy. Political feasibility will depend on most of the criteria discussed above. Specifically, political feasibility in Canada tends to depend significantly on the distribution of benefits and costs among different regions, economic sectors and segments of the population. Existing precedents increase the feasibility of a policy, as does consistency with a government's policy stance and philosophy.

Use of Policy Evaluation Criteria

Ideally, a given policy option should pass all of the "tests" derived from the evaluation criteria with flying colours, which would make a government's decision to implement the policy an easy one. However, experience has shown that there are often tradeoffs — both real and perceived — between the criteria. In response, policy actors must frequently decide which criteria matter most to them.

A strong case can be made that environmental effectiveness should be considered the pre-eminent criterion because improving the environment is almost always the goal of undertaking an environmental policy. But although all sectors of society will likely agree that the environmental effectiveness criterion is important in shaping environmental policies, various groups tend to give other criteria a nearly equal weighting. For politicians, political feasibility is extremely important, and fiscal impact may be crucial to a finance minister. Competitiveness concerns and integration with global policies may preoccupy multinational firms, while administrative simplicity may matter most to the owner of a small business.

Although each of the criteria was used in the assessment of policy options in this report, environmental effectiveness, economic efficiency, fairness and cost-effectiveness emerged as the dominant criteria.

Fiscal impact raises questions of government priorities and revenues too large to be adequately addressed here. Political feasibility matters greatly, but policy experience shows that the boundaries of political feasibility can expand quickly, making it difficult to rule out policy options simply on the basis of their perceived low score on political feasibility at a given moment. Because administrative simplicity can likely be improved through well-considered policy design, it seemed to the authors to be a second-order criterion.

Similarly, policy design provides significant latitude for addressing competitiveness concerns (see Section G for a more detailed discussion). And while the authors see the avoidance of international competitiveness impacts as an important criterion, international climate policy is currently in a time of rapid change: nations are in the midst of a two-year negotiation process for a post-2012 global climate agreement to take effect after the end of the first phase of the Kyoto Protocol. In the Canadian context, it is also notable that climate policies in the United States are likely to change significantly after the November 2008 presidential election. Given the urgent need to reduce emissions, as noted above, none of this can be considered a reason for a delay in taking action in Canada. It is perhaps a reason for a complete assessment of a policy's integration with global policies to take place at a later date.[10]

Finally, in light of the current uncertainty about the shape of a post-2012 global climate agreement, the concept of "policy evolution" also merits attention. Governments may choose to implement meaningful policies unilaterally, but as international or regional circumstances change, they may also choose to preserve the flexibility to alter those policies. Governments should, of course, also monitor the effectiveness of their policy commitments, and — guided by the latest information presented by climate scientists — adjust them as needed to reach the emission reduction goals they have set themselves.

The approach to policy evaluation described above aligns fairly well with that described in the Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report. The IPCC, a UN body charged with summarizing the science and economics of climate change, is widely considered the world's foremost authority on the issue. In the *Summary for Policymakers* of its work on mitigating[11] climate change, the IPCC noted the use of four main criteria to evaluate policy instruments: "environmental effectiveness, cost-effectiveness, distributional effects, including equity, and institutional feasibility." The IPCC further noted that "monitoring to improve implementation is an important issue for all instruments."[12]

[10] In its 2008 report *Getting to 2050: Transition to a Low-Emissions Future* (pages 13–14), the National Round Table on the Environment and the Economy (NRTEE) reached a similar assessment of the role of international policy development in determining Canadian policy: the global framework is very important in assessing competitiveness impacts and potential linkages to emissions trading opportunities elsewhere, but Canada should also demonstrate leadership and not use policy development elsewhere as an excuse for inaction.

[11] In the climate change literature, "mitigation" means reduction of GHG emissions (or enhancement of GHG sinks).

[12] IPCC, "Summary for Policymakers," in B. Metz et al., eds., *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK, and New York, NY: 2007), 19. Also available online at www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf.

C. Overview of Policy Options

This section describes the key policy options available to governments in reducing GHG emissions, both directly and indirectly.

Regulations

Regulations mandate specific standards and impose penalties if those standards are not met. Regulations can be used to set targets for GHG emissions; they can also specify standards for performance measures such as energy efficiency or the composition of fuels.

Environmental regulations fall into two main categories. Traditional regulations prescribe standards or technology. They are often used to regulate the energy efficiency of appliances and equipment[13] or to limit the release of harmful substances. "Market-based" regulations[14] allow emissions trading or certificate trading as a means to comply with the regulation. For example, in a cap-and-trade system, the government places a regulated cap on total emissions from a group of emitters. Emitters are required to hold allowances (also known as permits) for every tonne they emit, but they are free to trade allowances amongst themselves. The government sets the overall cap by issuing a fixed number of allowances, although such systems also frequently include "offset" credits[15] from sources outside the group of industries covered by the cap.

Trading produces a market price for emission reductions or performance improvements. For firms where reducing emissions would be very costly, trading provides a lower-priced option for meeting their targets. A cap-and-trade or certificate trading system also creates a financial incentive for firms to exceed their regulated targets. Overall, the market price of the traded allowances or certificates serves as a sector- or economy-wide signal to redirect investments to technologies and practices with lower emissions. A cap-and-trade system is one of two key carbon pricing policy options.

Voluntary Agreements

Voluntary agreements have often been proposed as an alternative to regulations for reducing industrial emissions. Such agreements differ from regulations in that they are not legally binding

[13] Energy efficiency regulations for appliances and equipment can cover both industrial and residential categories. Residential "equipment" includes energy-using devices, such as fridges and water heaters.

[14] Market-based regulations are frequently referred to as "market-based instruments." Outside climate policy, this category includes options like effluent charges and toxics charges.

[15] "Offset credits" are credits for emission reductions or removals that take place outside sectors subject to a cap or a tax on emissions. Offset credits can be generated in Canada or internationally.

and do not include enforceable penalties for failure to comply. Voluntary agreements are sometimes used as a predecessor to regulation, or as a means of securing commitments to performance improvements when faced with the "threat" of future regulations.

Financial Incentives and Disincentives

Governments can also encourage emission reductions directly by establishing financial incentives, through tax changes, grants, low-interest loans, or by allowing emission reduction projects to sell offset credits to industries covered by a cap-and-trade system or to the government itself. A tax on GHG emissions, i.e., a "carbon tax," is the main policy option for carbon pricing besides cap-and-trade. This kind of tax can produce a powerful financial disincentive that serves to reduce emissions by making them more costly.

It is important to note that financial incentives do not necessarily involve net government spending, i.e., they are not necessarily subsidies. Financial incentives can include negative incentives, i.e., disincentives, as with "feebates" programs that combine rebates for high environmental performance and fees for low performance. A tax on GHG emissions could become a significant source of government revenue, although some proposals require that such a tax be accompanied by offsetting reductions in other taxes to achieve a net neutral outcome for taxpayers. The provision of offset credits does not involve any government spending unless governments allocate their own funds to purchase credits.

Investments in Infrastructure

In sectors commonly dependent on public funding, governments can invest directly in low-GHG infrastructure (including subsidizing operating costs). Examples include public transit, bike paths and other urban infrastructure that facilitate a reduction in the use of private vehicles; lower-emission freight and intercity passenger transportation infrastructure, such as railways; renewable electricity generation facilities and associated optimization of electricity grids; community energy systems; and landfill gas capture systems.

Improvement of Government Operations

Through their own operations, Canada's governments are themselves non-negligible sources of GHG emissions. They can therefore realize a modest level of GHG reductions by requiring that their buildings and vehicles meet the highest standards of energy efficiency, by implementing low-carbon procurement policies and by maximizing their use of low-impact renewable energy. They can also purchase GHG offsets to reduce their net emissions further.

These actions can also have significant indirect effects outside government by helping to kick-start markets for low-carbon products, such as green power.[16]

[16] Johanne Whitmore and Matthew Bramley, *Green Power Programs in Canada — 2003* (Drayton Valley, AB: The Pembina Institute, 2004), 4. Also available online at climate.pembina.org/pub/173.

Indirect GHG Reduction Policies

There are four key types of policies that will produce emission reductions in an indirect manner:

1. Investments in Technology Development

In contrast to the near-term deployment of the low-emissions technologies that are already available, research and development (R&D) policies aim at reducing the costs of low-GHG technology for later deployment.

Regulations that set targets and standards but allow emitters the flexibility to choose how to meet them should, in theory, be very effective in inducing the private sector to invest in technology development to reduce future costs of compliance, especially if the targets and standards are known well in advance. But firms can be deterred from investing in technology development because of the risk that competitors will benefit from the results. Thus, the value of R&D cannot be fully appropriated by the firm that made the initial R&D investment, with the result that markets will not allocate an optimal quantity of resources to research activities. The existence of these spillover benefits is the basis of a widely accepted argument that governments should also invest to some extent in technology development. (The IPCC, for example, notes that the public benefits of R&D investments "are bigger than the benefits captured by the private sector, justifying government support.")[17]

In addition to patent protection, government support of R&D typically takes the form of direct investment in research, subsidies to businesses and research institutions, procurement policies that favour new technologies and tax incentives.[18]

2. Investments in Public Awareness

As the direct source of about a quarter of Canada's national GHG emissions, individual consumers can play a significant role in combating climate change. Individuals make decisions that can strongly affect the emissions for which they are directly responsible, notably those associated with energy use in homes and transportation. Voluntary action by individuals is unlikely to produce emission reductions comparable to those achieved through regulation of the energy efficiency of buildings and vehicles or major financial incentives in the same areas. However, individual action is an important complement to corporate and government action. It can serve as a motivating force in driving individuals to demand more ambitious and more effective environmental action from their government and industries.

Polls demonstrate that the level of public awareness of climate science remains relatively low in Canada. For example, a July 2006 poll found that 50% of Canadians believed that there is "a lot of disagreement" among scientists about the causes of global warming (in sharp contrast to the findings of the IPCC), while a survey of 2000 Canadians conducted in December 2007–January 2008 found that 56% of Canadians were unable to choose the correct cause of global warming

[17] IPCC, "Summary for Policymakers," in *Climate Change 2007: Mitigation*, 20.

[18] Department of Finance Canada, "Part I: The Need for Governments to Support R&D," in *Why and How Governments Support Research and Development*, www.fin.gc.ca/resdev/why_e.html (accessed April 17, 2008).

from a list of options.[19] Well-designed public education initiatives could both encourage lower-emission choices by Canadians and inform them about the causes of global warming and the solutions required to reduce GHG emissions. This in turn may help to build public support for emission reduction policies.

3. Targets

Clear numerical targets are essential to transparency and accountability in any endeavour. Without targets, policies' intended outcomes are unclear and governments cannot be easily held accountable for their success or failure. Targets represent a future goal or endpoint, but they also serve to create present-day pressure on governments to implement climate plans that credibly demonstrate that they are on track to achieving the emission reduction goals. For example, the legally binding Kyoto Protocol targets have clearly created this kind of pressure in many of the countries subject to them. For this reason, this report classifies targets as an indirect GHG reduction policy in their own right.

4. Conditional Transfers

In a federal system like Canada's, the federal government can encourage and help strengthen provincial, territorial and municipal governments' policies in addition to taking direct action in its own areas of jurisdiction. This approach is especially appropriate in areas where the federal government does not have the power to regulate (e.g., modes of electricity production, building codes).

The federal government's considerable spending power is a powerful tool to help achieve emission reductions in areas outside of federal jurisdiction. Using this power, the federal government could seek negotiated agreements on climate policy with provincial, territorial and certain municipal governments in exchange for federal dollars. Such agreements would include four key features: (i) the provision of substantial federal funds; (ii) the use of those funds for clear purposes that result in GHG reductions beyond what would have occurred without them; (iii) the adoption or strengthening of regulations in areas of non-federal jurisdiction; and (iv) transparent numerical targets for outcomes.

In other words, the federal government could initiate transfers to provincial and territorial governments that are made conditional on appropriate, clearly defined provincial/territorial policies. The same approach could be applied to federal transfers to municipal or First Nations governments. Federal funds transferred to other orders of government in this context will generally be used for financial incentive policies or investments in infrastructure. Infrastructure spending may therefore fall either into the category of conditional transfers or into the category of direct federal investments in infrastructure.

[19] McAllister Opinion Research, *The Environmental Monitor* (Interim Report from Jan. 2007, and 2007 Highlights Report from Feb. 2008).

D. Canadian Policy Experience

Jurisdiction

The question of jurisdiction is always among the first issues to emerge when dealing with emission reduction policies in Canada. Constitutionally, the environment is a shared jurisdiction; for reasons of efficiency and administrative simplicity, however, there are good arguments for a strong federal role. There is strong public support for federal leadership as well: 70% of Canadians believe that the federal government has "a great deal of responsibility for reducing [GHG] emissions."[20] Johanne Gélinas, the federal Commissioner of the Environment and Sustainable Development at the time, echoed this view in her fall 2006 report where she called for the federal government to provide "bold, decisive top-down leadership."[21]

Overall, the federal government's role can be seen as including efforts to maximize the effectiveness and coherence of the GHG reduction policies implemented by all orders of government. As the Environment Commissioner put it, "the federal government … must lead to establish and, in some cases, rebuild strong and long-lasting partnerships with other levels of government."[22]

The federal government does not lack tools for the job. It has well-established powers to regulate emissions from all sources, fuels and the energy efficiency of appliances, equipment and vehicles. It also has broad taxation and spending powers. Legally, the federal government is responsible for meeting its obligations under the international treaties that it has ratified, notably the UNFCCC and the Kyoto Protocol. Both these treaties require signatory governments to implement GHG reduction policies.[23]

Provinces also hold crucial levers controlling climate policy. These include control over electricity supply, natural resource project approvals and the administration of municipal governments. While the federal government also invests in public transit and road infrastructure, provinces and municipalities are the major players in many transportation decisions.

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[20] The figure for provincial governments was 57%. See ClimateforChange.ca for a summary of the Harris/Decima poll conducted August 15–21, 2007, available online at www.climateforchange.ca/?q=MR-09-24-2007.

[21] Office of the Auditor General of Canada. *Report of the Commissioner of the Environment and Sustainable Development to the House of Commons* (Ottawa, ON: Minister of Public Works and Government Services of Canada, September 2006), 12. Also available online at www.oag-bvg.gc.ca/internet/docs/c20060900ce.pdf.

[22] Ibid.

[23] Article 4.2 of the Convention and Article 2.1 of the Protocol.

Canada's Main Sources of GHG Emissions

Table 1 shows Canada's main sources of GHG emissions in 2005 and the amount by which each has increased or decreased since 1990. Emissions have risen in nearly every category, in some cases dramatically. This trend is projected to continue in the absence of new government policies.[24]

Because 82% of Canada's GHG emissions inventory is accounted for by the production or burning of fossil fuels for energy[25] — especially coal-fired plants in electricity generation, natural gas-fired units in other industrial facilities and buildings, and gasoline and diesel engines in transportation — reducing GHG emissions in Canada requires:

- energy conservation — eliminating unnecessary energy-consuming activities
- energy efficiency — maintaining current activities but using more efficient processes, engines, buildings, equipment and appliances
- a shift to cleaner energy — maintaining current activities but with energy sources that have near-zero GHG emissions or lower emissions than those used now (while avoiding creating new environmental hazards and impacts).

[24] In March 2008, Environment Canada projected that under business-as-usual conditions, Canada's GHG emissions would rise from 749 Mt in 2005 to 940 Mt in 2020. See Environment Canada, *Turning the Corner: Detailed Emissions and Economic Modelling* (Ottawa, ON: Government of Canada, March 2008), 41. Also available online at www.ec.gc.ca/doc/virage-corner/2008-03/571/tdm_toc_eng.htm.

[25] Environment Canada, *National Inventory Report — Greenhouse Gas Sources and Sinks in Canada 1990–2005* (Ottawa, ON: Environment Canada, 2007), 12.

Table 1. Canada's Main Sources of GHG Emissions. [26,27,28,29]

Source	% of national emissions (1990)	Emissions (Mt CO_2e[30], 2005)	% of national emissions (2005)	% change in emissions (1990–2005)
Industrial facilities	**52.2**	**393**	**52.6**	**26**
Electricity generation	15.5	122	16.4	32
Oil and gas production, transmission and distribution	16.7	148	19.8	49
Other industrial facilities	20.0	123	16.4	3
Transportation	**24.0**	**190**	**25.4**	**33**
Passenger cars and trucks	11.3	74	10.0	11
Freight trucks	5.2	60	8.0	92
Railways	1.2	6	0.8	−14
Aviation (domestic)	1.1	9	1.2	36
Other transportation (off-road, marine, buses, etc.)	5.3	41	5.5	31
Buildings	**11.7**	**79**	**10.5**	**13**
Residential buildings	7.4	42	5.6	−5
Commercial buildings	4.3	37	4.9	43
Agriculture (apart from energy use)	**7.7**	**57**	**7.6**	**24**
Landfills	**3.9**	**28**	**3.7**	**22**
Other	**0.9**	**4**	**0.6**	
Federal government operations[a]	**0.7**	**3**	**0.4**	[b]**–24**
Total		**747**		**25**

[a] These emissions have already been counted once in the preceding sources.

[b] Change 1990–2002.

In addition to what is shown in Table 1, Canada's forests and agricultural soils can significantly affect Canada's CO_2 emissions, depending on whether the overall amount of carbon stored in these biological "reservoirs" is decreasing (a source) or increasing (a sink). Thus, forest

[26] Environment Canada, *National Inventory Report*, 12, 581.

[27] Office of Energy Efficiency, *Energy Use Data Handbook Tables (Canada)*, Natural Resources Canada, oee.nrcan.gc.ca/corporate/statistics/neud/dpa/handbook_tables.cfm (accessed October 9, 2007).

[28] Government of Canada, *Federal House in Order — Annual Report on Emissions Reductions From Federal Operations* (Ottawa, ON: Government of Canada, 2004), 11. Also available online at oee.nrcan.gc.ca/publications/statistics/fhio04/pdf/fhio2004.pdf.

[29] All data has been derived from Environment Canada's *National Inventory Report* except for the cars and trucks data, which has been derived from Natural Resources Canada's *Energy Use Data Handbook Tables*, and the federal government operations data, which has been derived from the *Federal House in Order* report.

[30] Megatonnes of carbon dioxide equivalent.

conservation, better forest management and practices that increase the carbon content of soils help to combat climate change.

In summary, the federal policies needed to effectively reduce Canada's emissions must focus on bringing about near-term investments in energy conservation, energy efficiency and cleaner energy. This approach covers the large majority of Canada's GHG emissions that result from the production or burning of fossil fuels for energy. In addition, the government must implement policies to induce the deployment of technologies and/or practices to reduce the minority of national GHG emissions that are unrelated to energy. The sectors affected by these policies include agriculture, forestry, waste management and certain industrial operations.

Canadian Climate Policy Implementation to Date

Canada has to date been timid in its implementation of climate policy relative to both its international peers and to the scientific assessment of the scale of reductions needed to avoid dangerous climate change.[31]

Prior to 2005, the federal government produced a series of climate plans and implemented some policies, but those were overwhelmingly focused on voluntary agreements, public information and a few subsidy programs. When the Kyoto Protocol came into force in 2005, the federal government responded with an updated approach and increased funding for climate initiatives, notably through the 2005 Budget and in a plan known as "Project Green."[32] This effort included a commitment to regulations setting emissions intensity[33] targets for heavy industry to come into effect in 2008. However, the compliance options for industry built into that proposal significantly weakened the potential carbon price signal. The 2005 proposals also continued the government's emphasis on spending and subsidy programs relative to regulations.

When a new government took office in 2006, ministers opted to "sunset" or cut many of the climate-related programs implemented by the previous government.[34] Over time, the government has restored several of these initiatives under new names and made new investments in GHG-related subsidy programs, such as biofuel production and transit pass tax credits.[35] The

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[31] See, for example, Jeffrey Simpson et al., *Hot Air: Meeting Canada's Climate Change Challenge* (Toronto, ON: McClelland & Stewart, 2007), Chapter 2. For an international comparison, see Jan Burck et al., *The Climate Change Performance Index* (Bonn, Germany: Germanwatch, 2007). Also available online at www.germanwatch.org/klima/ccpi2008.pdf. (Note: The Pembina Institute contributed information to the Canadian policy assessment.)

[32] Government of Canada, *Project Green: Moving forward on Climate Change — A Plan for Honouring our Kyoto Commitment* (Ottawa, ON: Government of Canada, 2005).

[33] Emissions per unit of production.

[34] Government of Canada, "First Steps Taken Towards Made-in-Canada Approach," news release, April 13, 2006. Also available online at www.nrcan-rncan.gc.ca/media/newcom/2006/200609-eng.php.

[35] Regarding support for biofuels, see Environment Canada, "Canada's New Government Takes Steps to Protect the Environment With Biofuels," news release, December 20, 2006. Also available online at www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=430AF7BE-B44F-4CFD-9313-E74EC4B28CCD. The transit pass tax credit was announced in Budget 2006. See Department of Finance Canada, *The Budget Plan 2006: Focusing on Priorities* (Ottawa, ON: Department of Finance Canada, May 2006), 116. Also available online at www.fin.gc.ca/budget06/pdf/bp2006e.pdf.

government has also re-instated and updated much of the previous government's approach to a regulatory proposal for heavy industry emissions, while moving the proposed implementation date from 2008 to 2010. In March 2008, the government announced an update to its regulatory framework. The update set targets for 2018 at the level of carbon capture and storage (CCS) technology for all new coal and oil sands facilities that come on stream after 2012.[36] (Note, however, that this is not a requirement to implement CCS, as industry can meet the targets through emissions trading.) The government has also committed to implement fuel efficiency regulations for passenger vehicles for the 2011 model year, in contrast to the voluntary approach adopted by the previous government in 2005. It has committed to do the same for the rail sector by 2011.

In the past two years, public opinion surveys have consistently found climate change or the environment at or near the top of Canadians' list of concerns. Perhaps in response to the growing public concern, several provincial governments have announced provincial climate strategies that are — in some cases — more ambitious than the federal government's plans and targets.[37] In recent months, British Columbia has distinguished itself by committing to and taking steps to implement relatively strong climate policies. In most cases, however, provincial climate policy implementation remains a work in progress.[38] The response to this trend has been mixed: while some business organizations have voiced concerns about a "patchwork quilt" of varied policies, environmentalists have largely encouraged those provinces taking action on a problem that environmental non-governmental organizations deem too urgent to wait for stronger federal leadership.

[36] The government's commitment to implement this regulatory framework based on emissions intensity targets is confirmed in the 2008 Conservative election platform. However, the platform also makes a new commitment to "work with the provinces and territories and our NAFTA trading partners in the United States and Mexico, at both the national and state levels, to develop and implement a North America-wide cap-and-trade system for greenhouse gases and air pollution, with implementation to occur between 2012 and 2015." In the absence of further information, these two commitments appear to be incompatible, because, as noted in Section G, the proposed framework based on intensity targets is not a true cap-and-trade system, and it is due to last until 2020 at the earliest.

[37] For a summary of policy announcements in key provinces as of July 2007, see Johanne Whitmore and Clare Demerse, *Highlights of Provincial Greenhouse Gas Reduction Plans* (Drayton Valley, AB: The Pembina Institute, August 2007). Also available online at climate.pembina.org/pub/1504.

[38] For a list of provincial climate change commitments, see Government of New Brunswick, *Climate Change: Leading Practices by Provincial and Territorial Governments in Canada* (Council of the Federation, 2007). Also available online at www.gnb.ca/cf/PDF/CCInventory-e.pdf. Jillian Bollinger and Kari Roberts have also produced a recent inventory of federal, provincial and territorial climate policies in Canada: *Building On Our Strengths* (Calgary, AB: Canada West Foundation, 2008). Also available online at www.cwf.ca/V2/files/Building on our Strengths Report.pdf.

E. Policy Assessment and Combination: General

The IPCC's work on climate change mitigation provides a good starting point for a climate policy assessment and discussion of how various policies can be used in combination. As noted above, the IPCC is generally accepted as the world's most authoritative source of information on climate science and economics. The UN body is charged with summarizing peer-reviewed climate research into regular comprehensive "Assessment Reports," the most recent of which was published in 2007.

Based on a comprehensive review of relevant research, the IPCC concluded in 2007 that "[a]n effective carbon-price signal could realize significant mitigation potential in all sectors."[39] However, the report also notes that "implementation barriers" — which vary by country, but can be financial, institutional, technological, informational or behavioural — currently prevent the realization of cost-effective mitigation opportunities. These barriers can even result in opportunities that provide "net negative costs" (i.e., financial savings from using the technology) going unrealized.

A more detailed examination of this phenomenon was presented in an article published in 1994 in the journal *Energy Policy*.[40] The authors examine an "energy paradox" where energy-efficient technologies have failed to gain widespread acceptance, despite the fact that they save consumers money. (In other words, consumer demand for energy appears to be puzzlingly unresponsive to price signals.) The authors identify a number of market barriers that help account for this inelasticity of demand, including:

- uncertainty about future energy prices, which can lead potential buyers to doubt the cost savings of reduced energy consumption
- the qualitative attributes of efficient products might be judged less desirable (for example, a consumer might prefer the hue of incandescent lighting to that of compact fluorescent bulbs)
- the adoption of a new technology always requires an investment (whether in dollars or simply in time) to install and learn how to use it
- although a technology may be cheaper for an average purchaser, it may not be cheaper for all consumers
- and finally, the "inertia" of consumers' adaptive behaviour: it takes time for individuals and businesses to adapt to any new technology and to understand the potential cost saving associated with it.

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[39] IPCC, "Summary for Policymakers," in *Climate Change 2007: Mitigation*, 19.

[40] Adam B. Jaffe and Robert N. Stavins. "The energy-efficiency gap: What does it mean?" *Energy Policy* 10, no. 22 (1994): 804–10.

The authors also list a number of "market failures," which they define as being market barriers that can be fixed by a public policy intervention. These include:

- the "principal-agent" problem — a market failure that arises when the potential adopter of the efficient technology is not the person who pays the energy bill. (For example, home builders have a very different incentive to spend money on efficient technologies than home buyers do.)
- the "non-appropriability" of information — a company that invests in developing a new technology and informing people about it will not be able to prevent other companies from benefiting from that information. (As noted above, governments typically intervene in two ways to help correct this market failure — by funding R&D and by protecting intellectual property through patents.)
- a related point is that the adopter of a new technology typically provides useful information about it to others but is usually not compensated for that service
- the energy prices that consumers pay are often lower than the true social costs of providing that energy (especially when environmental externalities are factored in), which means that consumers do not capture the full social benefits of saving energy.[41]

In the absence of government intervention, these barriers and market failures often result in individuals buying inefficient products in the place of efficient ones, or in a lack of efficient options being available for purchase.

The case of vehicle fuel efficiency standards in North America provides an effective illustration of the energy efficiency paradox described above. Following the oil shocks of the 1970s, the United States set regulated Corporate Average Fuel Economy (CAFE) standards that required a doubling of new car fuel efficiency over a ten-year period. Automakers succeeded in meeting the standards, and the sale of more efficient vehicles produced cumulative economic benefits on the order of US $40–80 billion, according to a calculation from the U.S. National Academy of Sciences.[42] After the 1980s, U.S. lawmakers opted not to tighten the targets. The result was that "[o]pportunities to improve fuel efficiency were often traded off against increases in other vehicle attributes, such as horsepower, acceleration rate, speed and weight,"[43] and the more powerful models proved popular with consumers. Progress towards vehicle fuel efficiency in North America essentially stopped, and the number of available fuel-efficient options dwindled: a recent survey of the auto markets in the EU, China, Japan and North America conducted by Pollution Probe found that just 15 of the globe's 200 most efficient vehicles are available in North America.[44]

The IPCC's Working Group III report also makes the case for vehicle fuel efficiency regulations, noting that:

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[41] Donald N. Dewees, "Pollution and the Price of Power," *The Energy Journal* 29, no. 2 (2008): 81–100.

[42] Bob Oliver, *A Strong Canadian Auto Industry in a Fuel Efficient Future* (Toronto, ON: Pollution Probe, December 2007), 1, 3.

[43] Ibid., 2.

[44] *A Global Survey of Highly Fuel Efficient, Low Greenhouse Gas Emitting Vehicles* (Toronto, ON: Pollution Probe, November 2007). Also available online at www.pollutionprobe.org/Reports/Backgrounder-Global Survey_FEvehicles.pdf.

"Improved vehicle efficiency measures, leading to fuel savings, in many cases have net benefits (at least for light-duty vehicles), but the market potential is much lower than the economic potential due to the influence of other consumer considerations, such as performance and size … Market forces alone, including rising fuel costs, are therefore not expected to lead to significant emission reductions."[45]

In other words, emission reduction opportunities that are cost-effective in purely financial terms go unrealized because of non-financial considerations. This provides a rationale for governments to implement regulations to realize those opportunities on the basis that the financial cost-effectiveness for society as a whole outweighs some individuals' non-financial preferences.

Similarly, the IPCC notes that "about 30% of the projected GHG emissions in the building sector can be avoided with net economic benefit" by 2030, but only if the "many" existing barriers to the take-up of those opportunities are removed through policy implementation.[46] This finding is echoed in a study of the financial costs of mitigation published in the *McKinsley Quarterly* in 2007, which concluded that "nearly one-quarter of the [global] abatement potential at a cost of up to 40 euros a ton involves efficiency-enhancing measures (mainly in the buildings and transportation sectors) that would reduce demand for energy and carry no net cost."[47]

The IPCC's report describes some of the strategies needed to overcome the barriers that reduce the deployment of energy efficiency. For example, education and training programs can increase the acceptance of energy efficiency, and better urban planning and transport demand management can reduce the use of personal vehicles. While voluntary efforts can play a limited role, the report concludes that the "majority of [voluntary] agreements have not achieved significant emissions reductions beyond business as usual."[48]

The IPCC summarized its findings about policy implementation in a table of "selected sectoral policies, measures and instruments that have shown to be environmentally effective in the respective sector in at least a number of national cases."[49] That table is reproduced below as Table 2. It provides a useful summary of the range of policy options available to governments.

[45] Ibid., 13.

[46] Ibid., 13.

[47] Per-Anders Enkvist, Tomas Naucler and Jenker Rosander, "A cost curve for greenhouse gas reduction," *The McKinsley Quarterly 2007*, Number 1 (Stockholm: McKinsley & Company), 40.

[48] IPCC, "Summary for Policymakers," in *Climate Change 2007: Mitigation*, 19.

[49]Ibid., 20, Table SPM 7.

Table 2. Sectors, Policy Measures and Key Constraints or Opportunities
(from IPCC 2007: Summary for Policymakers, Working Group III)

Sector	Policies,[a] measures and instruments shown to be environmentally effective	Key constraints or opportunities
Energy Supply	Reduction of fossil fuel subsidies	Resistance by vested interests may make them difficult to implement
	Taxes or carbon charges on fossil fuels	
	Feed-in tariffs for renewable energy technologies	May be appropriate to create markets for low-emissions technologies
	Renewable energy obligations	
	Producer subsidies	
Transport	Mandatory fuel economy, biofuel blending and CO_2 standards for road transport	Partial coverage of vehicle fleet may limit effectiveness
	Taxes on vehicle purchase, registration, use and motor fuels, road and parking pricing	Effectiveness may drop with higher incomes
	Influence mobility needs through land use regulations, and infrastructure planning	Particularly appropriate for countries that are building up their transportation systems
	Investment in attractive public transport facilities and non-motorized forms of transport	
Buildings	Appliance standards and labelling	Periodic revision of standards needed
	Building codes and certification	Attractive for new buildings. Enforcement can be difficult
	Demand-side management programs	Need for regulations so that utilities may profit
	Public sector leadership programs, including procurement	Government purchasing may expand demand for energy-efficient products
	Incentives for energy service companies	Success factor: access to third-party financing
Industry	Provision of benchmark information	May be appropriate to stimulate technology uptake. Stability of national policy important in view of international competitiveness.
	Performance standards	
	Subsidies, tax credits	
	Tradable permits [i.e., cap-and-trade]	Predictable allocation mechanisms and stable price signals important for investments.
	Voluntary agreements	Success factors include: clear targets, a baseline scenario, third-party involvement in design and review and formal provisions of monitoring, close cooperation between government and industry

Sector	Policies,[a] measures and instruments shown to be environmentally effective	Key constraints or opportunities
Agriculture	Financial incentives and regulations for improved land management, maintaining soil carbon content, efficient use of fertilizers and irrigation	May encourage synergy with sustainable development and with reducing vulnerability to climate change, thereby overcoming barriers to implementation
Forestry/ Forests	Financial incentives (national and international) to increase forest area, to reduce deforestation, and to maintain and manage forests	Constraints include lack of investment capital and land tenure issues. Can help poverty alleviation
	Land use regulation and enforcement	
Waste management	Financial incentives for improved waste and wastewater management	May stimulate technology diffusion
	Renewable energy incentives and obligations	Local availability of low-cost fuel
	Waste management regulations	Most effectively applied at national level with enforcement strategies

[a] Public RD&D[50] investment in low-emissions technologies has proven to be effective in all sectors

[50] Research, development and demonstration.

F. Policy Assessment and Combination: Canada

Canadian policy assessment has benefited from a number of recent comprehensive studies, as well as from some policy implementation by federal, provincial and municipal governments. Appendix B, entitled *Review of Experience of and Research on Greenhouse Gas Reduction Policies in Canada and Internationally,* provides significantly more detail about both relevant economic modelling work (including sectoral impacts) and the policy implementation experience, but the broad strokes will be summarized here.

Until very recently, carbon pricing policies have been virtually absent from the Canadian policy landscape. And despite the announcement of several carbon pricing proposals since 2007, few significant carbon pricing policies have been implemented. None have been in operation long enough to gauge their effectiveness empirically.

In contrast to the lack of mandatory, market-based policies, Canada has a richer history of financial incentive/subsidy policies and voluntary efforts. Despite the implementation of some public information and subsidy programs that achieved the public information goals that the government set for them, Canada's emissions have increased rapidly.

Canada's track record provides compelling evidence that a meaningful reduction in domestic emissions will require moving beyond subsidy programs and voluntary approaches to implement mandatory policy options, including regulations and carbon pricing. This conclusion was reached, notably, by the National Round Table on the Environment and the Economy (NRTEE), which recently published the results of an economic modelling exercise based on reaching the Government of Canada's 2050 target of a 60–70% reduction in GHG emissions below the 2006 level.[51] The NRTEE concluded that in order to reach the federal target, Canada will need to:

> "1. Implement a strong, consistent long-term emission price signal across the entire Canadian economy. Applying the emission price broadly ensures an equitable distribution of cost while seeking emission reductions from all segments of the economy.
>
> 2. Complement emission pricing with targeted measures. These could include regulations, strategic investments in infrastructure, and support for research, development and demonstration programs that address areas where the price signal is less effective. To a lesser extent, information programs will be required to educate Canadians and build support so that individuals will take action on climate change.

[51] Specifically, the NRTEE analyzed a slightly different scenario than the government's target, based on a mandate assigned before the current target was set. The analysis examined a 45–65% reduction in energy-related emissions (about 80% of the national total) below current emission levels.

> There is a critical need to instil confidence in the policy direction over the long term by clearly and consistently communicating these policies of economy-wide emission pricing and targeted measures."[52]

The NRTEE's modelling also found that significantly more emission reductions were obtained when regulations in the transportation and building sectors were added to an economy-wide carbon price. The report concludes that "regulatory policies can be very effective in closing gaps between actual emissions and targets when some segments of the economy are insensitive to emission prices."[53] This insensitivity refers to the market barriers and market failures discussed above.

In his book *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy*, economist Mark Jaccard reached similar conclusions about the prioritization of climate policies. His assessment is summarized in Table 3 below.

Table 3. Policy Evaluation Summary[54]

	Environmental Effectiveness	Economic Efficiency	Administrative Feasibility	Political Feasibility
Command-and-control regulations	Good	Poor	Good	Medium
Financial disincentives	Medium	Good	Good	Poor
Financial incentives	Medium	Poor	Medium	Good
Voluntarism and information	Poor	Poor	Good	Good
Emissions cap and tradeable permit	Good	Good	Medium	Medium
Niche market regulations[55]	Good	Medium	Medium	Good

Jaccard contends that financial incentives and voluntary/information policies, which enjoy high political feasibility, have been the first choice of numerous governments despite their track record of mixed environmental — and poor economic — performance.

In the three years since the publication of Jaccard's book, however, increasing public concern about climate change in Canada means that his assessments of political feasibility may err on the pessimistic side, particularly in the case of "financial disincentives," a category that includes carbon taxes. The implementation of carbon taxes in Canada — through Québec's very modest tax and British Columbia's more ambitious initiative — supports a less constrained view of the

[52] NRTEE, *Getting to 2050: Canada's Transition to a Low-emission Future* (Ottawa, ON: NRTEE, January 2008), 20–21. Also available online at www.nrtee-trnee.ca/eng/publications/getting-to-2050/Getting-to-2050-low-res-eng.pdf.

[53] Ibid., 28.

[54] Reproduced from Mark Jaccard, *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy* (New York, NY: Cambridge University Press, 2005), 290.

[55] A form of market-based regulation (see Section C).

politically possible. (It is arguable that the low carbon price levels in those provinces to date have not fully tested the political feasibility of carbon pricing, as a more negative response from voters could kick in as carbon prices rise.)[56]

The failure of voluntary policy approaches in reducing GHG emissions on a large scale has been well documented (see Appendix B, Section 4). Experience confirms that firms whose mandate is to maximize value for shareholders will rarely agree to take voluntary action when such action carries a significant net cost, unless they have strong expectations of future regulation. If a government makes a credible threat to regulate, it may be able to persuade industry associations to sign voluntary agreements that aim for results comparable to those obtainable from the regulation. Such voluntary agreements will not be enforceable in the same way as a regulation, however, and there may be little to deter industry from simply choosing not to comply.[57,58]

If voluntary approaches are inadequate to effectively reduce Canada's national emissions, policymakers are faced with a choice between — in most cases — regulations and financial incentives/disincentives. It should be noted that these categories include, respectively, cap-and-trade policies and carbon taxes — the two main carbon pricing policy options. More specific consideration is given to carbon pricing in Section G below.

From the perspective of environmental effectiveness, there are two primary reasons for which regulatory policies may be favoured over financial incentives and disincentives. First, financial incentives/disincentives typically do not specify — and thereby provide less confidence in — environmental outcomes. Second, these policies will usually be less effective than regulations in overcoming non-financial barriers, such as lack of information. In addition, incentives that involve net government spending will generally impose much higher costs on government and taxpayers than comparable regulations.

However, financial incentives and disincentives function effectively instead of, or as a complement to, regulations in four cases in Canada. First, there are key areas in which the Government of Canada does not have the power to regulate (e.g., modes of electricity production, building codes). In those areas, federal action is restricted to incentives/disincentives, either as stand-alone policies or in support of provincial or municipal regulatory action. Second, it may be too administratively complex to regulate in some areas (for example, energy management in small businesses). Third, when seeking to shift the market for a category of

[56] Notably, the Leader of the Official Opposition has also publicly stated his support for a carbon pricing regime similar to British Columbia's. Stéphane Dion stated: "I commit to you that when I am Prime Minister, my government will be equally as courageous and serious when it comes to putting the appropriate price on carbon." See "Canada Must Succeed in its Green Revolution," speech, March 14, 2008. Also available online at www.liberal.ca/story_13726_e.aspx.

[57] See the description of Canada's Memorandum of Understanding with the Automotive Industry (which the government has decided to replace with regulated fuel efficiency standards) at Section 4.1.2 of Appendix B.

[58] This is what appears to be happening with the voluntary agreements between the European Commission and car makers under which the latter undertook to meet targets for CO_2 emissions per kilometre by 2008–09. The commission recently expressed "growing concerns regarding the progress made by the industry under this voluntary approach" and concluded that it should be replaced by legislation. See European Commission, *Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles* (Brussels, Belgium: European Commission, 2007), 5. Also available online at eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0019en01.pdf.

products or equipment towards higher performance, regulations to eliminate the lowest-performing products can be complemented by incentives to reward the highest-performing ones. Fourth, incentives may be needed to offset costs imposed by regulations, including damage to international competitiveness. For example, in areas of provincial jurisdiction or of municipal authority, federal incentives could offset costs imposed by provincial/municipal regulations, thereby facilitating their implementation.

In its 2007 report *Moving Forward on Energy Efficiency in Canada: A Foundation for Action,* the Council of Energy Ministers describes numerous barriers to the deployment of energy efficient technologies in Canada. Echoing the conclusions of international research described above, the Canadian ministers' report notes that market barriers often block the realization of cost-effective energy efficiency opportunities:

"Too often, consumers, including governments in their own operations, overlook the operating cost reduction that offsets the upfront capital costs associated with making an investment in energy efficiency.

Businesses and the public sector also tend to under-invest in energy efficiency despite more analytical decision-making processes. Barriers to investment include [the fact that] efficiency investments have to compete against other uses for capital and equity, and efficiency investments with good returns may not be adopted when compared with more fundamental requirements (e.g. meeting payroll) or better returns from other investments (e.g. expanding product lines)."[59]
In areas that are affected by these kinds of market barriers but not covered by regulations or direct government investments in infrastructure, financial incentives/disincentives will need to be large enough to change a substantial proportion of firms' and individuals' decisions to invest in GHG-intensive technologies and practices. In some cases, incentives will work by ensuring that low-GHG technologies or practices that were previously uneconomic become the lowest-cost choice; for example, renewable energy production may displace fossil-fuel generation once incentives take effect. In other cases, incentives will work by attracting wide attention to low-GHG technologies or practices that were already the lowest-cost choice but were neglected because of the barriers to implementation described above.

The ubiquity of these non-financial barriers means that the effectiveness of financial incentives will, in many cases, be significantly enhanced by "support policies" such as marketing, labelling, training, resource mapping, access to financing, the establishment of technical standards, certification and performance auditing. By allowing companies and individuals to capitalize on cost-effective emission-reduction opportunities that would otherwise have been overlooked, these support policies serve to increase the effectiveness of other climate policy measures.

It should be noted that incentive policies on their own do not deter high carbon investment; they merely reward low-carbon investment. And by decreasing the cost of an end product (for example, electricity produced from renewable energy), they could lead to increased consumption of that product.

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[59] Council of Energy Ministers, *Moving Forward on Energy Efficiency in Canada: A Foundation for Action* (Whistler, BC: Council of Energy Ministers, 2007), 9. Also available online at www.nrcan-rncan.gc.ca/com/resoress/publications/cemcme/cemcme-eng.pdf.

Another key challenge to the cost-effectiveness of financial incentive policies is the "free rider" problem. Free riders are firms or individuals that receive money for actions that they would have taken even if they had not received the money. By failing to factor in free riders, governments can overestimate the effectiveness of their incentive policies. If the incentives provided are truly large enough to change a substantial proportion of investment decisions, the proportion of free riders will likely be reduced.[60] However, policies should nonetheless be designed to minimize the problem.

The same problem occurs in the case of offset credits, an option often provided to firms facing mandatory targets in cap-and-trade systems. Purchasing offsets is offered as an alternative to making in-house emission reductions or purchasing reductions from other capped firms that have exceeded their own targets. To avoid free ridership, offset systems must ensure that these credits are provided only to projects that go beyond business as usual by subjecting the credits to effective "additionality" rules.[61] If non-additional credits are permitted, firms can meet their targets using credits for actions that would have happened anyway. Environmentally, the consequence will be that a cap-and-trade system achieves fewer emission reductions than expected. Policy experience shows that applying additionality rules effectively is often challenging.[62]

As the IPCC's policy assessment demonstrated (see Table 2), certain policy approaches align well with specific sectors/sources of emissions. In Canada, jurisdictional requirements impose another set of considerations in determining policy implementation: for example, deploying more solar energy in Alberta could reduce emissions from electricity generation there, but the federal government cannot make direct decisions about a province's electricity supply mix because this jurisdiction falls under the purview of provincial governments.

Using the IPCC's template, the tables below (Tables 4–6) provide a relatively comprehensive list of the policy options available to federal and provincial/municipal governments in Canada to reduce emissions from each of the major sources in Canada's economy. Governments interested in maximizing domestic emission reductions would choose to implement a greater number of the policies described below, in order to reduce emissions more broadly.

[60] TD Bank's report *Market-Based Solutions to Protect the Environment* (Drummond et al., March 2007) documents the phenomenon of too-low financial incentives in the case of hybrid vehicles (page 9). When incentives are set at too low a level, the proportion of free riders increases and the program's effectiveness is diminished accordingly.

[61] Additionality rules often include a requirement for financial additionality (i.e., the project could not have gone ahead without the revenue that the sale of offset credits would provide) and a requirement that the project go beyond common practice and be surplus to all government regulations and incentives.

[62] See, for example, the discussion of the Clean Development Mechanism in Section 2 of Appendix B.

Table 4. Policy Options Available to Both Federal and Provincial Governments[63]

Policies By Sector
Industrial facilities (including electricity generation)
Financial incentives for co-generation of heat and electricity
Provision of energy management assistance to small and medium-sized enterprises
Regulations to strengthen standards for the energy efficiency of appliances and equipment[a]
Financial incentives for the most energy-efficient appliances and equipment[a]
Passenger cars and trucks[b]
Regulations to set standards for fuel economy or GHG emissions from cars and light trucks
Financial incentives for the production/consumption of ethanol fuel with low life cycle impacts[c]
Regulations to require low-impact ethanol in gasoline
Freight transportation
Public investments in lower-emission freight and intercity passenger transportation infrastructure
Financial incentives for the production/consumption of biodiesel with low life cycle impacts[c]
Regulations to require low-impact biodiesel in diesel fuel
Residential buildings
Financial incentives for energy efficiency retrofits to existing residential buildings, with targeted provisions for low-income households and multi-family units
Financial incentives for production of renewable heat for use in residential buildings
Commercial buildings (including institutional and industrial buildings)
Financial incentives for energy efficiency retrofits to existing commercial buildings
Provision of energy management assistance to building managers
Financial incentives for production of renewable heat for use in commercial buildings
Agriculture
Financial incentives for GHG emission reductions and enhanced carbon storage in agriculture
Forestry
Financial incentives for carbon storage in forests
Government operations
Improvement of government operations to reduce GHG emissions
Economy-wide Policies
Carbon Pricing
Carbon taxes, cap-and-trade systems[d] or a combination of the two
Conditional transfers/infrastructure investments
Conditional transfers to municipal governments to support, and/or direct investments in, GHG-reducing infrastructure and municipal policy implementation
Numerical targets
Adoption of a target for national/provincial GHG emissions in the near term (e.g., 2012)
Adoption of a target for national/provincial GHG emissions in the medium term (e.g., 2020)
Adoption of a target for national/provincial GHG emissions in the long term (e.g., 2050)
Adoption of clear numerical targets for the short and medium term for each policy listed above

[63] In the policy option tables, "financial incentives" cover both incentives and disincentives. They therefore do not necessarily involve net government spending — they can include fees or be implemented through revenue-neutral tax shifting, or they can be created through offset credits that are sold to emitters subject to mandatory GHG targets.

Other indirect policies
Investments in development of low-GHG technology for future deployment
Investments in public awareness about climate change and actions to reduce GHG emissions

[a] These policies are placed here because they reduce emissions mainly from electricity generation facilities.

[b] Investments in public transit are covered under "Conditional transfers / infrastructure investments".

[C] It is important to note that the net reductions in GHG emissions over the entire life cycle of both ethanol and biodiesel depend on how the fuel is made. It should also be noted that ethanol and biodiesel from cropped feedstocks (e.g. corn) are controversial methods of reducing GHG emissions due to their cost, their real and perceived impacts on food prices, deforestation and the overall environmental sustainability of agricultural practices.[64]

[d] Although cap-and-trade systems are commonly thought of as applying only to industrial facilities, they can be designed to include other sectors too (see Section G).

Table 5. Policy Options Specific to the Federal Government
(in addition to "shared" policies above)

Policies By Sector
Industrial facilities (including electricity generation)
Financial incentives for production/consumption of electricity from low-impact renewable sources (both large and small scale)[a]
Freight transportation
Transfers to provincial/territorial governments for lower-emission freight and intercity passenger transportation infrastructure
Provision of energy management assistance to small and medium-sized enterprises
Residential buildings
Financial incentives for construction of new residential buildings with low net energy consumption[a]
Commercial buildings (including institutional and industrial buildings)
Financial incentives for construction of new commercial buildings with low net energy consumption[a]
Economy-wide Policies
Conditional transfers/infrastructure investments
Conditional transfers to municipal governments to support, and/or direct investments in, GHG-reducing infrastructure and municipal policy implementation

[a] Provincial governments could also implement such incentives, but these are sectors where provincial governments can adopt regulations.

[b] Excluding freight and intercity passenger transportation infrastructure, covered under "Freight transportation."

[64] For example, a recent OECD report concluded that biofuel support in the U.S., Canada and the EU costs governments between US $960–1,700/tonne of CO_2e reduced. The study found that announced government biofuel policies are capable of reducing transportation emissions by less than 1% for most transportation sectors. However, current biofuel support measures are expected to increase average wheat, corn and vegetable oil prices by approximately 5%, 7% and 19% respectively in the 2013–17 period. See Martin Von Lampe, *Economic Assessment of Biofuel Support Policies* (Paris, France: OECD, 2008), 8–10.

Table 6. Policy Options Specific to Provincial and/or Municipal Governments
(in addition to "shared" policies above**)**

Policies
Industrial facilities (including electricity generation)
Requirement that new industrial facilities in relevant sectors be approved only if they capture and permanently store[65] all major point sources of CO_2
Feed-in tariffs and/or renewable portfolio standards for electricity produced from low-impact renewable sources, with targeted measures for small-scale production
Residential buildings
Strengthened energy efficiency requirements in the building code for new residential buildings
Commercial buildings (including institutional and industrial buildings)
Strengthened energy efficiency requirements in the building code for new commercial buildings
Other
Regulations to limit urban sprawl
Regulations to require capture of methane at landfills

In light of Canada's history of rising emissions, it is clear that financial incentives, voluntary measures and public information policies, while useful in limited "niches," are not sufficient to reduce Canada's total national emissions on their own. By process of elimination, this strongly suggests that Canadian governments must look to policy options at the more mandatory end of the policy spectrum presented in Tables 4–6. As approximately 50% of Canadian emissions come from heavy industry, which is a portion of the economy that has shown itself to be relatively responsive to price signals,[66] carbon pricing appears to be a crucial piece of the puzzle.

Given its centrality to emission reduction policy, carbon pricing is explored in more detail in Section G below. As described above, however, international experience — notably as summarized by the IPCC's work and echoed in the NRTEE's findings — suggests that carbon pricing policies function more effectively when complemented with regulatory policies and financial incentives to overcome existing market barriers and market failures. In other words, carbon pricing appears to be necessary but not sufficient. A comprehensive suite of policies — so-called silver buckshot rather than a silver bullet — is likely needed in addition to a carbon price signal in order to capture the cost-effective emission reduction opportunities that would otherwise go unrealized. Clearly, these policies need to be carefully monitored to ensure their effectiveness, both environmentally and in terms of cost. In addition, policies should be re-evaluated periodically to assess their usefulness in the context of a rising price on carbon.

A key consideration when determining how to apply the policies above is the level of ambition, or target, for climate action. While it is outside the scope of this report to recommend specific targets, the level of ambition a government chooses will clearly have an effect on the policies it selects to meet that target. Governments have a relatively fixed number of policy tools available

[65] Implementation of a strong regulatory framework to ensure permanent storage, public safety, adequate monitoring and clear attribution of liabilities is essential before any CO_2 capture and storage operations are approved. Other conditions that we believe should be attached to such operations are outlined in *The Pembina Institute's Perspective on Carbon Dioxide Capture and Storage (CCS)*, available online at climate.pembina.org/pub/1542.

[66] See Appendix B, Section 2.2, for a discussion of carbon pricing experience internationally.

to them, whether they are aiming to reduce emissions deeply or barely at all (see Tables 4–6 for a relatively comprehensive listing of those tools). But the timing and manner of combining them will depend on the target as well as on the sources of emissions.

A recent study commissioned by WWF-Australia tackled this question by modelling rates of industrial growth for industries producing low-emissions technologies. The report concluded that, in the absence of a timeline for emission reductions, technology-neutral carbon pricing alone would be sufficient to reduce emissions substantially over the very long term. But in order to reach specific 2050 targets,[67] a "sequential" application of technologies — one that moves from the lowest-cost technology to the next-lowest cost technology and so on — is insufficient. Instead, a "concurrent" application of technologies will be required in order to avoid implausibly high levels of industrial growth in low-emissions technology industries. The report concludes that an effective concurrent application of technology can be achieved through policies such as:

- investing a portion of the revenues raised through carbon pricing in technologies that reduce emissions until they become competitive in the market
- choosing policies that require an entire portfolio of technologies to be developed, such as a "feed-in tariff" policy[68] for renewable energy
- establishing a mandatory carbon capture and storage target.[69]

The ambition of a country's target will also likely influence its approach to international offset credits. While a relatively modest target might be met entirely through domestic reductions, governments that adopt ambitious targets are more likely to choose to supplement domestic action by investing in cost-effective emission reductions in less developed countries.[70]

Finally, the jurisdictional division of labour facing federal, provincial and municipal governments in Canada means that, in some cases, a regulatory policy applied at one level of government can be effectively supplemented by an incentive policy from another level, thus leveraging the maximum cost-effective emission reductions.

In its report *Market-Based Solutions to Protect the Environment,* TD Bank noted that "[m]ost businesses around the world now expect some type of emissions regime and many have already geared up for it. As such, any delay or vagueness in policy announcements creates an economic

[67] The report examined three targets, with the least ambitious being Australian Prime Minister Kevin Rudd's commitment to reduce national emissions to 60% below the 1990 level by 2050. It also modelled U.S. presidential candidate Barack Obama's commitment to an 80% reduction below 1990 by 2050, and the EU's commitment to avoid 2°C of global warming relative to pre-industrial levels, which the report interprets as a commitment to emission reductions of about 90% below 1990 by 2050. For comparison, Canada's current 2050 target is equivalent to 51–63% below 1990.)

[68] Feed-in tariffs are regulated prices paid to producers of renewable energy over a guaranteed period. Prices are set to reflect the current costs of each renewable technological option at its proposed location. (Because wind technology is more developed and cost-effective than marine technologies and solar thermal, for example, it is paid less).

[69] Karl Mallon and Mark Hughes, *Industrial Constraints and Dislocations to Significant Emissions Reductions by 2050* (Ultimo, Australia: WWF-Australia, 2008), 1–5.

[70] The requirement to assure that offsets are additional to business as usual, which was noted above in Section F, applies with the use of international offsets as well.

cost in itself."[71] Debate will certainly continue about the precise policy package needed to effectively reduce GHG emissions in Canada, but governments have more than enough information about both the seriousness of the problem and the effectiveness of potential solutions to act. Given the urgency of that challenge, the inevitable time lag before policies take effect and the speed with which Canada's peer countries are moving, delay could indeed be extremely costly in economic as well as environmental terms.[72]

[71] Don Drummond et al., *Market-Based Solutions to Protect the Environment* (Toronto, ON: TD, March 2007), iii. Also available online at www.td.com/economics/special/bc0307_env.pdf.

[72] This was one of the key conclusions of the 2006 Stern Review (see www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm), which found that the economic costs of unchecked climate change far outweigh the costs of taking action.

G. Carbon Pricing

As noted above, carbon pricing will almost certainly form the linchpin of any effective climate strategy for Canada. Fortunately, federal and provincial political parties have started to make carbon pricing a priority, which has resulted in extensive media coverage of the issue and a debate about costs, benefits and pricing mechanisms.

However, a casual reader of this media coverage might be forgiven for having picked up some misconceptions about carbon pricing. For example, several recent announcements of emissions trading and carbon tax proposals have produced a heated tax vs. trading discussion in media and political circles in Canada. However, careful assessment shows that the two approaches have far more in common than their respective proponents tend to suggest.

A key starting point is that carbon taxes and cap-and-trade systems each enjoy a strong rationale for their likely success as environmental policies. The IPCC notes that "[a]ll instruments can be designed well or poorly, and be stringent or lax."[73] This statement is particularly true in the case of carbon pricing, where the detailed policy design (including the approach to recycling revenue and the approach to mitigating international competitiveness concerns) matters almost as much as the initial choice of mechanism. Either a carbon tax or cap-and-trade system, or a combination of the two, is capable of providing an environmentally effective outcome, and either can fail to deliver if it is poorly designed.

In theory, environmental taxes are intended to close the gap between the private cost of producing or using a good and the full social cost, including environmental damage, that the good imposes. In a 2008 report, Jack Mintz and Nancy Olewiler note that a "significant advantage of environmental taxes over many general taxes is that they have the potential to correct market distortions rather than introducing new ones," so that replacing a distortionary tax with an environmental tax can "have the effect of improving the efficiency and fairness of the tax system as a whole."[74]

Despite the shorthand sometimes seen in media stories, carbon taxes are not simply "gas taxes." British Columbia's carbon tax, for example, covers the combustion of all fossil fuels included in Canada's National Inventory Report for GHG emissions, including gasoline, diesel, natural gas, coal, coke, propane, light and heavy fuel oil, aviation gasoline, aviation turbo fuel and kerosene. The tax excludes emissions from biofuels (such as firewood, ethanol and biodiesel) and emissions from industrial processes that do not involve fuel combustion (e.g., aluminium production), as well as emissions from landfills. The emissions covered by BC's tax account for

[73] IPCC, "Summary for Policymakers," in *Climate Change 2007: Mitigation*, 19.

[74] Jack Mintz and Nancy Olewiler, *A Simple Approach to Bettering the Environment and the Economy: Restructuring the Federal Fuel Excise Tax* (Ottawa, ON: Sustainable Prosperity, University of Ottawa), 10. Also available online at sustainableprosperity.ca/wp-content/uploads/2008/04/sustprosper-qx-5.pdf.

about 70% of the province's total GHG emissions, including emissions from both industries and individuals.[75]

In their recent report, Mintz and Olewiler point to the comprehensiveness of carbon taxes as an important strength of this policy tool. They compare a broad-based carbon tax on all fossil fuels to the existing federal excise tax, which applies only to gasoline and diesel. "By raising the price of vehicle fuel, this [excise] tax encourages reductions in fuel use for transportation, but not for other purposes. This is inefficient from an environmental standpoint because other fuel uses that release emissions, such as the use of coal to generate electricity, are not taxed, even if they produce more pollution."[76]

While carbon taxes purport to offer "price certainty" about the cost of emissions, cap-and-trade systems can theoretically provide certainty about the quantity of emission reductions that the system will produce, a key consideration in assessing a policy's environmental efficiency. Cap-and-trade policies do this by imposing a "hard cap," set through regulation, on the total number of tonnes of GHGs that the sectors covered by the regulation are allowed to emit. Emitters are required to hold allowances (also known as permits) for each tonne they release into the atmosphere. They are also allowed to trade the allowances amongst themselves. The trading component creates an incentive for individual emitters to surpass their regulated target (i.e., the emissions level corresponding to the allowances that they are given free of charge), because they can then sell the unneeded allowances on the market. In this way, the system provides companies with the flexibility to seek out the lowest-cost emission reductions first.[77]

(It is notable in the Canadian context that the current federal proposal for GHG regulations for industry is not a true cap-and-trade system. Instead, the proposal is a baseline-and-credit system[78] that sets targets not for absolute emissions but for emissions intensity, which means emissions per unit of production. Emitters are required to improve their emissions intensity relative to a baseline, and they can trade with others who have exceeded their regulatory targets. Baseline-and-credit systems do not require firms to hold allowances for their emissions; intensity targets can be met while absolute emissions rise if production grows rapidly. Thus, intensity targets do not provide an equivalent level of "quantity certainty" to a stringent cap-and-trade system.)

It is sometimes assumed that a carbon tax is for consumers because it covers fuels such as gasoline or natural gas for home heating, while cap-and-trade is for industry. It's true that individuals might see a carbon tax more readily — carbon taxes could show up as a line item in a home heating bill, for example. And most cap-and-trade systems place the requirement to hold allowances for emissions solely on industrial emitters larger than a designated size. But both theory and practice confirm that companies subject to cap-and-trade policies often pass the value of their allowances on to consumers indirectly by charging higher prices. This happens more in

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[75] British Columbia Ministry of Finance, *Budget and Fiscal Plan: 2008/09 to 2010/11* (Victoria, BC: February 2008), 13. Also available online at www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf.

[76] Mintz and Olewiler, vi.

[77] For a review and policy assessment of existing cap-and-trade and carbon taxation policies, see Appendix B, Section 2.2.

[78] Environment Canada, *Regulatory Framework for Air Emissions* (Ottawa, ON: Government of Canada, 2007), 14. Also available online at www.ecoaction.gc.ca/news-nouvelles/pdf/20070426-1-eng.pdf.

some sectors than others; for example, it was found in the EU's emissions trading system that regulated electricity vendors were very successful in passing the market price of allowances on to their customers, even when the companies had received nearly all of their allowances free of charge from governments.[79]

Administratively, even carbon taxes would be unlikely to be applied "directly" to consumers. Instead, it is simpler for governments to collect a carbon tax from fuel wholesalers, just as the existing excise tax on gasoline and diesel is collected. The wholesalers would pay the tax on the emissions that will come from burning the fuel they sell, and then pass the tax on to consumers through fuel prices. In theory, cap-and-trade could be applied to consumers using essentially the same approach: instead of paying tax, fuel wholesalers would have to buy emission "allowances" to cover the emissions from burning the fuel they sell. The cost of the credits would again be passed on in fuel prices.

Table 7 assesses the cap-and-trade and carbon tax approaches against the key criteria identified in Section B (fiscal impact and political feasibility are not addressed explicitly but will depend on assessments made under the other criteria).

Table 7. Comparing the Tax and Trading Options[80]

	Emissions cap-and-trade	Carbon tax
Environmental effectiveness		
Certainty offered	In theory, offers certainty about the quantity of GHG reductions. In practice, governments may set a price ceiling (or "safety valve"), a feature that reduces certainty about GHG reductions.	In theory, offers certainty about the price of carbon. In practice, governments may decide to adjust tax rates frequently, thus reducing price certainty.
Ease of increasing the carbon price or the quantity of reductions	Relatively easy to increase the quantity of reductions by decreasing the number of allowances issued. However, the resulting effect on the carbon price would be uncertain.	Relatively easy to increase the carbon tax rate to a desired price level. However, the effect on GHG emissions of the new price level would be uncertain.

[79] More information about the EU's Emissions Trading System is provided at 2.2.1 of Appendix B.

[80] Adapted from Clare Demerse, "Carbon Pricing: Efficiently Stimulating Greenhouse Gas Reductions," in *Big Steps Forward: Recommendations for Budget 2008* (Ottawa, ON: Green Budget Coalition, 2007), 12. Also available online at www.greenbudget.ca/pdf/GBC_2008.pdf.

	Emissions cap-and-trade	Carbon tax
Use and recipient of carbon price revenues	Money spent on offset credits (credits generated from emission reduction projects outside the cap-and-trade system) remains in the private sector, is spent on near-term emission reductions and can be a mechanism for financing emission reductions in poorer countries. Money spent on auctioned allowances goes to government and may be spent on emission reductions. However, the revenue may also be directed to non-climate government priorities, including reductions in other taxes.	Money spent on paying carbon taxes goes to government and may be spent on emission reductions. However, the revenue may also be directed to non-climate government priorities, including reductions in other taxes. A carbon tax could allow for the purchase of offset credits as a means to reduce taxable emissions, and to ensure that some money is redirected to immediate emission reductions, including reductions in poorer countries.
Economic Efficiency		
Consistent marginal incentive for emission reductions?	By creating a market, provides a single marginal price for emission reductions, maximizing economic efficiency. However, this is only true when governments use absolute targets; intensity targets (and/or the use of offset credits) will result in different types of reductions being priced differently.	A common tax rate on all sectors provides a single marginal price for emission reductions, maximizing economic efficiency. However, if governments set different tax rates/exemptions for different sectors (or if offset credits are allowed), the unique marginal price is lost.
Fairness		
Polluter pays?	Yes, if targets are stringent or all allowances are auctioned.	Yes, as long as the tax level is appropriate and tax exemptions and reductions are not offered.
Means of addressing distinct sectoral/public pressures	Flexibility to allocate allowances free of charge according to sectors' ability to pay. Allocation of free allowances tends to be contentious and susceptible to lobbying. Auctioning of allowances provides revenue that can be used to protect low-income people and/or vulnerable sectors from associated cost increases.	Flexibility to recycle revenue to protect vulnerable sectors/low-income people. Revenue recycling has the potential to be contentious and vulnerable to lobbying.
Simplicity of administration		
Administrative Complexity	Can be designed to be simple (e.g., by auctioning 100% of allowances) but allocating some allowances free of charge would undermine the system's simplicity.	Can be designed to be simple, but sectoral exemptions or variations would undermine the system's simplicity.

	Emissions cap-and-trade	Carbon tax
Applicability to individuals and small businesses[81]	For administrative reasons, not easy to apply *directly* to individuals or small businesses (except through "carbon credit cards").[82] However, can be applied to fuel wholesalers, thereby covering individuals' and small businesses' emissions "upstream." The effectiveness of the price signal in encouraging reductions will depend on factors such as complementary policies, the visibility of the carbon cost and the carbon price level.	Can be applied to individuals and small businesses directly, but more likely to be applied to fuel wholesalers, thereby covering individuals' and small businesses' emissions "upstream." The effectiveness of the price signal in encouraging reductions will depend on factors such as complementary policies, the visibility of the tax and the tax level.
Federal experience and powers	The Canadian federal government has little experience with the administration of cap-and-trade systems. The *Canadian Environmental Protection Act* (CEPA) provides a basis for federal regulation of GHGs, but this power has yet to be exercised. CEPA also includes "economic instruments" powers (Ss. 322–327) that could be used for a cap-and-trade system.	The Government of Canada has significant administrative capacity and policy expertise in taxation. The federal government's taxation powers are well established.
Avoidance of international competitiveness impacts		
Consistency with international GHG reduction regime	The current international regime (Kyoto Protocol, first commitment period) is based on a cap-and-trade architecture and includes emissions trading.	Some argue that it will be easier to reach agreement on an effective future international regime (post-2012) if it is based on carbon taxes.[83]

In fact, rather than choosing between the two approaches described above, a growing number of jurisdictions are choosing to treat them as complementary. Both British Columbia and Québec are committed to cap-and-trade for industry through the Western Climate Initiative (WCI) and also to provincial taxes on carbon.[84] Norway has charged a tax on CO_2 since 1991, but recently it opted to join the EU's Emissions Trading Scheme (ETS) as well.

Tax and trading policies can be combined in a number of ways, including:

[81] Industries whose emissions are subject to a cap-and-trade system or carbon tax will also pass on some of the associated costs to consumers (industries' ability to do this will vary by sector), resulting in an indirect carbon pricing effect on individuals and small businesses.

[82] For a discussion of the potential applicability of individual carbon credit cards, see Department for Environment, Food and Rural Affairs, *Synthesis Report on the Findings from Defra's Pre-feasibility Study into Personal Carbon Trading* (London, UK: DEFRA, 2008). Also available online at www.defra.gov.uk/environment/climatechange/uk/individual/carbontrading/pdf/pct-synthesis- report.pdf.

[83] See, for example, "Option 13" at www.option13.org, or N. Gregory Mankiw, "One Answer to Global Warming: A New Tax," *New York Times*, September 16, 2007. Also available online at www.nytimes.com/2007/09/16/business/16view.html.

[84] See Appendix B, Section 2.1, for more detail.

- an economy-wide carbon tax that offers a tax exemption to industrial emitters when they purchase allowances or credits from an approved cap-and-trade or offset system
- an "upstream" cap-and-trade on industrial emitters combined with a "downstream" carbon tax for individuals, transportation and the commercial sector.

The two can also be de facto combined through such measures as a cap-and-trade system where all allowances are auctioned (i.e., firms do not receive any free allowances) and the auction includes a reserve price, or price floor. If emitters are required to pay a reserve price of $10 per allowance, the cap-and-trade system effectively charges a $10/tonne carbon tax to the firms covered by the system. Yet another possibility is a sequential application of the two systems. For example, implementing new regulations is normally a multi-year process, but applying a new tax can be done in a matter of months through a ways-and-means motion. Thus, a Canadian government could decide to apply a carbon tax as quickly as possible while keeping the door open to future integration with regional cap-and-trade systems that are still being developed. British Columbia chose this approach: the province's carbon tax came into effect on July 1, 2008, and BC is also an active member of the California-led WCI, which is developing a cap-and-trade system currently proposed to take effect by 2012. The province has promised that its industrial emitters will not have to pay twice, but the details of that commitment remain to be fleshed out. Some advocates of hybrid approaches believe that a well-designed system can combine some of the quantity certainty of emissions trading with some of the price certainty of a carbon tax.[85]

Recent fuel price increases have prompted questioning of the need for carbon pricing policies. In the spring and summer of 2008, oil reached record-high prices, resulting in dramatic increases in the prices consumers pay at the pump for gasoline. In response, sales of trucks and SUVs plunged in the United States[86]; although the effect was less pronounced in Canada, the share of trucks sold "retreated steadily in 2008, which may reflect the first move by drivers to boost fuel efficiency in response to higher prices," according to Statistics Canada.[87] On its own, the market has increased the price of gasoline more quickly than any carbon pricing policy currently proposed in Canada would do. This occurrence has led some to ask why a carbon price of any kind would be needed.

Defenders of carbon pricing offer a number of responses to that question. As noted above, carbon pricing extends far beyond gasoline to cover sectors such as electricity production, aviation and home heating. Carbon pricing can also send a more consistent price signal to consumers than market prices do: while we're all familiar with the ups and downs of world oil prices, governments can commit to a multi-year price schedule for a tax (as BC has done), or to a multi-year target schedule for a cap-and-trade system. Either approach could send a powerful message that the price of carbon is only headed in one direction: up. Also, regardless of the price of oil, exempting any sector from carbon pricing reduces economic efficiency by allowing society as a whole to bear that sector's environmental costs. Finally, carbon pricing raises revenue that governments can use, including for reductions in emissions or in taxes.

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[85] See, for example, Adam Whitmore, "Taxes and Trading: Better Together," *Carbon Finance*, September 14, 2007.

[86] See, for example, Associated Press, "U.S. Auto Sales Plunge," August 1, 2008.

[87] Statistics Canada, *Study: Over a barrel? Canada and the rising cost of energy* (August 14, 2008), www.statcan.ca/Daily/English/080814/d080814a.htm.

Several of the arguments for carbon pricing at a time of record oil prices were summarized in *The Economist*'s lead article of May 29, 2008:

> "…everything high prices achieve could be done better by sensible carbon taxes. As well as curbing oil use, high prices have put tar sands in business which create far more carbon dioxide than conventional oil. Profits are going to ugly oil-fed regimes, not Western exchequers. And the wild unpredictability of prices will blunt the effect of dear oil on people's behaviour.
>
> From this perspective, governments should speed up the adjustment — or at least stop delaying it. Half the world's people are sheltered from fuel prices by subsidies — which, perversely, have boosted demand and mostly benefited the better off."[88]

Despite the strong agreement in the economic literature about the need for a carbon price mechanism in Canada, there is ongoing debate about how best to implement that price. Two of the most contentious policy issues are how best to use the revenue raised by carbon pricing policies and how to mitigate potential impacts on international competitiveness created by carbon pricing. These questions are discussed in turn below.

Revenue Recycling

Both a tax on emissions and a cap-and-trade system with auctioned allowances are capable of raising significant new revenue for governments. At higher carbon prices, these revenues could quickly come to represent an important share of governments' total revenues. For example, an analysis commissioned by the David Suzuki Foundation concluded that if Canada were to meet a science-based GHG target in 2020, the resulting carbon price would generate revenue of at least $50 billion (in 2003 dollars) annually by 2020.[89]

Because they can be so substantial, the use of revenues raised through carbon taxes can be an important contributor to their political feasibility. The Government of Québec opted to levy a low-level tax (of about $3/tonne) and direct the resulting revenues to GHG-related spending programs in its climate plan. In contrast, the Government of British Columbia opted for a more ambitious tax — reaching $30/tonne by 2012 — but will devote all the revenue raised to cuts in personal and corporate taxes. The latter approach, a "revenue-neutral" tax shift, is also the one recommended by Jack Mintz and Nancy Olewiler in their study cited above. (It is worth noting that Mintz and Olewiler also support the concept of combining a tax shift with a cap-and-trade system.)[90,91]

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[88] "The oil price: Recoil," *The Economist*, May 29 2008. Also available online at www.economist.com/opinion/displaystory.cfm?story_id=11454989.

[89] M. K. Jaccard and Associates and Environmental Economics, *Pricing Carbon: Saving Green* (Vancouver, BC: The David Suzuki Foundation, 2008), 8. Also available online at www.davidsuzuki.org/files/reports/Pricing_Carbon_saving_green_eng.pdf. This estimate is based on a tax rate of $200/tonne. At that rate, government revenues would in fact generate approximately $100 billion (in 2003 dollars), as noted on pages 18 and 28 of the report. However, the authors assumed that complementary policies (which they did not model) would reduce the costs of meeting that target, which led them to the more conservative estimate of "at least $50 billion" cited above.

[90] Mintz and Olewiler, vi.

An important consideration in recycling revenues is the treatment of low-income individuals. Meaningful carbon pricing will increase the cost of some essential goods, such as home heating fuel, whether the price is applied through a tax or passed on from firms subject to a cap-and-trade system. Simple tax shifting — where governments use the revenue from carbon taxes to lower the rates of existing taxes, such as income taxes — will fail to protect people who pay no taxes because their incomes are too low (although refundable tax credits may provide a means of doing so within a revenue neutral framework). In a non-revenue neutral carbon pricing scenario, governments could invest in home retrofit programs, expanded public transit systems or other uses of the revenue that help alleviate the additional costs faced by low-income individuals while reducing emissions.

Investing tax or allowance auction revenues in further emission reductions serves to strengthen the effect of the carbon price: the initial price signal should spur reductions up to the price level (although barriers will likely prevent the realization of all cost-effective mitigation opportunities), and then the revenues can be used to invest in additional reductions that have a higher cost per tonne. Doing so would effectively produce a higher carbon price in certain targeted areas, which would likely have the effect of spurring low-carbon investments more quickly. (Speeding up the effect of a carbon price would be even more important if other governments follow BC's example of allowing a "relatively long phase-in period up to the $30 per tonne level."[92] BC's 2008 Budget states that the phase-in period "is intended to give people and business time to adjust their habits and purchasing patterns, and to respect decisions taken before the tax was announced.") The IPCC's assessment is that "costs will be reduced if policies that correct the two market failures are combined by incorporating the damage resulting from climate change in carbon prices, and the benefits of technological innovation in [financial] support for low-carbon innovation. An example is the recycling of revenues from tradeable permit auctions to support energy efficiency and low carbon innovations."[93] Governments would have to carefully design a process for allocating this additional support, and should assure that it includes the criteria of simplicity of administration, transparency and cost-effectiveness in addition to the key criterion of effectiveness in reducing emissions.

Revenues can also potentially be recycled back to industrial emitters, a policy that can be used to protect them from any potential damage to their competitiveness caused by the application of the carbon price. This recycling can be done through tax cuts, although — as with low-income Canadians — tax cuts provide little assistance to those firms that have not earned enough income to pay taxes. Any targeted support programs and measures to assist struggling industries would need to be carefully designed; if they are not, these measures may not be economically efficient or cost-effective.

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[91] Governments may also want to consider the relative efficiencies of the taxes in question when designing a revenue-neutral tax shift. Economists consider personal income taxes, for example, to be less efficient than broad-based consumption taxes. By carefully selecting the taxes to be "shifted," governments can aim to increase the overall efficiency of the tax system through a targeted recycling scheme.

[92] British Columbia Ministry of Finance, *Budget and Fiscal Plan: 2008/09 to 2010/11* (Victoria: February 2008), 12.

[93] Terry Barker et al., "Mitigation from a Cross-Sectoral Perspective," in B. Metz et al., eds., *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK, and New York, NY: Cambridge University Press, 2007), 622. Also available online at www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter11.pdf.

Specifically, an important consideration in the design of revenue recycling policies is the final "incidence" of the price: just because a tax is applied on refineries, for example, does not mean that those companies will pay the entire cost of the tax, as they may be able to pass most of their costs on. Thus, the initial "site" of the carbon price may not reflect the regions, businesses and individuals who end up paying it. Governments designing revenue recycling policies will need to understand this phenomenon and account for it, so that any "targeted" recycling they provide reaches the right targets.

International Competitiveness Concerns

An important starting point for a discussion of competitiveness concerns is to what degree carbon pricing actually damages the international competitive position of industrial emitters subject to the price. The answer provided by the economic literature, and confirmed by policy experience, seems to be that "it depends."

In his 2004 report *The European Emissions Trading Scheme: Implications for Industrial Competitiveness*, energy economist Michael Grubb concludes that the EU's Emissions Trading Scheme (EU ETS) is "unlikely to reduce the profitability of most industrial sectors" overall. However, there will be winners and losers amongst individual companies, and some sectors will be affected more than others. (Grubb's analysis identified only one European sector, aluminium, that was likely to come out a loser once the EU ETS came into effect.)[94]

Another relatively positive assessment of the competitiveness impacts of carbon pricing in Europe comes from the European Environment Agency, which has estimated that the use of tradeable allowances in the EU ETS will reduce the cost of compliance with Kyoto Protocol targets by at least €3.5 billion annually.[95] Its assessment concluded that the perceived negative impacts of market-based policy instruments on competitiveness have often been overstated:

> "There is no evidence that existing economic instruments have a major adverse effect on competitiveness at the macro and sector level. This is partly due to the design of the instruments (use of low rates of taxes and charges), partly to exemption possibilities to avoid cost impacts and partly due to well designed measures that compensate those affected by recycling revenues (e.g. such as the NO_x charge in Sweden). However, there can be impacts on individual companies as some companies will be more able or willing than others to respond to the signals from taxes, charges and subsidies, or opportunities of emissions trading schemes. Therefore, the issue is not about 'unfair loss of competitiveness,' rather increasing willingness and ability to respond will keep companies competitive, whereas polluting companies that cannot adapt have usually had to close. Competitiveness issues have often been given greater weight than is justifiable when selecting or designing instruments or when granting or designing subsidies. Many subsidies have applied for too long. Some of this

[94] Michael Grubb, *The European Emissions Trading Scheme: Implications for Industrial Competitiveness* (London, UK: The Carbon Trust, 2004), 3. See also J.-C. Hourcade et al., *Differentiation and Dynamics of EU-ETS Industrial Competitiveness Impacts: Final Report* (Climate Strategies, 2007), www.climatestrategies.org/reportfiles/1_climatestrategies_competitiveness_final_report_140108.pdf.

[95] European Environmental Agency, *Market-Based Instruments for Environmental Policy in Europe* (Luxembourg: Office for Official Publications of the European Communities, 2005), 3. Also available online at reports.eea.europa.eu/technical_report_2005_8/en.

> is based on industries exaggerating the cost of measures and underestimating their ability to react."[96]

A 2006 OECD study also found that some competitiveness impacts can occur, but that these are restricted to specific sectors and can be mitigated, albeit at some cost to the environmental effectiveness of the policy:

> "Model simulations indicate that the use of economic instruments to reduce greenhouse gas emissions is likely to have negative impacts on the international competitiveness position of some industrial sectors, especially when such instruments are implemented in a non-global manner. This has, e.g. been demonstrated in case studies of the steel and the cement sectors. However, both studies show that in spite of some element of carbon leakage, significant global reductions in carbon emissions can be achieved.
>
> …The case studies looked at some ways to limit the burden on affected firms, while maintaining the pollution abatement incentives. One option could be to recycle (a part of) the revenues raised back to the affected firms. The case studies indicate that revenue recycling would reduce global emission reductions in the sector. In other words, protecting competitiveness through recycling revenues back to the affected sectors is likely to lower the environmental effectiveness of the policy as a whole."[97]

In Canada, the NRTEE's *Getting to 2050* report — which modelled carbon prices of $200/tonne ($2003) and more en route to reaching a 2050 emissions target of 65% below current levels — concluded that the national economic impact would be at most two years of "lost growth" over the next 42 years. However, specific regions or sectors will feel greater or lesser impacts, especially in the short term. The NRTEE's analysis made the assumption that Canada's emission reduction activities occur "in concert with the rest of the world in terms of both domestic emission reduction efforts and access to potentially lower-cost international emission reductions." In the event that Canada's major trading partners, "particularly the United States, do not implement comparable policies within a reasonable time frame, the economic risk of the deep domestic reductions investigated in this report rises." (The NRTEE is careful to note that "It is not the NRTEE's view that any of this should be justification for Canada not taking action now.") On the other hand, the report notes that, "If all countries more or less act in concert on emission pricing, competitiveness impacts largely disappear."[98]

Although this conclusion is important, the NRTEE's assessment is painted in broad strokes. In reality, we may see a scenario where Canada's major trading partners act at different speeds, with some forging ahead while others continue with business as usual. Over time, the definition of "major trading partners" may shift as well. This shift points to a need for detailed assessments, on a sector-by-sector basis, of the real international competitiveness impacts facing Canadian industries and the role that climate policies play over the short and longer term. (Any such assessments should also take into account international best practices in forecasting the GHG reductions resulting from government policies, which were the subject of a July 2008 report from

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[96] Ibid., 9.

[97] OECD, *The Political Economy of Environmentally Related Taxes* (Paris, France: OECD, 2006), 11. Also available online at www.oecd.org/document/20/0,3343,fr_2649_34295_36815124_1_1_1_1,00.html.

[98] NRTEE, *Getting to 2050*, 13, 14, 37, 41.

the NRTEE. The NRTEE recommends that modellers use consistent baselines, assumptions and conditions, and communicate these transparently; use consistent definitions of key terms, such as "free ridership"; incorporate international perspectives that accurately reflect climate policy implementation outside of Canada; and have regular reviews of past forecasts to evaluate their accuracy.[99] In Canada, relatively few models have been used to generate the majority of such forecasts to date, which further increases the need for review of models' past performance and transparency about key assumptions.)

The competitiveness question is not simply an economic one. GHG emissions are a global pollutant. There is no net environmental gain if a company simply moves its emissions to another jurisdiction rather than reducing them. Emissions could even increase if there is a shift in market share from relatively efficient producers in one country to less efficient producers in another. This phenomenon, known as "carbon leakage," could occur if firms face high carbon costs in one jurisdiction and low or no carbon costs in another. Thus, there are both good environmental and economic reasons to be concerned about the international dimensions of carbon pricing. Assuaging concerns about competitiveness is also an important step in assuring the political feasibility of carbon pricing.

As carbon pricing is a relatively new policy question in Canada, with current carbon price levels quite low, neither British Columbia nor Québec have implemented policies explicitly aimed at avoiding leakage in their carbon pricing policies. (However, the corporate tax cuts that the Government of British Columbia included with its revenue-neutral carbon tax proposal are intended to bolster the competitive position of BC industries.) The leakage question has arisen in the policy design of both the WCI cap-and-trade system and the EU's Emissions Trading System; neither has opted to implement policies specifically to address it at this time, except for one special provision for electricity generation in the WCI design recommendations (the WCI cap will cover emissions from electricity generated outside the WCI region if it is consumed in the region[100]).

One prominent option for mitigating competitiveness concerns is to include a generalized "border carbon adjustment" (BCA) in a Canadian carbon pricing policy. One form of this policy is a border tax adjustment (BTA), which would impose a charge on imports to Canada that is equal to the difference between the Canadian carbon tax and the carbon tax levied in the importers' home country, if any. This adjustment is intended to level the playing field between imported products and their Canadian competitors. Similarly, a BTA would allow exporters to receive a refund on the carbon tax they paid on production that is exported.

If Canada opts instead for a cap-and-trade system, the BCA would require importers to purchase allowances or offsets equivalent to the carbon charge faced by domestic producers. There could also be refund provisions for exporters.

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[99] NRTEE, *GHG Emissions Forecasting: Learning from International Best Practices* (Ottawa: NRTEE, July 2008), 2. Also available online at www.nrtee-trnee.com/eng/publications/green house gases forecasting/nrtee-ghg-emissions-forecasting-eng.pdf.

[100] See WCI, *Design Recommendations for the WCI Regional Cap-and-Trade Program*, www.westernclimateinitiative.org/ewebeditpro/items/O104F19866.PDF.

A 2007 assessment of BTAs by Ismer and Neuhoff found that this policy tool could be compatible with World Trade Organization (WTO) rules if correctly designed,[101] although others have concluded that the WTO acceptability of BTAs is not assured.[102] Ismer and Neuhoff contend that BTAs "would allow countries to abolish free allocation [of allowances], with all its implied distortions, without risking leakage." However, they also note that determining the carbon content "embedded" in products could be extremely difficult if exporting countries failed to cooperate. The authors also identify a political dimension of BTA policies that they see as critical, which is the impact of BTAs on the international climate negotiations. These negotiations "aim to ensure countries cooperate on reducing emissions — and the cooperative approach should not be undermined by a perceived implementation of trade barriers."[103] In other words, implementing a BTA policy risks undermining the crucial international climate talks currently underway by creating ill-will (or, in the worst-case scenario, trade wars) between negotiation partners.[104]

There are several other potential drawbacks of the BCA approach. In the Canadian context, a BCA policy could effectively exempt most of the oil sands sector — responsible for close to half the projected business-as-usual growth in Canada's GHG emissions from 2006–2020[105] — from the effects of a carbon price, as the overwhelming majority of its projected production is destined for export to the United States. BCAs also imply application of equal carbon costs to developed and developing countries, which appears to run counter to the UNFCCC and Kyoto Protocol principle that developed countries must take the lead in making emission reductions. Applying a BCA to manufactured goods poses very difficult accounting and quantification issues. However, if a BCA were applied to basic commodities (e.g., steel) but not to manufactured goods, it would penalize manufacturers attempting to add value to commodities. Finally, applying a BCA policy requires accurately calculating the "difference in stringency" between the climate policies of two countries, an extremely complex exercise that could invite dispute about the chosen interpretation.[106]

The BCA discussion raises important questions about the treatment of traded goods in a carbon-constrained world. Questions are now being raised about the fair point of imposition of a carbon price: should the price target the producers of a good, or its consumers?[107] Under the UN's current emissions accounting practices, the emissions from producing a barrel of oil in Canada's oil sands are attributed to Canada. If that barrel is then used to fuel American cars, the emissions from burning the oil are attributed to the United States.

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[101] Roland Ismer and Karsten Neuhoff, "Border Tax Adjustment: A Feasible Way to Support Stringent Emissions Trading," *European Journal of Law and Economics* 24 (2007): 137–64.

[102] Harro van Asselt and Frank Biermann, "European emissions trading and the international competitiveness of energy-intensive industries: A legal and political evaluation of possible supporting measures," *Energy Policy* 35 (2007): 497–506.

[103] Ismer and Neuhoff, 139–40.

[104] Aaron Cosbey, *Border Carbon Adjustment: Background Paper for the Trade and Climate Change Seminar — June 18–20, 2008 in Copenhagen, Denmark* (Winnipeg: International Institute for Sustainable Development, June 2008), 6–7.

[105] Environment Canada, *Turning the Corner: Detailed Emissions and Economic Modelling*, 41.

[106] Cosbey, *Border Carbon Adjustment.*

[107] See, for example, Thomas Courchene and John Allan, "The Carbon Footprint Belongs To...," *Globe and Mail*, July 17, 2008.

Another way of thinking about this question is to consider "embedded" or "embodied" carbon, meaning the total amount of GHGs emitted from the production and marketing of a manufactured good. In the example cited above, this would mean factoring in the "embedded" emissions from producing and transporting the barrel of oil and adding those to the emissions from burning it. The question is clearly an important one: a 2008 analysis found that internationally traded products accounted for almost a quarter of global CO_2 emissions in 2001. Although Canada was a net exporter of "embedded" emissions, according to the study — "exported" emissions accounted for about 33% of total domestic emissions in 2001 — our "imported" embedded emissions were nearly as large, totalling just under 30%.[108] A 2008 assessment of "Balance of Emissions Embodied in Trade," or BEET, again found that Canada has a small "positive" trade balance, exporting 15.5 Mt CO_2e more than we imported in 2001. This assessment puts Canada in the minority among the group of industrialized countries that face Kyoto Protocol targets; Germany, the United Kingdom, Japan and the United States are all significant net importers of emissions.[109]

Despite these national-level assessments, it remains an open question whether a robust accounting of embodied emissions is possible at the level of individual products. In addition, attributing all embodied emissions to consumers could have the effect of diluting producers' incentive and responsibility to reduce the emissions intensity of their production, despite the fact that producers have tools at their disposal to do this directly.

A central consideration in the BCA discussion is Canada's position in climate policy implementation relative to its peers. The EU's emissions trading market has already reached a carbon price of over $40/tonne for December 2008-vintage carbon credits,[110] so Canadian firms clearly do not require protection from their European competitors. And although the United States does not currently have a federal carbon pricing policy in place, it is well on its way to launching two regional emissions trading systems: the WCI and the Regional Greenhouse Gas Initiative in the north-eastern United States, a system designed to cover emissions from fossil-fuel electricity generation starting in 2009. Both systems are based on absolute targets, not emissions intensity, and both will require at least a portion of their allowances to be auctioned. An important piece of climate legislation considered by the U.S. Congress in 2008, *American's Climate Security Act* (usually referred to as the Lieberman-Warner bill), would also impose absolute caps on emissions if it became law, again with mandatory auctioning of a portion of allowances. (The Lieberman-Warner bill also proposes imposing border carbon adjustments after a two-year period during which the U.S. must "intensify its efforts to convince other nations to start reducing their greenhouse-gas emissions.")[111] Finally, both presidential candidates favour a

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[108] Glen P. Peters and Edgar G. Hertwich, "Trading Kyoto," *Nature Reports* (20 March 2008), www.nature.com/climate/2008/0804/full/climate.2008.25.html.

[109] Glen P. Peters and Edgar G. Hertwich. "CO_2 Embodied in International Trade with Implications for Global Climate Policy," *Environmental Science and Technology* 42, no. 5: 1401–1417. Cited in Aaron Cosbey et al., *Embodied Carbon in Traded Goods: Background Paper for the Trade and Climate Change Seminar — June 18–20, 2008 in Copenhagen, Denmark* (Winnipeg: International Institute for Sustainable Development, June 2008), 4.

[110] The price was listed at €26.60 at www.europeanclimateexchange.com/default_flash.asp on June 4, 2008.

[111] Office of Senator Joseph Lieberman, *The Liberman-Warner America's Climate Security Act: A Detailed Summary*, Title VI, Global Effort to Reduce Greenhouse Gas Emissions, www-tc.pbs.org/nbr/supplemental/Detailed_ACSA_Description.pdf. The bill originally proposed an eight-year

hard cap on emissions in a cap-and-trade system, with Barack Obama committed to 100% auctioning of allowances.[112] The U.S. bipartisan commitment to absolute emission targets, in fact, raises the possibility that a Canadian intensity-based system would be barred from linking with the U.S. system because the Canadian system would not be sufficiently environmentally rigorous.

In this context, competitiveness concerns would likely emerge mainly in the case of rapidly developing countries, such as China and India, rather than from Canada's fellow OECD countries. (However, it should be noted that some of the rapidly developing countries are far from inactive in the application of emission-reduction policies: China's vehicle fuel efficiency standards, for example, are more stringent than Canada's proposed approach.)[113] An alternative to BCAs that seeks to address concerns about leakage is the sectoral-based approach, an idea that has been given a cautious welcome by some environmental groups. In one variation of this approach, developing countries would agree to a global sectoral standard for a given sector's emissions intensity in exchange for financial incentives from developed countries. By holding all industries to the same standard, the sectoral approach would aim to eliminate the incentive for leakage.[114,115] Competitiveness concerns could also be mitigated by commitments to nationally appropriate mitigation action by rapidly industrializing countries such as China. This is a hoped-for outcome of the post-2012 UN climate negotiations that are scheduled to conclude in December 2009 in Copenhagen. Finally, the Canadian government could provide targeted compensation — including tax measures, support for R&D, revenue recycling from carbon pricing schemes, financial incentives or the provision of free emissions allowances — to those industries it deems to be vulnerable to international competitiveness concerns. The decision to provide such compensation should be based on an independent assessment of a sector's trade exposure, its compliance costs as share of profits, the sector's return on investment net of compliance costs and its global mobility.

For a quantitative assessment of projected sectoral impacts of carbon pricing in Canada, see Appendix B, Section 2.

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period before the imposition of border carbon adjustments, but this delay has been amended to two years. The bill was defeated earlier this year in the U.S. Senate, but it may be re-introduced.

[112] See "Barack Obama: Promoting a Healthy Environment" at www.barackobama.com/pdf/issues/EnvironmentFactSheet.pdf.

[113] Transport Canada, *Background Paper for the Development of Motor Vehicle Fuel Efficiency Regulations* (Ottawa: Government of Canada, January 2008), 20.

[114] This approach should be distinguished from the so-called "bottom-up sectoral approach," under which developed countries would set their national targets based on a "bottom-up" assessment of the emission reductions each sector is judged capable of making. Environmental groups do not support that approach because they prefer to see national targets based on scientific assessments of the emission reductions needed to avoid dangerous climate change.

[115] A version of this proposal is described by the Center for Clean Air Policy, *Sector-Based Approach: How Might it Work in a Practical Sense?*, www.ccap.org/docs/resources/276/Schmidt_Sector-based_Approach_Practicalities_July_07_Joint_Dialogue.pdf.

H. Areas for Further Research

This report has highlighted a number of areas that merit further investigation. These include the following:

- Climate policy in Canada raises a host of jurisdictional questions that would benefit from further research. These include:
    - How do equivalency agreements under the Canadian Environmental Protection Act apply to carbon pricing policies?
    - If both federal and provincial governments apply a carbon tax, how should the two tax regimes interact? How should provincial or regional cap-and-trade systems or carbon taxes interact with the federal government's regulatory proposal for heavy industry?
    - In an update to its regulatory framework proposal released in March 2008, the federal government committed to intensity targets based on carbon capture and storage (CCS) for new oil sands and coal-fired electricity facilities that come on stream starting in 2012. The CCS-level targets would apply starting in 2018, but emitters could choose to meet the targets through emissions trading instead of actually implementing CCS. Legally speaking, would it instead be possible for the federal government to make the use of CCS technology a requirement on all new facilities that come on stream after 2012 (assuming CCS were judged to be a cost-effective option to address emissions from such facilities)?
- As discussed above, economically rational industrial sectors are expected to respond more quickly to a carbon price signal, while consumer demand for goods such as gasoline and home heating fuel is often seen as relatively inelastic, especially in the short term. This inelasticity or insensitivity to price signals is, at least in part, the result of market barriers and market failures that result in consumers failing to take advantage of energy efficiency opportunities that would save them money over the longer term. A more thorough understanding of which complementary policies are best able to overcome the non-financial barriers to emission reductions would be very useful. (For example, is it effective to make the cost savings of energy efficiency more visible through labelling? Or, does it matter whether a rebate is offered at the point of purchase rather than as a tax credit returned to the purchaser later on?)
- There is a need for an independent assessment of the vulnerability of various Canadian industrial sectors to carbon leakage as a result of carbon pricing. As noted above, sectoral vulnerability depends on a variety of factors, including trade exposure, compliance costs as share of profits, return on investment net of compliance costs and mobility. A more nuanced and independent understanding of Canadian sectors' exposure to a carbon price signal would help design appropriate and tailored policies to address international competitiveness issues and leakage.

- As discussed in Section G, border carbon adjustment (BCA) policies are a possible response to the question of how best to protect sectors vulnerable to international competition once a carbon price is applied. This approach raises a host of questions that merit further exploration in the Canadian context, including the following:
    - How would BCAs work in the context of NAFTA or the WTO?
    - What would be the consequences of a BCA policy for the oil sands sector?
    - Is it possible to account accurately for embodied carbon? Is it legally feasible to do so?
    - How will regional emissions trading initiatives like the WCI deal with border issues?
- As noted in Section G, economists assess taxes according to their economic inefficiency (so-called deadweight loss, or output lost per tax dollar raised). How economically efficient is a broad-based carbon tax in relation to other taxes? And what form of "revenue neutral" tax shifting would maximize economic efficiency?
- Section F notes that the policies selected by governments will depend, at least in part, on the level of ambition of their climate targets. A comprehensive economic modelling study of a range of climate targets in Canada would help determine the packages of policies that appear best suited to reach a variety of target levels, starting with Canada's current 2020 and 2050 targets.[116] This modelling should include the economic costs and benefits of reaching each target, both in aggregate and by sector and region, and include an assessment of how costs might best be mitigated through policy design. This assessment could also include sector-specific estimates of likely future technological progress, which would provide useful estimates of how costs might fall as technologies become more developed and widespread with time.
- To date, no one in Canada has performed and published an economic modelling assessment of the feasibility of achieving a science-based GHG target for Canada using a reasonably comprehensive policy package. According to the IPCC, for the world to have a chance of limiting average global warming to 2ºC,[117] — a limit strongly supported by leading climate scientists — a reduction in net GHG emissions of 25% below the 1990 level by 2020 is the minimum required of industrialized countries.[118] At the UN negotiations in Bali in December 2007, countries agreed to use the science-based target range of 25–40% below 1990 in 2020 as the basis for negotiating 2020 targets for industrialized countries.[119] In this context, an assessment of the package of policies required to reduce Canada's net emissions to 25% below 1990 by 2020 could provide critical data, both for domestic policy development and for determining Canada's negotiating position internationally.

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[116] Although the NRTEE examined the carbon price level required to meet the Government of Canada's 2050 target, its analysis did not look in detail at the complementary policies required, nor did it focus on achieving 2020 targets.

[117] See, for example, the 2007 *Bali Climate Declaration by Scientists*, www.ccrc.unsw.edu.au/news/2007/Bali.html.

[118] Sujata Gupta et al., "Policies, Instruments and Co-operative Agreements," in B. Metz et al., eds., *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK, and New York, NY: Cambridge University Press, 2007), 776. Also available online at www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter13.pdf. The IPCC's analysis applied to stabilization of the atmospheric concentration of GHGs at 450 parts per million of CO_2e. This limit is necessary to have a better than 50% chance of limiting average global warming to 2ºC relative to the pre-industrial

- Finally, as noted in Section G, relatively few economic models have been used to date in Canada to generate the majority of forecasts of GHG reductions resulting from government policies. This suggests the desirability of a review of leading models' past performance and an analysis of their key assumptions.

level. See Bill Hare and Malte Meinshausen, "How Much Warming Are We Committed to and How Much Can Be Avoided?," *Climatic Change* 75, nos. 1–2 (2006): 111.

[119] UNFCCC, *Report of the Conference of the Parties serving as a meeting of the Parties to the Kyoto Protocol on its third session, held in Bali from 3 to 15 December 2007*, paragraph 16.

Appendix A: "Straw Dog" Policy Combination

This Appendix presents a "straw dog," or proposal for discussion, that seeks to combine many of the elements discussed above into a policy package for Canada. Although it is aimed primarily at the federal government, there are important roles for provincial and municipal governments as well. The package described here would likely be most effective if implemented in a cooperative pan-Canadian manner.

The policies described here could be implemented at various levels of ambition in order to meet a variety of potential emission reduction targets.

Although this package is consistent with the report's conclusions, it represents only one of many possible policy combinations that would align with the conclusions found in Section F. It might require adjustment in light of further research, as described in Section H.

This proposal is guided by the following principles, which build on and combine the principles outlined in Section A and the criteria described in Section B:

- Simplicity: to ease communication, speed implementation and facilitate accountability
- Comprehensiveness: to address all the most significant GHG sources and sinks
- Cost-effectiveness: to meet a given emission reduction objective at least cost
- Fairness: including consideration of the polluter pays principle, ability to pay and regional balance
- Accountability: to ensure a strong incentive for timely and effective implementation.

Drawing on these principles, the proposed federal GHG reduction plan comprises the following eight components:

1. A **carbon tax** to cover the broadest practical subset of Canada's emissions, including most of those from industries, transportation and buildings. International competitiveness impacts and the regressiveness of the carbon tax would respectively be mitigated by corporate tax cuts targeted to vulnerable sectors and personal income tax cuts/refundable credits.
2. A **GHG reduction fund** to "purchase":
    - emission reductions from strategic emission reduction projects until the carbon tax rate is high enough to make such projects economic without additional support
    - emission reductions/removals in agriculture and forestry
    - emission reductions in poorer countries
3. **Regulations** to address market barriers that hinder energy efficiency improvements and other GHG reduction actions in vehicles, appliances and equipment.

4. **Negotiations** with provincial and/or municipal governments to secure regulations to address market barriers to GHG reduction actions under provincial/municipal jurisdiction (e.g., building codes, urban sprawl).
5. **Targeted financial incentives** to address remaining market barriers to GHG reduction actions in residential buildings, commercial buildings and smaller businesses.
6. **Investments in public infrastructure** that reduces emissions.
7. **Investments in the development of GHG reduction technologies**.
8. Legislation setting a **national target** for Canada's net emissions in 2020 and requiring annual reporting.

1. Carbon Tax

The government would apply a tax to the broadest practical subset of Canada's CO_2e emissions, which will include most of those from industries, transportation and buildings:

- In order to send a long-term price signal, the government would commit to a phased track of tax increases out to 2020 and a clear qualitative commitment to rising taxes beyond 2020.
- The federal government would agree to "stand down" up to 50% of its carbon tax in provinces where the provincial government implements its own carbon tax policy (or equivalent carbon pricing policy) on the same emissions. This would allow for a single tax rate across the country at the "default" federal level, but give provinces the option of retaining up to half of the tax revenues by charging a tax equivalent to half of the federal rate.[120]
- Any international competitiveness impacts of the carbon tax would be mitigated by corporate tax cuts or other measures targeted to vulnerable sectors, with vulnerability evaluated transparently by independent experts.
- The regressiveness of the carbon tax on individuals would be mitigated by personal income tax cuts and/or refundable credits.

A clear price signal is the most cost-effective way to reduce emissions from sources subject to "economically rational" decision making, notably sources controlled by large businesses. Fairness requires that the polluter pays principle be applied to all sources of emissions, including those controlled by individuals. A broad polluter pays policy could be implemented either through a tax or a cap-and-trade system. This straw dog policy proposal selects the tax option for the following reasons:

- Federal powers and administrative capacity for taxation are well established; the federal government has far less experience with market-based environmental regulations.
- A tax avoids arguments over the allocation of allowances, which are inevitable when establishing a cap-and-trade system (however, arguments over differentiated tax levels are still possible).
- A tax can likely be implemented much more quickly than a cap-and-trade system.

[120] For example, if the federal carbon tax were set at $50/tonne, a province with a $10/tonne tax rate would retain $10/tonne of the revenues, while a province with a $25/tonne tax would retain $25/tonne.

- Some business organizations prefer the price certainty that is provided by a tax to the fluctuating prices of a cap-and-trade system.

"Standing down" up to 50% of the federal carbon tax in provinces where the provincial government implements its own pricing policy on the same emissions (such that the total tax does not fall below the default federal rate) would:

- prevent an unmanageably high price on emissions in provinces that have their own carbon tax (this is especially important for provinces that have implemented carbon tax policies in advance of the federal government)
- preserve the federal government's ability to lead on climate policy
- take advantage of the federal government's established national tax base and capacity for tax administration, while providing regional flexibility
- create an incentive for all provinces to implement a carbon tax of at least half the default federal rate
- help mitigate net inter-regional financial flows (however, these flows will also depend on the details of the tax cuts proposed to mitigate the competitiveness impacts and regressiveness of the tax, and other components of the GHG reduction plan, notably items 2 and 5–7 below)
- maintain a measure of "polluter pays" applied to regions.

The tax could immediately cover all emissions from combustion of traded fossil fuels (including gasoline, diesel, natural gas, coal, coke, propane, aviation fuel and home heating fuel), which represent approximately 65% of national emissions. It could be expanded quite quickly to cover fuel combustion during fossil fuel production/distribution, which represent about another 7% of national emissions. After the necessary quantification protocols are agreed, the tax could be extended to fugitive emissions from fossil fuel production and distribution (9%), industrial process emissions (7%) and large landfills (4%), to reach a total coverage of 92% of national emissions.[121] It would appear to be administratively challenging to cover the remaining 8% of emissions, which are mostly from agriculture, with a carbon tax.

Whether the current excise tax on gasoline and diesel would be removed when the carbon tax is implemented is a decision that depends on the extent to which the government wishes to secure incremental emission reductions from vehicles, and on whether it has sound justifications for the excise tax that go beyond climate policy.

The carbon tax could be integrated with a cap-and-trade system for some emission sources in a few years' time, if that is judged to be beneficial (for example, to allow Canadian industries to link to cap-and-trade policies in the U.S. and elsewhere). But any future federal cap-and-trade system should auction 100% of allowances, to maximize its equivalence to the tax.

"Offset credits" are credits for emission reductions that take place outside of sectors subject to a cap or a tax on emissions. In order to represent real reductions in emissions, offset credits can be granted only to projects that would not have been implemented without the revenue from credit sales (this is known as the "additionality" or "incrementality" criterion). To meet the

[121] This national total excludes emissions from land use change and forestry.

additionality standard, offset projects must go beyond activities that are required by regulations or are receiving sufficient financial incentives from governments to proceed; granting offset credits for these activities would double count the emission reductions. This means that when governments implement comprehensive and ambitious emission reduction plans, there will be relatively few opportunities to create offset credits.

Once a broad-based tax of the type described here was applied, covering 92% of Canadian emissions, offset credits would not be allowed as a means of reducing exposure to the tax. The reason is there would be very few opportunities to create offsets that meet a strict additionality criterion, and the considerable administrative costs of an offset system would not be justified.

2. GHG Reduction Fund

The government would create a GHG reduction fund (which could be funded by the carbon tax, or from general tax revenues) to "purchase":

- Emission reductions from strategic emission reduction projects, until the carbon tax rate is high enough to make such projects economic without additional support. The fund would pay the difference between the tax rate and the cost per tonne of such projects, selected through a request for proposals process. The scale of the fund should be designed to achieve specific levels of deployment of key technologies.
- Emission reductions/removals in agriculture and forestry that are not covered by the carbon tax.
- Emission reductions in poorer countries (e.g., through the Clean Development Mechanism and its successors, depending on confidence in their environmental performance) in order to meet national targets.

Political feasibility and the avoidance of an economic shock to businesses and individuals likely require that a carbon tax start at a lower level and gradually increase to the higher levels needed over a transition period of a decade or so. But climate science indicates the urgency of initiating larger emission reductions than those expected from a modest initial carbon tax, and key strategic technologies such as CCS only become economic at higher price levels.[122] The price gap could be closed if the government provided targeted funding to bridge the difference between the short-term carbon tax level and the higher emissions price needed to make strategic emission reduction projects economic in the near term.

Substantial fractions of Canada's GHG emissions come from agriculture and forests; it would likely not be practical for the carbon tax to cover these emissions in the near term. There are also opportunities to create or enhance carbon sinks in agriculture and forestry. Therefore, instead of implementing a domestic offset system, this proposal would see the government use a portion of the GHG reduction fund to support emission reductions/removals in agriculture and forestry.

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[122] Based on analysis by the ICO_2N group of companies, the "fast-as-possible," large-scale deployment of CCS in Canada requires the expectation of an effective carbon price of at least $50/tonne in 2012 and at least $70/tonne soon thereafter. ICO_2N, *Carbon Capture and Storage: A Canadian Environmental Superpower Opportunity* (Calgary, AB: ICO_2N Group of Companies, December 2007). Also available online at www.ico2n.com/docs/media/ICO2N Report_Carbon Capture and Storage_A Canadian Environmental Superpower Opportunity.pdf.

Finally, there are strong arguments for developed countries such as Canada to provide funding for emission reductions in developing countries:

- Canada has an obligation to provide this kind of assistance under the UNFCCC.
- GHG reductions have the same environmental benefit wherever they occur.
- The "purchase" of foreign emission reductions is a flexibility mechanism that allows Canada to meet deeper emission reduction targets than can be achieved cost effectively domestically.

A portion of the GHG reduction fund would therefore be reserved for this purpose.

The fund should focus on large-scale projects that respond efficiently to price signals. A robust process (e.g., an independent confidential audit) should be used to obtain credible financial analysis quantifying the emissions price needed to make a proposed project economic. Projects should be selected based on transparent criteria including cost-effectiveness and strategic importance. To provide clarity, envelopes of funding should be reserved for specific technologies (such as low-impact renewable energy) and regions.

3. Federal Regulations

The government would establish and/or regularly update regulations setting energy efficiency standards and/or GHG emission rates in vehicles and the most important energy-using appliances and equipment.

When it runs up against market barriers, a price signal such as a carbon tax — or the proposed GHG reduction fund — can fail to bring about cost-effective energy efficiency improvements (and the consequent emission reductions) by individuals or smaller businesses (see Section E). To overcome these barriers, governments need to complement carbon pricing by regulations or targeted financial incentives. Well-designed regulations should be chosen that effectively overcome market barriers and failures.

Federal legislation enabling the regulation of the energy efficiency of appliances and equipment, and the fuel efficiency of vehicles, is already in place.

4. Negotiation with Other Levels of Government

The federal government would also undertake negotiations with provincial and, in some cases, municipal governments to secure strengthened regulations such as energy-efficient building codes, requirements for transportation demand management and limits to urban sprawl.

As noted above, regulations are needed to overcome market barriers that prevent a price signal such as a carbon tax, or the proposed GHG reduction fund, from bringing about cost-effective GHG reduction actions by individuals or businesses. In cases such as construction and urban development, the ability to regulate falls under provincial (and/or municipal) jurisdiction. The federal government must therefore negotiate with provincial/municipal governments if it aims to ensure the implementation of these regulations.

Federal provision of the financial incentives and investments covered in item 2 and items 5–7 below will likely be part of these negotiations.

5. Targeted Financial Incentives

The federal government would provide targeted financial incentives to stimulate energy-efficiency retrofits to residential buildings, commercial buildings and smaller businesses, and better energy management in smaller businesses. The incentives should be designed to achieve specific levels of market penetration (e.g., x% of buildings retrofitted by year y) and will be complementary to the provincial regulations described above (item 4).

As noted in item 3 above, regulations or targeted financial incentives are needed to overcome market barriers that prevent a price signal such as a carbon tax — or the proposed GHG reduction fund — from bringing about cost-effective GHG reduction actions by individuals or businesses. Examples such as retrofits to buildings and industrial equipment, and better energy management in commercial/industrial operations, are not easily addressed through regulations. But they are important because of the multi-decade lifetime of the capital stock involved. Therefore, targeted financial incentives appear to be the policy mechanism best suited to stimulate these actions. To reduce costs, financial incentives should be designed so as to avoid (to the extent possible) the "free-rider" problem of subsidizing individuals or firms that would have acted anyway.

6. Infrastructure Investments

An effective GHG reduction plan for Canada would also require public investments in emissions-reducing public infrastructure. The scale of investment should be designed to achieve specific objectives.

Public investments are needed in these cases because key parts of our energy system are owned by governments and depend on government investment for improvements leading to GHG reductions. Provincial and municipal governments often require federal government support for such improvements. A price signal such as a carbon tax applied to individuals and businesses cannot be relied upon to stimulate government investment in infrastructure, as the price signal and investment decision are only remotely connected.

7. Technology Investments

The federal government would also invest in the development of GHG reduction technologies. The scale of investment should be designed to achieve specific objectives for key technologies.

A wide range of technologies to achieve deep GHG reductions are available today, but further development is needed to reduce their costs. To a considerable degree such development will be stimulated by businesses' desire to reduce their exposure to a price on emissions (such as a carbon tax) that is clearly expected to increase over time. However, it is broadly understood that governments also need to invest in technology development because of the market failure that arises when a firm cannot be confident that it will retain the benefits of its investment (see Section C).

8. National Target and Reporting

The final element of the proposed federal plan is legislation to (i) set a national target for net GHG emissions in 2020 and (ii) require an independent commission to report annually on the government's progress towards the target and to recommend policy adjustments as needed. Canada's target should be accompanied by a clear demonstration that it represents a fair contribution to the global effort, taking into account our national circumstances.[123]

National targets for GHG emissions are necessary for three primary reasons:

- They are transparent metrics for negotiating each country's contribution to a concerted global effort to cut emissions. Given the urgency of global emission reductions based on climate science, and the fact that benefits of GHG cuts are global while the costs are local, agreement on a concerted international effort is essential to give countries confidence that if they take ambitious action, they will not be disadvantaged relative to others.
- They allow the public to understand their government's declared level of ambition, to compare it to that of other countries, and to hold the government to account for making that ambition a reality.
- They give governments the ability to determine an appropriate level of ambition for individual GHG reduction policies, such as carbon price levels, regulations, financial incentives and investments. Without a national target, there is no clear basis for assessing the adequacy of individual policies, and accountability is thus considerably reduced.

Requiring annual independent public reviews of progress towards national targets is a mechanism that should considerably reduce the temptation for governments to adopt targets but then fail to implement policies capable of achieving them.

For the purposes of holding the government to account and assessing individual policies, the most important dates for national GHG targets fall within the horizon of such policies, i.e., a few years to a decade. This makes the year 2020 a key date for accountability purposes in Canada. The year 2020 is also expected to be a major focus of the current UN negotiations on a post-2012 global climate treaty.

[123] For example, a variety of "burden-sharing" formulae are available in the literature to determine each country's contribution to emission reductions.

Appendix B

Review of Experience of and Research on Greenhouse Gas Reduction Policies in Canada and Internationally

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the PEMBINA institute
Sustainable Energy Solutions

Table of Contents

1. Introduction

This appendix presents descriptions of policies for reducing greenhouse gas (GHG) emissions. The examples chosen are drawn from experience in Canada and in other countries, as well as from relevant economic modelling studies.

The examples presented here cover each of the major policy tools available to governments to reduce emissions. Those tools include:

- regulations and carbon pricing
- voluntary approaches
- financial incentives (other than carbon pricing)
- investments in infrastructure
- improvement of government operations
- indirect GHG reduction policies.

This appendix is not intended to be exhaustive, but rather to provide illustrative examples of the types of policy in question.

In the case of Canadian policies, the examples were selected because they are among the most significant policies in a given category that governments have implemented or committed to implement. Many of the international policies selected represent best practices; others were selected to illustrate the range of policy implementation occurring outside of Canada. Finally, the modelling studies were selected on the basis of their relevance in the Canadian context.

These empirical policy assessments, along with the projections provided by economic modelling, helped to shape the policy conclusions that we reached in the main part of this report.

2. Regulations and Carbon Pricing

Policy Experience in Canada

Carbon Pricing in Canada

A. Federal

On April 26, 2007, the Government of Canada announced a regulatory framework for GHG emissions from heavy industry (including electricity generation) based on reductions in emissions intensity (emissions per unit of production).[1,2] Scheduled to take effect in 2010, the system will set a target in its first year of an 18% improvement in GHG intensity (excluding fixed process emissions) for existing facilities in each sector, relative to 2006 levels, with annual 2% improvements thereafter. Targets for new facilities (beginning operation in 2004 or later) will apply starting in the fourth year of operation, and will be based on a sector-specific "cleaner fuel standard." Facilities can choose from several compliance options to meet their target, including on-site emission reductions, emissions trading with other regulated facilities, purchases of domestic offset credits and limited purchases of international project-based credits created through the Kyoto Protocol's Clean Development Mechanism (CDM).

An additional compliance option allows facilities to pay into a technology fund, consisting mainly of a "deployment and infrastructure" component, to be spent on "investments that have a high likelihood of yielding greenhouse gas emission reductions in the near term." (The government's 2007 overview document cites two specific examples of such projects: a pipeline to facilitate carbon capture and storage (CCS) in Alberta and an east-west electricity grid linking Manitoba to Newfoundland.) The technology fund's "deployment and infrastructure" component can account for up to 70% of a facility's regulatory obligation in 2010, but that cap tightens annually thereafter, falling to 10% by 2017 and to zero from 2018 on. The rate for payments into the technology fund rises from \$15/tonne CO_2e in 2010 to \$20/tonne in 2013, with subsequent annual rate increases tied to the rate of nominal growth in gross domestic product (GDP).

The regulatory framework includes a provision for a review of the approach in 2012.

The Government of Canada presented its regulatory agenda as one component of a national climate strategy that would halt Canada's GHG emissions growth by 2010–2012 and see total

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[1] Environment Canada, *Regulatory Framework for Air Emissions* (Ottawa, ON: Government of Canada, 2007). Also available online at www.ecoaction.gc.ca/news-nouvelles/pdf/20070426-1-eng.pdf.

[2] For a more detailed assessment of the regulatory framework, see Matthew Bramley, *Analysis of the Government of Canada's April 2007 Greenhouse Gas Policy Announcement* (Drayton Valley, AB: The Pembina Institute, 2007). Also available online at climate.pembina.org/pub/1464.

Canadian emissions fall to 20% below the 2006 level by 2020; this is equivalent to a reduction of 3% relative to the 1990 level. The government also proposed a target of a 60–70% reduction in Canada's GHG emissions below the 2006 level by 2050; this represents a reduction of 51–63% relative to the 1990 level.[3]

The federal government published an updated version[4,5] of its regulatory framework in March 2008. The update mostly retains the targets and architecture of the 2007 version, but sets new targets for oil sands operations and coal-fired electricity plants: any facilities that start up in 2012 or later will face intensity targets based on CCS from 2018 onwards. The treatment of oil sands can be considered the litmus test of any policy to limit Canadian industrial emissions because, under business-as-usual conditions, Environment Canada projects that the oil sands sector will account for 44% of the growth in Canada's total GHG emissions between 2006 and 2020: the government projects an increase in oil sands emissions from 29 Mt CO_2e[6] in 2006 to 108 Mt in 2020, using an assumed medium-term oil price of $50/barrel.[7]

CCS is a technological process for trapping carbon dioxide (CO_2) emissions from large industrial facilities, compressing the gas, and then transporting it in a pipeline to a location where it can be stored underground. In theory, the CO_2 storage is permanent. The government's projections show that its timeline for CCS-based targets will allow oil sands companies to nearly triple their emissions between 2006 and 2017 before reducing them sharply in 2018–20. (With its regulations, the government expects oil sands emissions to rise from 29 Mt in 2006 to about 80 Mt in 2017, before dropping to 49 Mt in 2020.)[8]

To be clear, the government's approach does not "require" companies to capture and store carbon; instead, it proposes to set targets that will be "based on" CCS. However, the government has not yet explained in detail how these targets will be set and the emissions they will apply to. Furthermore, the government has calculated that its framework will result in a carbon price of about $65/tonne CO_2e by 2018,[9] but the assumptions underlying this calculation have not been publicly stated. It is plausible that the lack of any limit on the use of offset credits could result in a much lower price on emissions, in which case firms would be expected to meet their targets by buying credits instead of actually implementing CCS. It is therefore difficult to assess whether

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[3] Our recalculation of these targets relative to the 1990 level is based on a 21.8% increase in Canada's emissions between 1990 and 2006. See Environment Canada, *Canada's 2006 Greenhouse Gas Inventory — A Summary of Trends* (Ottawa, ON: Environment Canada, 2008), 2. Also available online at www.ec.gc.ca/pdb/ghg/inventory_report/2006/som-sum_eng.pdf.

[4] Environment Canada, *Turning the Corner: Regulatory Framework for Industrial Greenhouse Gas Emissions*, (Ottawa, ON: Government of Canada, 2008). Also available online at www.ec.gc.ca/doc/virage-corner/2008-03/pdf/541_eng.pdf.

[5] For a fuller assessment of the update to the regulatory framework, see Clare Demerse and Matthew Bramley, *The March 2008 Federal Regulatory Framework for Industrial Greenhouse Gas Emissions* (Drayton Valley, BC: The Pembina Institute, 2008). Also available online at climate.pembina.org/pub/1614.

[6] Megatonnes of carbon dioxide equivalent.

[7] Environment Canada, *Turning the Corner: Detailed Emissions and Economic Modelling* (Ottawa, ON: Government of Canada, 2008), 40–42. Also available online at www.ec.gc.ca/doc/virage-corner/2008-03/pdf/571_eng.pdf.

[8] For detailed references see Demerse and Bramley, 2.

[9] Environment Canada, *Turning the Corner: Detailed Emissions and Economic Modelling*, 7.

the new targets for oil sands operations will effectively curtail GHG pollution from the sector from 2018 onwards.

The updated regulatory framework also confirms a new compliance option for industry that it calls "pre-certified investment credits." These credits are available to companies "for investing directly in large-scale and transformative projects… selected by the firm from a menu set out by the federal government." This option allows companies to meet their targets by setting aside funding for future emission reductions in their own operations. Under the government's 2007 approach, pre-certified investments would have been subject to the same restrictions as payments into the technology fund.[10] But the updated proposal states that for companies investing in CCS projects, "contributions of up to 100% of a firm's regulatory obligation in these pre-certified projects will qualify for credits up to 2018."

For example, consider the application of this compliance option to a new oil sands facility starting up in 2012. The facility first benefits from a three year grace period, which means it has no target until 2015. Then, in 2015–17, the company can meet 100% of its regulatory obligation by promising to start capturing CO_2 in 2018 and by setting some funding aside to do this. The net effect is that new oil sands facilities will be completely sheltered from the GHG price signal if they opt to pre-certify their investments.

New oil sands facilities that do not opt for pre-certified investment credits will also face only limited regulatory obligations until 2018. All new facilities that start up in 2004 or later will benefit from the standard three-year grace period. After that, their targets will be based on a 2% annual improvement from the emissions intensity of the industry-standard fuel, natural gas. An exception will be made for facilities using higher-emitting coke: their targets will be based on a 2% annual improvement from the emissions intensity of coke, as long as they are capable of capturing their emissions in the future. In 2018, the targets for facilities using coke that started up pre-2012 will switch to the natural gas level, but only facilities that started up in 2012 or later will then face targets based on CCS.

Overall, this means that no new oil sands facility is expected to face a target different from its actual planned emissions — apart from the 2% annual improvement starting in the fourth year of operation — before 2018.

The updated regulatory framework also includes a new provision for corporate-level intensity targets in the electricity sector. This means that companies will now be responsible for lowering the intensity of their "entire fleet of facilities," including renewable and nuclear power, instead of lowering the intensity of individual coal- and gas-fired plants only. These corporate-level targets introduce a degree of double-counting that will significantly diminish overall emission reductions from that sector, compared to the April 2007 regulatory framework. This is because emission reductions from government incentive programs and provincial regulations in the electricity sector will no longer add to (go beyond) the reductions from the regulatory framework; instead, the two sets of reductions will now overlap.[11]

[10] Bramley, *Analysis of the Government of Canada's April 2007 Greenhouse Gas Policy Announcement*, 13.

[11] Demerse and Bramley, 4–5.

Policy Assessment: As this policy is not yet in effect,[12] it is not possible to assess it empirically. However, the policy as presented to date raises several concerns. These include its relatively relaxed timeline (notably, the obligations for new oil sands facilities are very limited until 2018) and its inclusion of compliance options that significantly weaken or delay the carbon price signal, and/or make it highly uncertain.

B. British Columbia

In April 2007, British Columbia joined the Western Climate Initiative (WCI).[13] This alliance, which currently includes seven U.S. states and four Canadian provinces as full members, was established to develop "a design for a regional market-based multi-sector mechanism, such as a load-based cap-and-trade program," based on an overal regional goal for GHG emission reductions.[14]

The initiative's member jurisdictions have agreed to a regional GHG emission reduction goal of 15% below the 2005 level by 2020.[15] This goal is an aggregation of the economy-wide goals set in member jurisdictions and thus does not modify British Columbia's own goal of a 33% reduction below 2007 emission levels by 2020. The WCI's final cap-and-trade design recommendations, endorsed by senior officials from each state and province, were published in September 2008. They include:[16]

- A start date of 2012 for a cap on emissions from large industrial sources (including electricity generators) emitting over 25 kilotonnes CO_2e per year, with most other fuel combustion emissions (including those from gasoline and diesel vehicles, and buildings) being covered from 2015 on.
- An initial cap in 2012 "set at the best estimate of expected actual emissions" in that year for covered emissions sources, and a cap for 2020 "set so that reductions achieved by the cap plus reductions from other GHG reduction policies for uncapped sources will achieve the WCI regional 2020 goal."
- Three three-year compliance periods from 2012 to 2020 inclusive, with caps for all three periods set before 2012.
- Auctioning of at least 10% of allowances in the first compliance period, increasing to at least 25% by 2020.

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[12] The government's commitment to implement this regulatory framework based on emissions intensity targets is confirmed in the 2008 Conservative election platform. However, the platform also makes a new commitment to "work with the provinces and territories and our NAFTA trading partners in the United States and Mexico, at both the national and state levels, to develop and implement a North America-wide cap-and-trade system for greenhouse gases and air pollution, with implementation to occur between 2012 and 2015." In the absence of further information, these two commitments appear to be incompatible, because the proposed framework based on intensity targets is not a true cap-and-trade system, and it is due to last until 2020 at the earliest.

[13] Office of the Premier, "B.C. Joins Western Regional Climate Action Initiative," news release, April 24, 2007. Also available online at www2.news.gov.bc.ca/news_releases_2005-2009/2007OTP0053-000509.htm.

[14] See WCI, *Western Regional Climate Action Initiative*, www.westernclimateinitiative.org/ewebeditpro/items/O104F12775.pdf.

[15] See WCI, *Western Climate Initiative Statement of Regional Goal*, www.westernclimateinitiative.org/ewebeditpro/items/O104F13006.pdf.

[16] See WCI, *Design Recommendations for the WCI Regional Cap-and-Trade Program*, www.westernclimateinitiative.org/ewebeditpro/items/O104F19866.PDF.

- A "rigorous" offsets system, including a limit on the use of offset credits (plus allowances from other, non-WCI cap-and-trade systems) "to no more than 49% of the total emission reductions from 2012–2020."

As a complement to its involvement with the WCI, the Government of British Columbia obtained royal assent to its *Greenhouse Gas Reduction (Cap-and-Trade) Act* in May 2008.[17] This enabling legislation sets the legal framework for an eventual cap-and-trade system in British Columbia; the key details of target setting, compliance options and permit allocation are left to future regulations.

BC's government deepened its involvement with carbon pricing in its February 2008 budget, which included a revenue-neutral carbon tax that took effect in July 2008.[18] BC's tax, which is levied on GHG emissions from the burning of fossil fuels, is applied and collected at the wholesale level in a manner similar to the collection of existing motor fuel taxes. The tax starts at a rate of $10/tonne CO_2e in 2008 and rises in annual $5 increments to reach $30/tonne in 2012. The government has pledged to make the tax fully revenue neutral, and will implement this commitment through a legislated requirement that each year's budget must include a three-year plan for recycling the carbon tax back to individuals and corporations through tax cuts. (The initial three year plan shows a total of $1.1 billion in personal income tax cuts, including a low income tax credit, and $670 million in corporate income tax cuts to recycle a projected total of $1.8 billion in carbon tax revenue.) Because it covers all fossil fuels (i) purchased for use in BC and (ii) those used by fuel importers or fuel producers, the "carbon tax base" includes about 70% of British Columbia's total current GHG emissions.

The government estimates that a $30/tonne tax would add $105 annually to the cost of heating an average home with standard efficiency gas, and a $10/tonne tax would increase the cost of driving a Honda Civic by about $33/year. A projection of the tax's impact by M.K. Jaccard and Associates included in the budget concluded that the tax could reduce BC's annual GHG emissions in 2020 by up to 3 Mt CO_2e.

Policy Assessment: As British Columbia's tax has only recently taken effect and its cap-and-trade system is still being designed, it is not possible to assess them empirically. However, the province's actions to date clearly establish it as Canada's leading participant in carbon pricing initiatives. Because it is still being developed, the effectiveness of the WCI's cap-and-trade system remains to be determined. However, the relatively late start date (2012) and the setting of the intial cap at a business-as-usual level add up to a substantial delay in reducing emissions.

C. Alberta

The Government of Alberta announced its own regulatory framework for industrial GHG emissions in March 2007. Under the province's Specified Gas Emitters Regulation,[19] all

[17] The act is available online at www.leg.bc.ca/38th4th/3rd_read/gov18-3.htm.

[18] British Columbia Ministry of Finance, *Budget and Fiscal Plan: 2008/09–2010/11* (Victoria, BC: Ministry of Finance, 2008), 7–20. Also available online at www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf.

[19] The regulation is available online at www3.gov.ab.ca/env/air/pubs/Specified_Gas_Emitters_Regulation.pdf. Alberta has developed a number of offset quantification protocols, which are available online at environment.alberta.ca/1238.html. Some analysts have questioned the stringency of Alberta's application of the "additionality" criterion in these protocols (i.e., their ability to exclude business-as-usual emission reductions).

established facilities with annual GHG emissions of at least 0.1 Mt have been required, since July 1, 2007, to meet targets to limit their GHG intensity to 12% below the average level for 2003–05. "New" facilities — those beginning operation in 1999 or later — are exempt for their first three years of operation and then face targets that gradually increase to reach, in the ninth year of operation, 12% below the intensity measured in the third year. In addition to on-site emission reductions, firms can meet their targets by making payments at a rate of $15/tonne CO_2e into a Climate Change and Emissions Management Fund ("technology fund") or by purchasing offset credits from projects undertaken in Alberta. Because there is no limit on the use of the technology fund as a compliance option, emitters can treat it as a $15/tonne tax on emissions above the regulated target.

Prior to the regulation of industrial GHG emissions, Alberta implemented a limited carbon pricing policy through an offsetting requirement for new coal-fired electricity generation written into Energy and Utilities Board facility approvals. This "clean as gas" standard required all new coal-fired facilities to offset GHG emissions down to the level of a natural gas combined-cycle facility. According to Alberta's government, this standard represents a 53–63% reduction in net GHG emissions from these facilities.[20] At present, it appears that the "clean as gas" standard will likely continue to apply in cases where it was written into facility approvals. However, new facilities will not be subject to the standard as it has been superseded by the 2007 regulation.

Alberta's overall GHG targets, published in its January 2008 climate strategy,[21] would allow provincial emissions to continue to grow for over a decade. The province plans to stabilize emissions in 2020 and then reduce them to 14% below the 2005 level by 2050. Alberta's strategy to reach those goals focuses on energy efficiency, CCS, and cleaner energy production, but does not detail the government policies that will be needed to ensure those technologies are deployed to the necessary extent.

In July 2008, the Government of Alberta announced a commitment of $2 billion for the deployment of CCS, along with a $2 billion investment in public transit.[22] To allocate the CCS funding, the province issued a request for expressions of interest "to begin identifying those CCS proposals with the greatest potential of being built quickly and those which provide the best opportunities to significantly reduce greenhouse gas emissions." Alberta estimates that the three-to-five projects it will contribute to could reduce CO_2 emissions by up to 5 Mt annually by 2015. By way of context, Environment Canada projects that under business-as-usual conditions, oil sands emissions will reach 92 Mt per year in 2015.[23]

Policy Assessment: Because of the compliance options available to emitters, particularly the technology fund, Alberta's baseline-and-credit system creates an effective price cap of

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[20] Alberta Environment, *Albertans and Climate Change: Taking Action* (Edmonton, AB: Government of Alberta, 2002), 18. Also available online at environment.gov.ab.ca/info/library/6123.pdf.

[21] Alberta Environment, *Alberta's 2008 Climate Change Strategy* (Edmonton, AB: Government of Alberta, January 2008). Also available online at environment.gov.ab.ca/info/library/7894.pdf.

[22] Government of Alberta, "Alberta surges ahead with climate action plan," news release, July 8, 2008. Also available online at alberta.ca/home/NewsFrame.cfm?ReleaseID=/acn/200807/23960039FB54D-CC21-7234-31C3E853089A1E6C.html.

[23] Environment Canada, *Canada's Energy and GHG Emissions Projections,* (Ottawa, ON: Government of Canada, 2008). Also available online at www.ec.gc.ca/doc/virage-corner/2008-03/pdf/nat_eng.pdf.

$15/tonne. This price is widely acknowledged to be far too low to drive the implementation of CCS, likely the major technology needed to stop the growth in emissions in the oil sands. As such, Alberta's regulatory policy (unless it is strengthened or supplemented with complementary policies) is virtually guaranteed to fail the test of environmental effectiveness.

D. Manitoba

Like BC, Manitoba has joined the WCI. Manitoba has not yet set a target for provincial emissions in 2020, but did submit its 2012 target of 6% below the 1990 level as input into the WCI's aggregate regional emission goal.[24]

Policy Assessment: Because it is still being developed, the effectiveness of the WCI's cap-and-trade system remains to be determined. However, as noted above, there will be a substantial delay in reducing emissions under the WCI's system.

E. Ontario

In July 2008, Ontario joined the WCI as a full partner (the province had previously held observer status with the WCI).[25] Along with BC, Manitoba and Québec, Ontario's decision brought almost 80% of Canada's population into the California-led cap-and-trade system that will impose an absolute cap on GHG emissions.

Ontario had signalled its interest in cap-and-trade systems as early as March 2007, when Premier Dalton McGuinty expressed interest in both the WCI and the Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade system covering emissions from fossil-fuel-fired electricity in the northeastern U.S.[26] The government's news release noted that "Ontario supports the absolute emission targets that define both the Western Initiative and RGGI."

In June 2008, Ontario signed a Memorandum of Understanding (MoU) with Québec to work co-operatively "on the design and implementation of a joint regional market-based multi-sector greenhouse gas cap and trade system, based on real reductions that could be implemented as early as January 1, 2010."[27] The MoU also agreed to recognize early action by using the "internationally accepted base year of 1990," and to link with other North American and international emissions trading systems when possible. In its preamble, the agreement notes that "reliance on intensity-based targets does not provide for sufficient certainty of real reductions in greenhouse gas emissions."

Policy Assessment: Because it is still being developed, the effectiveness of the WCI's cap-and-trade system remains to be determined. However, as noted above, there will be a substantial

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[24] See WCI, *Western Climate Initiative Statement of Regional Goal.*

[25] Government of Ontario, "Ontario to Join Climate Change Leaders: McGuinty Government Unites With Provinces, States Tackling Climate Change," news release, July 18, 2008. Also available online at www.premier.gov.on.ca/news/Product.asp?ProductID=2363.

[26] Government of Ontario, "Ontario to Explore Joining Forces with U.S. States on Climate Change Initiative," news release, March 30, 2007. Also available online at ww.ene.gov.on.ca/en/news/2007/033001.php.

[27] *Memorandum of Understanding Between the Government of Ontario and the Government of Québec Concerning a Provincial-Territorial Cap and Trade Initiative,* www.premier-ministre.gouv.qc.ca/salle-de-presse/communiques/2008/juin/entente-chang-climatiques-en.pdf.

delay in reducing emissions under the WCI's system. The relationship between the WCI and the MoU that Ontario signed with Québec is not yet clear, but it appears possible that the provinces will consider the commitments made in their MoU to be entirely fulfilled by Ontario's decision to join the WCI.

F. Québec

Under its 2006–2012 climate plan,[28] the province of Québec has instituted a modest tax on CO_2 emissions from fuel use as a means of raising revenue for its GHG reduction activities. The tax, which took effect on October 1, 2007, applies to Québec's fossil fuel distributors and applies to all fossil fuels sold in the province, including imports. According to the provincial government, this carbon tax was the first of its kind in North America when it was announced.[29]

Québec's carbon tax rate will be set annually by dividing the budget of the Green Fund — an entity created to finance the suite of GHG reduction, adaptation and education initiatives in Québec's plan — by the province's CO_2 emissions from fossil fuel use.[30] Québec will use the tax to raise $1.2 billion, at a rate of $200 million/year, between 2006 and 2012 (the end date of Québec's Kyoto-based plan).[31]

When calculated using 2006 emission levels, the tax level would be approximately $3.50/tonne.[32] Québec's plan does not attribute any GHG emissions reductions to the direct effect of the tax on consumption, but expects $1.2 billion of expenditure by the Green Fund, combined with $350 million in federal funding and a number of regulatory initiatives, to reduce the province's annual GHG emissions by 14.6 Mt relative to the business-as-usual level in 2012, to reach a "Kyoto-level" target of 6% below 1990 emission levels by 2012[33] (Canada's Kyoto Protocol target covers the average emissions of the 2008–2012 period, not just 2012).

In April 2008, Québec joined British Columbia and Manitoba as a full "partner" in the WCI system.[34] As noted above, Ontario has subsequently joined the WCI and also signed an MoU

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[28] Ministère du Développement durable, Environnement et Parcs, *Le Québec et les changements climatiques : Un défi pour l'avenir* (Québec, QC: Gouvernement du Québec, 2008). Also available online at www.mddep.gouv.qc.ca/changements/plan_action/2006-2012_fr.pdf.

[29] Ministère du Développement durable, Environnement et Parcs, *Bilan de la deuxième année de mise en œuvre du plan d'action 2006–2012 sur les changements climatiques* (Québec, QC: Gouvernement du Québec, 2006), 5. Also available online at www.mddep.gouv.qc.ca/changements/plan_action/bilan2.pdf. British Columbia implemented a more aggressive carbon tax in 2008.

[30] *Règlement relatif à la redevance annuelle au Fonds vert*, available online at www.regie-energie.qc.ca/regie/Decrets/Decret_1049-2007_nov07.pdf.

[31] *Décret 407-2007*, available online at www.regie-energie.qc.ca/regie/Decrets/Decret_407-2007_6juin07.pdf.

[32] This is based on dividing the annual Green Fund budget of $200 million by Québec's 2006 energy-related CO_2 emissions (56.8 Mt), as stated in Environment Canada, *National Inventory Report 1990–2006* (Gatineau, QC: Environment Canada, 2008), 570.

[33] Ministère du Développement durable, Environnement et Parcs, *Le Québec et les changements climatiques : Un défi pour l'avenir*, 33, 46–47.

[34] Gouvernement du Québec, "Lutte contre les changements climatiques — Québec se joint à la Western Climate Initiative (WCI)," news release, April 18, 2008. Also available online at communiques.gouv.qc.ca/gouvqc/communiques/GPQF/Avril2008/18/c7137.html.

with Québec to work co-operatively on the design and implementation of a cap-and-trade system to take effect as early as 2010.

Policy Assessment: The effectiveness of Québec's carbon tax is limited by design, as the government conceives of it solely as a means to raise revenue rather than a spur to emission reductions. It is too early to assess the environmental effectiveness of the investments made with the tax revenue. Because it is still being developed, the effectiveness of the WCI's cap-and-trade system remains to be determined. However, as noted above, there will be a substantial delay in reducing emissions under the WCI's system. Also as noted above, the relationship between the WCI and the MoU that Ontario signed with Québec is not yet clear.

Vehicle Fuel Efficiency Regulations in Canada

In January 2008 Canada's Minister of Transport, Infrastructure and Communities announced consultations on the development of national fuel consumption regulations for new cars and light trucks, beginning with the 2011 model year.[35] The Government of Canada had previously confirmed its commitment to mandatory fuel efficiency standards in April 2007 with the release of its *Regulatory Framework for Air Emissions*, which stated that the fuel efficiency standards will be "designed for Canada to maximize our environmental and economic benefits and will be benchmarked against a stringent, dominant North American standard."[36] There are two major North American standards that the Government of Canada could draw on for this benchmarking exercise: the U.S. federal Corporate Average Fuel Economy (CAFE) standards and the tailpipe GHG emissions standards adopted by California (see Section 2).

In a North American context, the superior environmental stringency of California's standards relative to their federal counterpart is essentially indisputable, although California's are not among the world's leading standards.[37] A recent comparison of the cumulative GHG emission reductions in Canada resulting from the U.S. federal standards and the California standards found the following levels of cumulative GHGs reduced (expressed in Mt CO_2e):[38]

	Federal	California
By 2016	12	29
By 2020	44	87

[35] Transport Canada, "Canada's First Motor Vehicle Fuel Consumption Regulations: Consultations Begin," news release, January 17, 2008. Also available online at www.tc.gc.ca/mediaroom/releases/nat/2008/08-h006e.htm.

[36] Environment Canada, *Regulatory Framework for Air Emissions*, 29.

[37] Transport Canada, *Background Paper for the Development of Motor Vehicle Fuel Consumption Regulations* (Ottawa, ON: Government of Canada, 2008), 20. Also available online at www.tc.gc.ca/pol/en/environment/FuelConsumption//pdf/BackgroundPaper.pdf.

[38] California Air Resources Board, *Comparison of Greenhouse Gas Reductions for the United States and Canada Under U.S. CAFE Standards and California Air Resources Board Greenhouse Gas Regulations* (Sacramento, CA: California Air Resources Board, 2008), Table 18. Also available online at www.arb.ca.gov/cc/ccms/reports/pavleycafe_reportfeb25_08.pdf. Although the baseline for GHG reductions is not stated, it appears to be projected business-as-usual emissions.

By both 2016 and 2020, California's standards produce roughly twice the GHG reductions that the U.S. federal standards do.

To date, five Canadian provinces — British Columbia, Manitoba, New Brunswick, Nova Scotia and Québec — have publicly committed to adopt standards of comparable stringency to California's standards,[39] as have 15 other U.S. states. In a letter sent to other WCI premiers and governors in July 2008, Ontario also signaled a greater openness to California's standards than it has in the past, although the province has not adopted them.[40]

Policy Assessment: Because neither the federal nor provincial fuel efficiency standards are in place, it is not possible to offer an empirical assessment. Based on emission projections, California's standards will produce a more environmentally effective result. In addition, a federal decision to "level up" to the California standards may be the only way for the federal government to preserve the environmental benefit of the California-level standards that British Columbia, Manitoba, New Brunswick, Nova Scotia and Québec have committed to. That's because the competitor standards, those created by the U.S. *Energy Independence and Security Act,* are based on a national fleet average. If Canada were to adopt national fleet average standards set at similar levels to the U.S. federal standards, the presence of more efficient fleets in the four "California" provinces would allow other provinces' fleets to fall below even the less stringent national average level.

Low-Carbon Fuel Standards

In January 2007, California Governor Arnold Schwarzenegger signed Executive Order S-01-07, which committed to establish a low-carbon fuel standard (LCFS).[41] The order sets a statewide goal of reducing the carbon intensity of California's transportation fuels by at least 10% by 2020. This "niche market regulation" will apply to refiners, blenders, producers or importers of transportation fuels in California, will be measured on a full fuels cycle basis, and may be met through market-based methods. A number of California government agencies and expert advisers are charged with determining the application and implementation of this standard, which is slated to come into effect in 2010.[42]

In May 2007, the premiers of Ontario[43] and British Columbia[44] both signed agreements with Governor Schwarzenegger to adopt California's LCFS policy in their jurisdictions. The BC

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[39] Dale Marshall, *Provincial Power Play: Breaking Away from Federal Inaction on Climate Change* (Vancouver, BC: David Suzuki Foundation, 2008), 13. Also available online at www.davidsuzuki.org/files/DSF_ProvincialPowerPlay_Web.pdf.

[40] Premier McGuinty wrote: "We recognize the rights and commend the efforts of California, other U.S. states and Canadian provinces to adopt California's rigorous greenhouse gas vehicle standards." This quote is from Karen Howlett and Greg Keenan, "Deal lets Ontario join climate-change drive," *Globe and Mail*, August 4, 2008.

[41] The executive order is available online at gov.ca.gov/executive-order/5172/.

[42] See, for example, the University of California, "UC experts detail new standard for cleaner transportation fuels," news release, August 2 2007. Also available online at www.energy.ca.gov/low_carbon_fuel_standard/2007-08-02_UC-NEWS_RELEASE.PDF.

[43] Office of the Governor, "Ontario to adopt low carbon fuel standard," fact sheet, May 31, 2007. Also available online at gov.ca.gov/index.php?/fact-sheet/6505/.

government recently obtained royal assent to the *Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act*, a piece of enabling legislation that lays the legal framework for a future LCFS regulation.[45]

Policy Assessment: Because it is still being developed, the effectiveness of the LCFS policy remains to be determined. However, analysts have raised questions about the anticipated challenges of accurately determining the upstream emissions associated with transportation fuels, and about the overlap between a LCFS and a future cap-and-trade system, such as the one being developed by the WCI.

Policy Experience Internationally

European Union Emissions Trading Scheme[46]

The European Union Emissions Trading Scheme (EU ETS) came into force on January 1, 2005. It is now the world's largest GHG emissions trading system, with US $50 billion worth of trades in 2007.[47] The ETS is a central component of the EU's strategy for meeting its obligations under the Kyoto Protocol, which require total GHG emissions from the first 15 EU member states to be reduced to 8% below the 1990 level during 2008–12 (Kyoto targets for some of the more recent member states are slightly different).

Phase I of the ETS operated from 2005–7; phase II is running from 2008–12, and phase III will start in 2013. Key features of phases I and II include the following:

- Targets for absolute CO_2 emissions apply to all combustion facilities with a rated input over 20 megawatts (MW); oil refineries, coke ovens, metal ore roasting or sintering operations and pulp mills; and, with size thresholds, facilities for the production of iron and steel, cement, lime, glass, ceramics, paper and board. Some 10,500 facilities across the 27 member states are covered, accounting for around 50% of the EU's total CO_2 emissions or about 40% of its GHG emissions.[48] The aviation sector (all flights taking off or landing in the EU) will be added in 2012.[49] The European Commission has also said it will propose emissions trading legislation for marine transportation if the International Maritime Organization fails to establish its own system.[50]

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[44] Office of the Governor, "British Columbia to adopt low carbon fuel standard," fact sheet, May 31, 2007. Also available online at gov.ca.gov/index.php?/fact-sheet/6504/.

[45] The act is available online at www.leg.bc.ca/38th4th/3rd_read/gov16-3.htm.

[46] All official documents describing the EU ETS are available online at ec.europa.eu/environment/climat/emission/index_en.htm.

[47] Karan Kapoor and Philippe Ambrosi, *State and Trends of the Carbon Market 2008* (Washington, D.C.: The World Bank, 2008), 1. Also available online at carbonfinance.org/docs/State___Trends--formatted_06_May_10pm.pdf.

[48] European Commission, *EU Action Against Climate Change — EU emissions trading: an open system promoting global innovation* (Brussels, Belgium: European Commission, 2007). Also available online at ec.europa.eu/environment/climat/pdf/bali/eu_action.pdf.

[49] "Controversial EU ETS aviation extension passes Parliament," *Carbon Finance*, July 21, 2008, www.carbon-financeonline.com/index.cfm?section=lead&action=view&id=11388 (accessed October 21, 2008).

[50] "European Parliament calls for shipping emissions rules," *Carbon Finance*, April 30, 2008, www.carbon-financeonline.com/index.cfm?section=europe&action=view&id=11210 (accessed October 21, 2008).

- National governments are responsible for setting targets for each facility (in the form of tradeable "EU allowances" provided free of charge) through a "national allocation plan" (NAP). The NAPs for phase I were overly generous: in May 2006, the European Commission released verified emissions data showing that companies had emitted 44 Mt CO_2 *less* than the number of allowances allocated for the first year of the scheme.[51] This problem was at least in part a consequence of member states not possessing verified emissions data on which to base phase I allocations.
- The NAPs for phase II add up to a 6.5% reduction in average annual emissions below the verified 2005 level.[52] Robust allowance prices in phase II confirm that the over-allocation of phase I has not been repeated. In late October 2008, the price of EU allowances is around €21 ($34) per tonne CO_2.[53]
- Companies can meet their targets by making in-house emission reductions, purchasing excess allowances from companies that have surpassed their targets, or by purchasing limited amounts of the international credits issued under the Kyoto Protocol's CDM and Joint Implementation (JI) mechanisms.
- Member states were allowed to auction up to 5% of the total supply of allowances in phase I and up to 10% in phase II.
- There is no price ceiling on the cost of compliance; the penalty for non-compliance was €40 ($64) per tonne CO_2 in phase I and is €100 ($159) per tonne in phase II. Payment of the penalty does not excuse a firm from acquiring the requisite number of allowances.

The European Commission has proposed major changes to the ETS for Phase III (2013–20).[54] To become law they must be approved by the EU Council and the European Parliament. Key proposed changes include the following:

- Coverage would be expanded to include, notably, CO_2 emissions from the production of petrochemicals, ammonia and aluminum; nitrous oxide emissions from adipic acid production; and perfluorocarbon emissions from the aluminum sector.
- The total emissions cap and the allocation of allowances would be determined at the EU level instead of through the NAPs used in phases I and II. The cap would decrease linearly to at least 21% below the 2005 level in 2020.
- In the electricity sector, 100% of allowances would be auctioned starting in 2013. In all other sectors, 80% of allowances would be allocated free of charge in 2013, with the percentage of auctioning increasing linearly to reach 100% by 2020.

[51] "Slow collapse seen for EU allowance prices," *Carbon Finance*, June 1, 2006, www.carbon-financeonline.com/index.cfm?section=lead&action=view&id=1030 (accessed October 21, 2008).

[52] European Commission, *Proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community* (Brussels, Belgium: European Commission, 2008). Also available online at ec.europa.eu/environment/climat/emission/pdf/com_2008_16_en.pdf.

[53] Market data is available at www.europeanclimateexchange.com.

[54] European Commission, *Proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC.*

- 90% of the allowances to be auctioned would be distributed to member states in proportion to their 2005 emissions. The remaining 10% would be distributed to the less wealthy member states. At least 20% of the proceeds from the auctioning of allowances would be reserved for funding climate-related policies.
- Specific allocation rules would depend on a review by the Commission of potential carbon leakage from the EU's energy-intensive industries. The review, to be completed by June 2011 at the latest, will take into account the outcome of negotiations on a post-2012 global climate agreement. Options to be considered for sectors where carbon leakage is found to be a significant risk include 100% free allocation of allowances for affected sectors and a "carbon equalization system" (for example, requiring importers of carbon-intensive goods to acquire EU allowances).
- Domestic offset credits from projects not covered by the ETS would be allowed as a new compliance option.

Policy Assessment: Phase I of the EU ETS resulted in a 2% increase in CO_2 emissions from covered facilities between 2005 and 2007.[55] Despite this disappointing start, the EU and its member states have become the world's leading practitioners of cap-and-trade for GHG emissions. In Phase II (2008–12), net emissions will be reduced by 6.5% below the 2005 level, although actual physical emissions will be higher because of firms' use of CDM and JI credits. Phase II allowance prices in excess of $30/tonne CO_2 should be high enough to spur significant deployment of technologies to reduce GHG emissions. The proposed caps in phase III (2013–20) represent steep emission reductions, and the proposed broader coverage and transition to 100% auctioning of allowances should further strengthen the ETS after 2012.

Clean Development Mechanism

The CDM is one of three emissions trading mechanisms established under the Kyoto Protocol, and it is the only one that involves trading between industrialized and developing countries. It has two complementary objectives: to help developing countries achieve sustainable development and to provide cost-effective emissions reductions for industrialized countries.[56] CDM credits are granted to qualifying GHG emission-reduction projects in developing countries, and the credits are purchased by private firms or governments in industrialized countries for use in meeting those countries' Kyoto Protocol emissions targets. CDM credits are therefore a type of offset credits, and the CDM is currently the world's largest GHG offset market by far.

In late October 2008, 1,186 CDM projects in developing countries have been registered; these projects are expected to generate 1.3 billion credits (each representing one tonne CO_2e) by the end of 2012, of which 200 million have already been issued; as many as 2.7 billion credits in total could be generated by the end of 2012 if all projects in the CDM "pipeline" are registered.[57]

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[55] European Commission, "Emission trading: 2007 verified emissions from EU ETS businesses," news release, May 23, 2008. Also available online at europa.eu/rapid/pressReleasesAction.do?reference=IP/08/787&format=HTML&aged=0&language=EN&guiLanguage=en.

[56] Kyoto Protocol, article 12.2.

[57] UNFCCC, *CDM Statistics*, UNFCCC, cdm.unfccc.int/Statistics/index.html (accessed October 21, 2008).

In 2007, there were close to US $13 billion worth of trades of CDM credits;[58] about 90% of credit purchases were made by European buyers, mostly private firms involved in the EU ETS, and about 10% were made by Japanese buyers, including the Japanese government.[59]

China accounts for over half of total CDM credits in the pipeline and three-quarters of the volume of credits supplied in 2007.[60] Different types of projects' shares of the CDM credits supplied in 2007 were as follows:[61]

- energy efficiency and fuel switching: 40%
- hydropower: 12%
- nitrous oxide abatement: 9%
- destruction of HFCs (hydrofluorocarbons): 8%
- wind power: 7%
- biomass energy : 5%
- landfill gas capture: 5%
- coal mine methane capture: 5%
- waste management: 4%
- fugitive emissions reduction: 3%
- agro-forestry: 0.1%.

The price of CDM credits varies according to the type of project and the financing arrangement reached by the developer/broker. In late October 2008, the quoted market price is around €18 ($29), a little less than the price of EU allowances.[62]

Policy Assessment: The CDM has been very successful in creating a global market for GHG emission reductions, in effect extending a carbon price throughout much of the world. The CDM has increased awareness of clean technologies, emissions reduction and emissions trading in both the private and public sectors in some developing countries. However, numerous critics have raised questions about the "additionality" of CDM credits, suggesting that a significant proportion of the associated emission reductions would have occurred even in the absence of the CDM's funding[63] — despite the existence of relatively strict rules designed to ensure additionality. It has been estimated that the additionality of up to 40% of CDM projects registered by mid-2007 is "unlikely or questionable."[64] If this is true, then the environmental

[58] Kapoor and Ambrosi, 1.

[59] Ibid., 23.

[60] Ibid., 26–27.

[61] Ibid., 29.

[62] Market data is available at www.europeanclimateexchange.com.

[63] For a recent summary of such critiques, see Lori Pottinger, *Bad Deal for the Planet* (Berkley, CA: International Rivers, 2008), 6–9. Also available online at www.internationalrivers.org/files/DRP2English2008-521_0.pdf. See also Michael Wara and David Victor, *A Realistic Policy on International Carbon Offsets* (Stanford, CA: Program on Energy and Sustainable Development, Stanford University, 2008). Also available online at iis-db.stanford.edu/pubs/22157/WP74_final_final.pdf.

[64] Lambert Schneider. *Is the CDM fulfilling its environmental and sustainable development objectives? An evaluation of the CDM and options for improvement* (Berlin, Germany; Öko-Institut, 2007), 44. Also available online at www.oeko.de/oekodoc/622/2007-162-en.pdf.

effectiveness of policies that recognize CDM credits for purposes of compliance (notably, the Kyoto Protocol and the EU ETS) is seriously compromised. The CDM is also widely considered to have been less than successful in achieving the local sustainable development benefits that are part of its mandate.

Sweden's Carbon Tax[65]

Sweden introduced a tax on CO_2 emissions in 1991, at the same time as a reduction in existing energy taxes. The carbon tax rate is currently SEK 0.365/kg CO_2 ($58/tonne). Industry is only obliged to pay 50% of the tax, and electricity generation is exempt. Not only do the carbon tax rates differ for industry and consumers, but non-industrial consumers pay an additional, separate energy tax from which both industry and electricity generation are exempt. Since renewable fuels are not taxed, the carbon tax has led to a significant increase in the use of biomass for district heating and in industry. In 2007 Sweden granted exemptions from its carbon tax to industrial facilities covered by the EU ETS.[66]

The Ministry of Environment estimated in 1997 that by 2000 the higher tax rate would have reduced CO_2 emissions by 20–25% below their projected level if the 1990 tax regime had been maintained.

Policy Assessment: According to a 1995 study by the Swedish Ministry of the Environment and Natural Resources, the carbon tax influenced energy consumption patterns. Some plant owners who switched from fuel oil to biofuels said that the carbon tax was a decisive factor in their switch. In the six months after the carbon tax was reduced for industry in 1993, heavy fuel oil consumption rose by about 20% compared to the same period of the previous year. The preferential rate for industry also led some facilities to sell their bio-based byproducts to heating plants, which were taxed at the full rate and thus eager to use biofuels.[67]

Boulder, Colorado's "Carbon Tax"[68,69]

The municipal government of Boulder, Colorado made headlines in 2006 when it became the first government in the U.S. to adopt a "carbon tax." The Climate Action Plan Tax is actually a tax on residential and business use of electricity, most of which in Boulder is generated from coal. However, the tax revenues are used to fund the city's Climate Action Plan, which focuses

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[65] Bengt Johansson, *Economic Instruments in Practice 1: Carbon Tax in Sweden*, OECD, www.oecd.org/dataoecd/25/0/2108273.pdf (accessed October 21, 2008).

[66] International Energy Agency (IEA), *Energy Tax Exemption for EU ETS Installations*, IEA, www.iea.org/textbase/pm/?mode=weo&id=3545&action=detail (accessed October 21, 2008).

[67] Robert Anderson and Andrew Lohof, *The United States Experience with Economic Incentives in Environmental Pollution Control Policy* (Washington, DC: Environmental Law Institute, 1997), 11-27. Also available online at yosemite.epa.gov/ee/epa/eermfile.nsf/vwAN/EE-0216a-4.pdf/$File/EE-0216a-4.pdf.

[68] City of Boulder, Colorado, "Boulder voters pass first energy tax in the nation," news release, November 8, 2006. Also available online at www.ci.boulder.co.us/index.php?option=com_content&task=view&id=6136&Itemid=169.

[69] Carolyn Brouillard and Sarah van Pelt, *A Community Takes Charge: Boulder's Carbon Tax*, City of Boulder, Colorado, www.bouldercolorado.gov/files/Environmental%20Affairs/climate%20and%20energy/boulders_carbon_tax.pdf (accessed October 21, 2008).

on energy efficiency, renewable energy and reduced vehicle use. The plan aims to meet a "Kyoto-level" target of reducing GHG emissions to 7% below the 1990 level by 2012.

The "carbon tax" rates are set according to the amount of revenue required to support the Climate Action Plan. Since the plan is expected to cost US $860,000 in 2007 and US $1,342,000 in 2012, the tax rate was initially set to raise US $1,000,000 per year, with different tax rates applied to the residential, commercial and industrial sectors in consideration of the amount each sector will receive in city funds through the Climate Action Plan. Accordingly, for the first year the City Council set rates of US $0.0022 per kilowatt-hour (kWh) for residential customers, US $0.0004 per kWh for commercial customers and US $0.0002 per kWh for industrial customers. The average household will pay $1.33 per month and an average business will pay US $3.80 per month.

Policy Assessment: To the extent that it can be considered a carbon tax, this policy is precedent-setting in the U.S. context. But because of the very low rate of the tax, its environmental effectiveness will hinge on the investments made with the revenue.

Japan's Fuel Efficiency Standards for Passenger and Commercial Vehicles[70,71,72]

In March 1999, the Japanese government enacted a set of mandatory fuel efficiency standards for gasoline and diesel passenger and commercial vehicles. The standards specify average fuel efficiency targets by weight class and use a "top runner" system to establish the target levels. This system sets targets for each vehicle weight category that are benchmarked against the most fuel efficient vehicle currently available on the market in that category.

The standards for gasoline vehicles are to be met by 2010 and represent an improvement of approximately 23% in vehicle efficiency compared to 1995. Diesel passenger vehicles were required to meet their standards by 2005; they improved fuel efficiency by approximately 15% compared to 1995 levels. The financial penalties for non-compliance are considered nominal; the penalty system also includes publicly releasing the name of the company and the product which does not meet the standard. Most Japanese gasoline car models have already met the 2010 standard.

In December 2006, Japan's Ministry of Economy, Trade and Industry, in partnership with the Ministry of Transport, began consultations to increase the stringency of the "top runner" vehicle standards. Since then new requirements have been established that require automakers to improve the average fuel efficiency of passenger cars by 23.5% from 2004 levels by 2015. (This amount of improvement assumes that there will be no change in the model mix as a result of a shift in consumer demand.) The following table shows the new standards for different vehicle classes.

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[70] Energy Conservation Center, Japan, *Passenger vehicles*, Energy Conservation Center, www.eccj.or.jp/top_runner/e_07.html.

[71] Ryo Maeda, *Japan's Fuel Efficiency Standards* (Tokyo, Japan: Ministry of Economy, Trade and Industry, 2007). Also available online at www.jama-english.jp/europe/news/2007/no_3/MrMaeda.pdf.

[72] Steven Plotkin, "European and Japanese fuel economy initiatives: what they are, their prospects for success, their usefulness as a guide for US action," *Energy Policy* 29, no. 3 (2001): 1073–1084.

Vehicle class	2004 (L/100 km)	2015 (L/100 km)	% improvement in fuel economy (2004–2015)
Passenger cars (with a capacity of 10 persons or less)	7.4	6.0	23.5%
Small buses (with a capacity of 11 persons or more, and weighing less than 3.5 tonnes)	12.0	11.2	7.2%
Light cargo trucks	7.4	6.6	12.6%

The new regulation covers all new passenger and small commercial vehicles. The current standards have separate rules for diesel and gasoline vehicles, but these are combined under the new standards. Requirements are set for 16 vehicle weight categories, and the new rules allow manufacturers to earn credit from over-fulfillment of the target in one weight category to compensate for underperformance in any other category. They also modify how fuel efficiency is gauged to include heavy traffic and other driving conditions.

Policy Assessment: Although the penalties for non-compliance are nominal, Japan's fuel efficiency standards remain the toughest in the world, and they are supported by tax incentives for the most efficient cars (see Section 3). The standards set clear timelines and mandatory targets that are benchmarked against the most fuel efficient vehicle in each category. This "top runner" approach ensures constant technological improvements in every category. As opposed to a single fleet average standard, multiple weight-based standards do not guarantee overall emission reductions as they allow for the possibility of a market shift towards larger vehicles. However, Japan has combined its fuel efficiency standards with highly progressive taxes levied on gross vehicle weight and engine displacement.

EU's Proposed CO_2 Emission Standards for Cars

In February 2007 the European Commission announced that it would introduce legislation to regulate average emissions from new cars sold in Europe at 120g CO_2/km (equivalent to 4.5 L/100 km for diesel cars and 5 L/100 km for gasoline cars) by 2012.[73] To meet this standard, automakers would be required to limit emissions from light-duty car engines to 130g CO_2/km, while complementary measures (e.g., improvements to tires and air conditioning systems, reductions in the carbon content of fuels) would contribute a further emissions reduction of up to 10g CO_2/km. For light commercial vans, the fleet average emission targets would be 175g CO_2/km by 2012 and 160g CO_2/km by 2015. The announcement followed automakers' inadequate progress toward meetings the EU's voluntary agreement on emission reductions with the European, Japanese and Korean car manufacturers' associations.

The draft regulation, published in December 2007, defines a curve of permitted CO_2 emissions for new vehicles as a function of vehicles' weight. The curve is set such that a fleet average for

[73] European Commission, *Communication from the Commission to the Council and European Parliament: Results of the review of the Community Strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles* (Brussels, Belgium: European Commission, 2007). Also available online at eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0019:FIN:EN:PDF.

all new cars of 130g CO_2/km is achieved. From 2012, a manufacturer would be required to ensure that the average emissions of all new cars that it manufactures and that are registered in the EU are below the average of the permitted emissions for those cars as given by the curve. The curve is set such that heavier cars will have to improve more than lighter cars compared to today, but manufacturers will still be able to make cars with emissions above the curve provided that these are balanced by cars below the curve.[74]

On September 1, 2008 the European Parliament's Industry Committee voted to delay the standards by three years by making them applicable to only 60% of a manufacturer's fleet in 2012, rising to cover a company's entire fleet by 2015. This proposal will be examined by the Environment Committee. The European Parliament is scheduled to vote on the final legislation at the end of 2008.

According to a 2003 report commissioned by the European Commission, the cost of reducing emissions to 120g CO_2/km would average €577 ($920) per car, but drivers would save an average of €1,000 ($1,600) per car over three years in fuel costs.[75]

Policy Assessment: The failure of the EU's voluntary agreement with car manufacturers has prompted the EU to move to regulate vehicle emissions. The regulatory approach should provide much greater confidence that targets will be met.

U.S. CAFE Standards and California's Tailpipe GHG Emissions Standards[76,77,78,79]

The U.S. federal Corporate Average Fuel Economy standards were introduced in 1975 in response to the 1973–74 Arab oil embargo, with the intention of improving the average fuel economy of cars and light trucks (trucks, vans and sport utility vehicles) sold in the U.S. The *Energy Policy Conservation Act* (1975) established the first CAFE standards by adding Title V, "Improving Automotive Efficiency," to the *Motor Vehicle Information and Cost Savings Act*. The near-term goal was to double new car fuel economy by 1985. Congress gave the National Highway Safety Traffic Administration (NHSTA) authority to adjust the standards, but the standard for cars was not changed after 1990. The standard for light trucks has been slightly tightened over the past few years, but light trucks that weighed over 8,500 lbs — including several popular models of SUV and pickup truck — were completely excluded from CAFE standards until 2006.

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[74] European Commission, *Reducing CO_2 emissions from light-duty vehicles*, European Commission, ec.europa.eu/environment/air/transport/co2/co2_home.htm (accessed October 21, 2008).

[75] European Federation for Transport and Environment (EFTE), *Car Industry Failing on Climate Pledge*, EFTE, www.transportenvironment.org/Article185.html (accessed October 21, 2008).

[76] NHSTA, *CAFE Overview — Frequently Asked Questions*, NHSTA, www.nhtsa.dot.gov/CARS/rules/CAFE/overview.htm (accessed October 21, 2008)

[77] Union of Concerned Scientists (UCS), *Fuel Economy Basics*, UCS, www.ucsusa.org/clean_vehicles/solutions/cleaner_cars_pickups_and_suvs/fuel-economy-basics.html (accessed October 21, 2008)

[78] California Clean Cars Campaign, *California's Vehicle Global Warming Law*, California Clean Cars Campaign, www.calcleancars.org/about.html (accessed October 21, 2008)

[79] Transport Canada, *Background Paper for the Development of Motor Vehicle Fuel Consumption Regulations*.

If the average fuel economy of a manufacturer's annual fleet of car and/or light truck production falls below the defined standard, the manufacturer must pay a penalty, currently US $5.50 per 0.1 mpg over the standard, multiplied by the manufacturer's total production for the domestic market. If they exceed the standard, manufacturers earn CAFE "credits" that can be applied to any three consecutive model years immediately prior to or subsequent to the model year in which the credits are earned. Credits cannot be passed between manufacturers or between car and light truck fleets.

In December 2007, the *Energy Independence and Security Act* was adopted, requiring CAFE standards to reach 7.44 L/100km by 2015, and 6.72 L/100km by 2020 (cars and light trucks combined). Standards will be set separately for cars and light trucks and begin in 2011.

In 2002, Assembly Bill 1493 (Pavley) was signed into law in California. The Bill directed the California Air Resources Board to adopt regulations requiring automakers to meet increasingly stringent standards for tailpipe GHG emissions (closely related to fuel economy) for new passenger cars and light trucks. These regulations entered into force in January 2006. The standards would be phased in between 2009 and 2016, reaching approximately 7 L/100km by 2016. However, California needs a waiver from the federal government to implement the standards, and in December 2007 the waiver was denied. California is appealing this in the courts, but both presidential candidates for the 2008 election have indicated they would grant California the waiver if elected. Fifteen other U.S. states are also committed to California's standards.[80]

Policy Assessment: When the CAFE standards were first introduced, car manufacturers claimed that they would cause severe damage to the industry. But negative impacts from the standards were few, and the industry continued to flourish at greatly improved levels of fuel economy.[81] However, after 1990 the CAFE standards ceased to be significantly tightened, leaving the U.S. with the lowest average fuel economy in the developed world.

Brazil's Ethanol Blending Requirement[82]

In 1975, Brazil launched the Proàlcool program, which aimed to stimulate a domestic supply of ethanol from the country's sugarcane industry. To achieve its objectives, the Proàlcool program used a combination of quotas, marketing orders, price setting, and low-interest loans.

In 1993, the government passed a law requiring all gasoline marketed in Brazil to be blended with 20% to 25% ethanol. Ethanol is used by all regular gasoline vehicles, plus three million cars running on 100% anhydrous ethanol and six million flex-fuel vehicles. As of November 2007 the

[80] Transport Canada, *A Better Canada — A Cleaner Environment: The Development of Motor Vehicle Fuel Consumption Regulations* (Ottawa, ON: Government of Canada, 2008), 4. Also available online at www.tc.gc.ca/pol/en/environment/FuelConsumption/pdf/FuelConsumptionReg.pdf.

[81] Bob Oliver, *A Strong Canadian Auto Industry in a Fuel Efficient Future* (Toronto, ON: Pollution Probe, 2007). Also available online at www.pollutionprobe.org/Reports/AutoIndustryandMarketPolicy.pdf.

[82] Joao Martines-Filho, Heloisa L. Burnquist and Carlos E.F. Vian, "Bioenergy and the Rise of Sugarcane-Based Ethanol in Brazil," *Choices* 21, no. 2 (2006). Also available online at www.choicesmagazine.org/2006-2/tilling/2006-2-10.htm.

blend was raised to its limit of 25%. However, Brazil varies the blend percentage to compensate gasoline price fluctuations.

In February 2007, Brazil's consumption of ethanol surpassed that of gasoline. Hydrous ethanol consumption jumped 46% in 2007 to 10.4 billion litres, while the use of anhydrous ethanol, which is mostly blended into gasoline, rose nearly 20% to 6.2 billion litres.[83]

In 2004–05, Brazil was the world's largest producer of ethanol, with 37% of global production. Brazil mainly derives its ethanol from sugarcane, and in 2005 more than 50% of the country's sugarcane production was used to produce ethanol. Ethanol derived from sugarcane can reduce GHG emissions by approximately 85% compared to conventional gasoline.[84]

The most harmful environmental effect from sugarcane production is the burning of fields to facilitate manual harvesting. In 2000, the Brazilian government took steps to eliminate field burning and move to mechanized harvesting. The law specifies locations where the practice of burning is prohibited and must be replaced by mechanization (about 55% of production). It also established rules for the 45% of production area where burning is still allowed.

According to Brazil's Minister of Economic Development and International Trade, Luiz Fernando Furlan, "an analysis of our balance of payments shows that the increasing replacement of gasoline by ethanol saved some US $43.5 billion between 1976 and 2000."[85]

Policy Assessment: Brazil was the first country to mandate ethanol blending in gasoline. Since 1990, Brazil has successfully replaced more than 50% of its gasoline consumption with renewable fuel alcohol.

Brazil's Biodiesel Blending Requirement[86]

In 2005, the Brazilian government adopted a law requiring that diesel fuel sold in the country include 2% biodiesel (B2) starting in January 2008, and 5% biodiesel (B5) by 2013.

According to the Agencia Nacional do Petroleo (ANP), the agency responsible for administering Brazil's biodiesel program, the law is expected to create a market of one billion litres of biodiesel per year starting in 2008. The feedstocks used to produce the biodiesel will include soy, castor bean plant, palm, babassu (nut), tallow, dênde palm and sunflower. The minimum biodiesel requirements are supported by a manufacturing tax exemption for biodiesel production and fuel tax exemptions for biodiesel consumption.

According to Roberto Ardenghy, the supply chief of the ANP, each percentage point of biodiesel blended into Brazil's diesel fuel will save Brazil the equivalent of $140 million.

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[83] Floriano Filho, Fulbright/APSA Congressional Fellow, personal communication, August 30, 2008.

[84] Martin Von Lampe, *Economic Assessment of Biofuel Support Policies* (Paris, France: OECD, 2008), 44.

[85] Mark Langevin, "How Brazil's Ethanol Can Move the World and Clean the Air," Brazzil (September 27, 2005), www.brazzil.com/2005-mainmenu-79/156-september-2005/9412.html (accessed October 21, 2008).

[86] British Consulate General Sao Paulo, *Biodiesel in Brazil: Overview 2005* (Sao Paulo, Brazil: British Consulate General, 2005). Also available online at www.oti.globalwatchonline.com/online_pdfs/36488X.pdf.

Policy Assessment: Brazil's B5 requirement is one of the most ambitious in the world to date. Although other jurisdictions, such as the EU, have biofuel indicative targets of 5.75% by 2010 and 10% by 2020, these are not mandatory minimum requirements, and they apply to ethanol and biodiesel combined together.[87] Another important feature of Brazil's biodiesel requirement is that it is supported by financial incentives which make biodiesel increasingly competitive with conventional fuels.

California's Appliance Efficiency Regulations[88,89,90]

In 1976, California became the first U.S. state to adopt energy efficiency standards for appliances. In subsequent years, most U.S. states adopted California's standards. These state-level efforts led to the passage of the federal *National Appliance Energy Conservation Act* of 1987 and the *Energy Policy Acts* of 1992 and 2005.

The federal *Energy Policy Act* of 2005 created efficiency standards for sixteen products. Under the rules of "federal pre-emption," states that had standards prior to federal enactment may enforce the state standards until the federal standards become effective. But once a federal standard is established, it takes precedence, even if it is weaker. However, the federal government has generally based its standards on those already adopted by California, with a few exceptions.

Meanwhile, California has continued to adopt standards for other products. California's 2006 *Appliance Efficiency Regulations* created standards for twenty-one categories of appliances sold in California. Some minor changes were made to the regulations in 2007. Updated regulations for general purpose lighting and battery chargers are expected to be published by the end of 2008.

California's efficiency standards now cover 30 products. The standards are updated periodically to allow for the incorporation of new or upgraded energy efficiency technologies and methods. According to California Energy Commission officials, the regulations have been updated over 30 times since they were first adopted in 1976.

Policy Assessment: California's implementation of appliance efficiency standards has been a model for other states. California's standards have contributed to substantial improvements in energy efficiency. As a result, the state's per capita electricity consumption is flat, whereas for

[87] The net reductions in GHG emissions over the life-cycle of both ethanol and biodiesel depend on how the fuels are made. Ethanol and biodiesel from cropped feedstocks (e.g., corn) are controversial methods of reducing GHG emissions due to their impacts on food prices, deforestation and the overall environmental sustainability of agricultural practices. Concerns over the sustainability of biofuels and impacts on food prices have created pressure for the EU to downgrade its biofuels targets or to abandon them altogether.

[88] See California Energy Commission, *California's Appliance Efficiency Program*, California Energy Commission, www.energy.ca.gov/appliances/.

[89] Harinder Singh, Program Engineer, California Energy Commission Buildings and Appliances Office, personal communication, August 28, 2008.

[90] Arthur Rosenfeld, "Energy Efficiency in California: Some Possible Lessons for Ontario" (presentation given on March 20, 2006), www.energy.ca.gov/commissioners/rosenfeld_docs/index.html (accessed August 29, 2008)

the rest of the U.S. it is growing at a rate of 2% per year. California has now set a goal of reducing electricity consumption per capita by 0.5–1% per year.

Canadian Modelling Studies

In a 2006 report for Natural Resources Canada (NRCan),[91] M.K. Jaccard and Associates (MKJA) examined the impact of introducing an economy-wide carbon price, starting in 2006, on several relevant indicators, notably GHG emissions and GDP, for sectors, provinces and Canada as a whole. The model used was CIMS, a hybrid energy-economy model containing a database of emission reduction technologies and incorporating realistic technology adoption behaviour. CIMS also includes macroeconomic feedbacks that adjust the demands for products and services to their prices, and that simulate Canada's international trade in energy and other products. The MKJA study did not include GHG emissions from agriculture, waste management, and land-use change and forestry.

The study's results for national and regional emission reductions under different carbon prices are shown in the two following tables. It is noteworthy that under a uniform carbon price, 39–51% of the reduction in emissions by 2020, relative to business as usual, occurs in Alberta. Over the full period studied (2010–30), the study found positive cumulative impacts on national GDP at carbon prices up to and including $30/tonne CO_2e, and negative "expected resource costs" of actions to reduce GHG intensity up to and including $50/tonne (a consequence of actions that reduce financial expenditure without imposing significant intangible costs). Cumulative GDP impacts became negative and expected resource costs positive at higher carbon prices.

Reduction in annual national emissions relative to business as usual (Mt CO_2e) in 2010, 2015 and 2020 under different carbon prices in the MKJA study for NRCan[92]

	Carbon price ($/tonne CO_2e)									
	10	**20**	**30**	**40**	**50**	**75**	**100**	**150**	**200**	**250**
2010	7.5	13.7	19.9	28.6	36.3	56.4	77.0	97.4	111.8	122.0
2015	11.6	24.6	33.2	44.0	58.9	90.9	120.4	151.9	171.9	186.8
2020	15.7	30.1	43.8	60.4	76.3	118.6	160.0	203.6	230.5	249.4

[91] MKJA, *Cost Curves for Greenhouse Gas Emission Reduction in Canada: The Kyoto Period and Beyond* (report prepared for NRCan) (Vancouver, BC: MKJA, 2006).

[92] All inputs and outputs in this study were in 1995 dollars.

Regional contributions (%) to national emission reductions relative to business as usual in 2020 in the MKJA study for NRCan

	Carbon price ($/tonne CO_2e)									
	10	**20**	**30**	**40**	**50**	**75**	**100**	**150**	**200**	**250**
British Columbia	12	11	11	11	11	10	9	9	9	10
Alberta	39	40	42	41	43	47	51	50	49	47
Saskatchewan	6	5	5	6	6	7	6	6	6	6
Manitoba	2	2	2	2	2	1	1	1	1	2
Ontario	22	22	21	21	20	19	18	19	19	20
Québec	12	13	12	12	12	10	9	9	9	9
Atlantic	7	7	7	7	6	6	5	6	6	6

More recently, MKJA conducted a study for Alberta Environment[93] using the same model as in the earlier study for NRCan. GHG emissions from agriculture, waste management, and land-use change and forestry were again excluded. MKJA examined the effects of an economy-wide carbon price and various targeted regulations. Except where noted, the policies examined took effect in 2011.

Notable findings included the following:

- In the absence of other policies, relatively high carbon prices would be needed to reduce Alberta's emissions below current levels. A price of $60/tonne CO_2e starting in 2011 would stop emissions growth by about 2020, but the price would need to be $100/tonne to reduce emissions over the following two decades. A price starting at $50/tonne, increasing steadily to $200/tonne by 2031, would stop emissions growth by 2015, reduce emissions below current levels by about 2025, and reduce them to just below the 1990 level by 2050.[94]
- CCS would provide the majority of the reductions for carbon prices above $30/tonne, and the vast majority at $200/tonne. In the scenario where the price started at $50/tonne and reached $200/tonne by 2031, CCS accounted for a reduction in annual emissions of about 20 Mt CO_2e in 2015, about 50 Mt in 2020, and about 100 Mt in 2025, relative to business as usual.
- "A broad market-based policy is unlikely to significantly reduce Alberta's economic growth. The model used for this analysis is not a full economic equilibrium model and so cannot project impacts of the policy on the entire economy. However, the model suggests that even an aggressive carbon charge is unlikely to dramatically affect overall economic output in the portion of the economy covered by the model."
- Targeted regulations would produce the following results relative to business as usual:

[93] MKJA, *Economic analysis of climate change abatement opportunities for Alberta* (report prepared for Alberta Environment) (Vancouver, BC: MKJA, 2007).

[94] All carbon prices in this study were in 2003 dollars.

- » A residential building code requiring Built Green™ Gold for new construction after 2010 would reduce emissions by about 0.3 Mt in 2025 and about 0.6 Mt in 2050.
- » A commercial building code requiring new construction to meet LEED Gold™ standards would reduce emissions by 1 Mt in 2025 and about 5 Mt in 2050.
- » A California-level emissions standard for light-duty vehicles would reduce emissions by 2 Mt in 2025 and 2 Mt in 2050.
- » Construction of a 2,200 MW nuclear plant in 2020 would reduce emissions by about 11 Mt in 2050.
- » A requirement for 20% of electric generation to be from renewable sources by 2020 would reduce emissions by about 5 Mt in 2025 and by about 6 Mt in 2050.
- » A regulation requiring all large industrial facilities built after 2015 to implement CCS to the maximum extent possible would reduce emissions by about 61 Mt in 2025 and by 173 Mt in 2050.

In 2007, the National Round Table on the Environment and the Economy (NRTEE) submitted an advisory report to the Minister of Environment in response to his request for advice on long-term reductions in GHG emissions and air pollutants. The report was based on a study using the CIMS model (see above) that examined the economy-wide carbon pricing levels needed to achieve deep reductions in Canada's GHG emissions by 2050, assuming that Canada's major trading partners are implementing comparable policies.[95] GHG emissions from agriculture, waste management, and land-use change and forestry were again excluded.

A key conclusion of the report was that "the most effective and efficient policy that would result in deep GHG emission reductions is a market-based policy, such as an emissions tax, a cap-and-trade system, or a combination of the two. This core policy then needs to be complemented by other regulatory policies, to force emission reductions from parts of the economy that do not respond to a price policy."[96] The report also noted that "since expected future emission prices will influence investment decisions now,… the price signal must be communicated clearly, with an expectation that the price of emissions would escalate over a scheduled time period."[97]

Results from the modelling study are reproduced in the two following tables. They show that an economy-wide carbon price of $75/tonne by 2020 would be needed to reduce Canada's emissions substantially below current levels. It is also notable that to reach a given emissions target in 2050, the overall impact on GDP as well as cumulative emissions would be less in the "fast start" policy scenarios. The last line of the first table illustrates the smallness of the impact on annual GDP growth from the emission reduction scenarios.

The second table shows the impacts of a 65% reduction in Canada's emissions by 2050 on various sectors in the economy. The shift in energy production to low-emissions electricity and the decline in the production of coal and refined petroleum products are notable.

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[95] NRTEE, *Getting to 2050: Canada's Transition to a Low-emission Future* (Ottawa, ON: NRTEE, 2007), 14. Also available online at www.nrtee-trnee.com/eng/publications/getting-to-2050/Getting-to-2050-low-res.pdf.

[96] Ibid., 3.

[97] Ibid., 18.

Scenarios and overall results from the NRTEE modelling study[98]

	Business as usual	"Slow and shallow"	"Fast and shallow"	"Slow and deep"	"Fast and deep"
	Carbon price ($/tonne CO_2e)[99]				
2010	0	10	10	10	10
2015	0	15	15	15	15
2020	0	25	75	25	75
2030	0	75	160	100	225
2040	0	200	160	300	270
2050	0	200	160	350	270
	Change in annual emissions relative to 2003 levels (%)				
2020	+21	+8	−11	+2	−17
2050	c. +80	−45	−45	−65	−65
	Deviation in annual GDP from business as usual (%)				
2020	0	−0.6	−1.2	−0.5	−1.1
2050	0	−0.8	−0.5	−1.5	−0.8
	Average annual growth in GDP (%)				
2011–50	1.83	1.81	1.82	1.79	1.81

[98] NRTEE, *Interim Report to the Minister of the Environment* (Ottawa, ON: NRTEE, 2007), 9, 11, 12, 14. Also available online at www.nrtee-trnee.com/eng/publications/ecc-interim-report/NRTEE-Clean-Air-Interim-Report.pdf.

[99] In 2003 dollars.

Sectoral results from the NRTEE modelling study's "fast and deep" scenario[100]

	Increases in production costs (%) relative to business as usual		Changes in output (%) relative to business as usual	
	2020	**2050**	**2020**	**2050**
Residential	6	1	−8	−5
Commercial/institutional	1	1	−2	−2
Transportation	8	1	−6	−5
Industrial				
Chemical products	17	15	−6	−5
Industrial minerals	24	20	−49	−50
Iron and steel	9	13	−3	−4
Non-ferrous metal smelting	7	7	−3	−2
Metals and mineral mining	3	6	−2	−7
Other manufacturing	5	5	−1	−1
Pulp and paper	2	2	−6	−2
Energy supply				
Coal mining	25	93	−6	−20
Electricity generation	31	24	+6	+35
Natural gas extraction	19	39	−4	−9
Petroleum crude extraction	30	34	−3	−5
Petroleum refining	6	6	−12	−50

In a 2006 study,[101] Yazid Dissou used a dynamic general equilibrium model to examine different methods of permit allocation under a cap-and-trade system covering the majority of Canada's GHG emissions, designed to meet Canada's Kyoto Protocol emissions target during 2008–12 without any purchase of international permits or credits.[102] In the model the Canadian economy was integrated with the rest of the world through commodity exports and imports. The three methods of permit allocation were:

- a grandfathered gratis (free of charge) allocation (GFA)

[100] NRTEE, *Getting to 2050*, 41.

[101] Yazid Dissou, "Efficiency and Sectoral Distributional Impacts of Output-Based Emissions Allowances in Canada," *Contributions to Economic Analysis & Policy* 5, no. 1 (2006): article 26.

[102] The cap-and-trade system was designed to achieve a 190 Mt reduction in Canada's average annual CO_2e emissions relative to the business-as-usual level. In the study, the total reduction needed to meet the Kyoto target was 240 Mt, but 50 Mt of this was considered to be not amenable to a cap-and-trade policy.

- an output-based gratis allocation (OBA), where permits are provided in proportion to industries' production levels (equivalent to a system based on emissions intensity targets)
- an auction of permits with revenue recycling to reduce payroll taxes (RPT).

As shown in the following table, Dissou found that the economic welfare costs[103] associated with OBA were considerably higher than those of RPT, and the welfare costs of GFA were higher still. RPT also had the best outcome for employment and household consumption, while OBA had the best outcome for GDP, exports and investment. GFA had the worst outcomes on nearly every measure. The greatest beneficiaries of OBA were non-energy-producing energy-intensive industries. In contrast, fossil-energy-producing industries made a greater contribution to the total loss of GDP with OBA than they did with RPT and GFA. Dissou concluded that fossil energy producers "could not benefit that much" from OBA.

Deviation (%) from business as usual in 2010 under the three permit allocation methods in Dissou's study

Variable	Permit Allocation Method		
	GFA	OBA	RPT
Permit price ($/tonne CO_2e)	48	76	50
Economic Welfare	−2.9	−2.1	−1.3
GDP at market prices	−2.2	−0.6	−1.1
GDP at factor cost	−2.5	−0.8	−1.5
Employment	−0.7	+0.4	+0.5
Household consumption	−2.3	−2.1	−1.2
Total real investment	−8.9	−3.5	−7.3
Total real exports	−1.9	+1.2	−0.6
Total real imports	−4.1	−2.0	−3.1
Real exchange rate[104]	+1.7	+1.4	+1.9
Industrial abatement of CO_2e (Mt)	175	170	175
Household abatement of CO_2e (Mt)	15	20	14

Jack Mintz and Nancy Olewiler[105] recently examined the potential of introducing a economy-wide carbon tax to the Canadian economy through a restructuring of the current excise tax on gasoline and diesel fuel. They view this as a means to address the negative externalities associated with fossil fuel consumption as well as the distortionary effects of the excise tax. Noting that the existing gasoline excise tax rate is equivalent to a carbon tax of $42/tonne CO_2, the authors propose leaving this tax rate in place for gasoline, but applying the same carbon tax

[103] Economic welfare costs refer to reductions in producer and consumer welfare, which result in the erosion of producers' and consumers' ability to purchase a set quantity of goods or services.

[104] A positive number means depreciation.

[105] Jack Mintz and Nancy Olewiler, *A Simple Approach for Bettering the Environment and the Economy: Restructuring the Federal Fuel Excise Tax* (Ottawa, ON: Sustainable Prosperity, 2008). Also available online at sustainableprosperity.ca/wp-content/uploads/2008/04/sustprosper-qx-5.pdf.

rate to all other fossil fuels. This would result in an estimated $12–15 billion in new tax revenue annually for the federal government, above and beyond current excise tax revenue.

Mintz and Olewiler recommend that all the carbon tax revenues collected by the government be used to lower the rates of current taxes or to fund tax credits for environmental technologies. They calculate that this would allow corporate and personal income taxes to be reduced by 8–10%. The authors acknowledge that some jurisdictions in Canada would be more affected than others, but suggest that revenues could be used to mitigate specific distributional or regional impacts. The authors also recommend a border tax adjustment in conjunction with their revenue-neutral tax shift unless other countries implement similar policies and take account of the tax imposed on exports by Canada.

Policy Assessment: The studies reviewed above suggest the following conclusions, subject to the caveat that economic models do not perfectly represent the real economy:

- Economy-wide carbon pricing could achieve substantial reductions in Canada's GHG emissions with relatively modest impacts on GDP. Positive impacts on GDP are projected at carbon prices up to and including $30/tonne CO_2e. Much higher carbon prices could produce deep reductions in Canada's emissions by 2050 with minimal impact on GDP growth if Canada's major trading partners implement comparable policies. However, to reach a given emissions target in 2050, GDP impacts will increase if strong carbon pricing is delayed. An economy-wide carbon price of $75/tonne by 2020 would be needed to reduce Canada's emissions substantially below current levels.
- As much as half of the reduction in Canada's emissions by 2020 under a uniform economy-wide carbon price, relative to business as usual, would be realized in Alberta. However, a price reaching $200/tonne would be needed to reduce Alberta's emissions below the 1990 level by 2050. CCS would provide the majority of Alberta's emission reductions for carbon prices above $30/tonne.
- Carbon pricing is the most effective and efficient policy to achieve deep GHG emission reductions. However, it needs to be complemented by regulations to obtain emission reductions in parts of the economy that do not respond well to a carbon price.
- There is significant support for recycling revenues from carbon pricing back into the economy via reductions in corporate, income and payroll taxes. For instance, Dissou found that auctioning tradeable permits and recycling the resulting revenue to reduce payroll taxes produces a better outcome for welfare than gratis allocation of permits.

International Modelling Studies

Carbon Pricing

One of the most widely referenced studies on the options available to tackle global warming is the 2006 Stern Review of the economics of climate change. The review states that "a broadly similar price of carbon is necessary to keep down the overall costs of making [the necessary] reductions [in GHG emissions], and can be created through tax, trading or regulation. Creating a transparent and comparable carbon price signal around the world is an urgent challenge for

international collective action."[106] The review notes that the carbon price should rise over time to reflect the rising "social cost of carbon" resulting from increasing concentrations of GHGs in the atmosphere. So while the average cost of emission reductions using a given technology will decline over time as a result of innovation, the marginal cost of emission reductions (the carbon price) will increase as society moves from cheaper emission reduction technologies to more expensive ones.[107]

The Stern Review investigated the cost of reducing global energy-related GHG emissions from 24 gigatonnes (Gt) of CO_2e in 2002 to 18 Gt CO_2e in 2050. (This reduction is consistent with stabilizing atmospheric GHG concentrations at 550 parts per million (ppm) CO_2e by 2050.) The central estimate of the cost of this reduction was US $930 billion or less than 1% of global GDP in 2050.[108] Comparing this cost with that of unchecked climate change impacts, the review concluded: "In broad brush terms, spending somewhere in the region of 1% of gross world product on average forever could prevent the world losing the equivalent of 5–20% of gross world product for ever."[109]

In its Fourth Assessment Report (2007), the Intergovernmental Panel on Climate Change (IPCC) conducted a comprehensive review of studies that examined the policy options for reducing GHG emissions and the related costs. The IPCC's conclusions regarding the expected cost (in 2050) of stabilizing atmospheric GHG concentrations at various levels are presented in the following table.[110] Concentrations would need to be stabilized at the lowest level shown in the table to have a chance of limiting average global warming to 2°C above the pre-industrial level (an objective endorsed by many of the world's leading climate scientists[111]).

Estimated impacts on global GDP in 2050, relative to business as usual, for least-cost trajectories towards different long-term stabilization targets

Stabilization levels (ppm CO_2e)	Range of GDP reduction (%)	Reduction of average annual GDP growth rates (percentage points)
590–710	−1 to 2	<0.05
535–590	slightly negative to 4	<0.1
445–535	<5.5	<0.12

The IPCC also estimated the economic potential for global emission reductions by sector, relative to business as usual, as a function of carbon price in 2030. The estimated reductions in annual CO_2e emissions at a carbon price of US $100/tonne CO_2e were:[112]

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[106] Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge, UK: Cambridge University Press, 2006), 468. Also available online at www.hm-treasury.gov.uk/6520.htm.

[107] Ibid., 232.

[108] Ibid., 232.

[109] Ibid., 285.

[110] IPCC, "Summary for Policymakers," in B. Metz et al., eds., *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, UK, and New York, NY: 2007), 18. Also available online at www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf.

[111] See *2007 Bali Climate Declaration by Scientist*s, www.climate.unsw.edu.au/news/2007/Bali.html.

[112] IPCC, 11.

- energy supply: 2.4–4.7 Gt
- transportation: 1.6–2.5 Gt
- buildings: 5.3–6.7 Gt
- industry: 2.5–5.5 Gt
- agriculture: 2.3–6.4 Gt
- forestry: 1.3–4.2 Gt
- waste: 0.4–1 Gt

Policy Assessment: The following conclusions can be drawn from the studies reviewed above:

- Establising a rising price of carbon, at a broadly similar level througout the world, is a central task in the international community's effort to achieve deep reductions in GHG emissions.
- Stabilizing atmospheric GHG concentrations at 550 ppm CO_2e is expected to reduce global GDP in 2050 by about 1% (central estimate). Stabilization at a lower level, allowing a chance of limiting average global warming to 2°C above the pre-industrial level, could reduce global GDP in 2050 by up to 5.5%.

Renewable Portfolio Standards

A renewable portfolio standard (RPS) is a regulation requiring that specific quantities of electricity be produced from sources such as wind, solar, geothermal, small hydro and biomass energy. Electricity providers or producers who fail to meet the regulated targets can comply by buying tradeable certificates from others who have exceeded the targets. To date, 26 U.S. states plus the District of Columbia have implemented RPSs with a wide variety of targets and timeframes.[113] Many states set quantities for wind and solar specifically as a means to ensure that both markets develop simultaneously. Most of these state-level RPS programs target the short (2010) to medium (2020) term for green power deployment. Assuming their targets are met, these programs will result in over 70,000 MW of installed green power capacity in the U.S. by 2020, compared to only about 10,000 MW in 2004.[114]

Kydes[115] examined the impact of imposing a federal 20% non-hydropower RPS on the U.S. electricity markets by 2020. The analysis was performed using the National Energy Modelling System developed by the U.S. Energy Information Administration. The study found that by 2020 the national RPS would result in 99,000 MW of fossil fuel-based electricity generation being displaced and 166,000 MW of new renewable power generation. Between 2002 and 2020, fossil fuel consumption for electricity generation would decrease by 5.6% and related GHG emissions would fall by 6%.

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[113] UCS, *Renewable Electricity Standards Toolkit*, UCS, go.ucsusa.org/cgi-bin/RES/state_standards_search.pl?template=main (accessed October 20, 2008).

[114] UCS, *Projected Growth of Renewable Electricity*, UCS, www.ucsusa.org/clean_energy/res/overviewgrowth.html (accessed October 20, 2008).

[115] Andy Kydes, "Impacts of a renewable portfolio generation standard on US energy markets," *Energy Policy* 35, no. 2 (2007): 809–814.

Kydes estimated the economic impacts of the RPS to be relatively mild. In 2020, electricity prices are expected to be 3% higher than the base case. However, the overall cost to the electricity industry over the 18 year time period is estimated to be $35–60 billion (net present value). The author notes that not all of the benefits of this type of policy are accounted for in his assessment.

Policy Assessment: An RPS is a market-based regulation that provides an alternative to carbon pricing in reducing GHG emissions from electricity generation. Like a cap-and-trade system, an RPS minimizes compliance costs by allowing firms to trade with one another. However, an RPS can be considered to reflect additional benefits of renewable energy beyond GHG reductions. An RPS would overlap with a cap-and-trade system covering GHG emissions from electricity generation, and the two policies could be explicitly linked.

3. Financial Incentives

As carbon pricing was covered above, it is not included in this section.

Policy Experience in Canada

Ontario's Standard Offer Program

Feed-in tariffs are policies designed to foster the development of renewable energy industries. The "tariff" in question is a preferential rate paid to renewable electricity generators; feed-in-tariff policies also give renewable energy priority access to the electricity grid. A true feed-in-tariff program sets no upper limit on the amount of renewable energy that can take advantage of the program.[116]

In March 2006, the Government of Ontario announced a program modelled on the feed-in-tariff called the Standard Offer Program.[117] This program requires the Ontario Power Authority (OPA) to purchase electricity produced by wind, biomass or small hydroelectric projects at 11 cents/kWh. Electricity generated from solar photovoltaic technology receives a higher premium of 42 cents/kWh. Eligible projects must have a capacity of less than 10 MW, and the tariffs are designed to apply for 20 years.[118] By September 2008, projects totalling 69 MW had reached commercial operation.[119]

In May 2008 the OPA reported that "the Renewable Energy SOP has exceeded all expectations. The program achieved more than 1,300 MW of contracted projects in a little more than a year. When the Renewable Energy SOP was launched in 2006, it was expected to develop 1000 MW over 10 years."[120] Accordingly, the OPA announced that it was launching an immediate review to develop revised rules for applications received after May 12, 2008.

Policy Assessment: As noted above, Ontario's program has had a take-up rate ten times faster than expected. The Ontario Sustainable Energy Association (OSEA) published a detailed

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[116] For a more detailed explanation of the feed-in-tariff mechanism, see Roger Peters and Tim Weis, *Feeding the Grid Renewably* (Drayton Valley, AB: The Pembina Institute, 2008). Also available online at www.pembina.org/pub/1599.

[117] Office of the Premier, "Expanding Opportunities For Renewable Energy In Ontario: New Standard Price will add up to 1,000 megawatts over the next 10 years," news release, March 21, 2006. Also available online at ogov.newswire.ca/ontario/GPOE/2006/03/21/c4345.html.

[118] Ministry of Energy and Infrastructure, "Ontario's Standard Offer Program," backgrounder, March 21, 2006. Also available online at www.energy.gov.on.ca/index.cfm?fuseaction=english.news&back=yes&news_id=124&backgrounder_id=96.

[119] OPA, *A Progress Report on Renewable Energy Standard Offer Program* (Toronto, ON: OPA, 2008), 5. Also available online at www.powerauthority.on.ca/sop/Storage/84/7927_RESOP_September_2008_report.pdf.

[120] OPA, "Celebrating success and forging ahead on renewable energy," news release, May 13, 2008. Also available online at www.powerauthority.on.ca/Page.asp?PageID=122&ContentID=6538&SiteNodeID=134.

assessment and review of the program in late 2007.[121] The organization recommends several measures to strengthen and expand the program, but also commends it as a "groundbreaking" mechanism for the deployment of renewable energy.

EnerGuide for Houses Retrofit Program

In 2003, the Government of Canada began providing grants for energy efficiency audits and retrofits in the residential sector under the EnerGuide for Houses (EGH) program. EGH grants averaged about $750 per home, with several provinces providing additional top-up grants to the federal contribution. The grants typically leveraged home improvement investments of $5,000–$7,000 per home. The size of the grant each homeowner received was based on the difference between a house's pre- and post-retrofit energy rating, as determined by an EGH home energy evaluation. The program typically offered these audits at a 50% subsidized price of $150.[122]

NRCan found that the program resulted in an average 27% reduction in a home's energy consumption. As of March 2006, more than 49,000 Canadian homeowners had received the retrofit grants.[123]

In May 2006, the Government of Canada discontinued the program effective March 2007. Howver, on January 21, 2007, the government announced that it would invest $220 million over four years in a new ecoENERGY Retrofit program, similar to the previous EGH program.[124] (For comparison, by the end of 2005, the federal government had allocated a total of $452 million to the EGH program, with $37 million paid out in grants by March 2006.[125]) Unlike the EGH program, the new program does not subsidize the cost of the home energy evaluations, which may represent a significant barrier to program take-up.

Policy Assessment: The EGH program enabled qualifying homeowners to reduce their energy use and costs, as well as the corresponding GHG emissions, by 27% on average. However, it should be noted that it is very difficult to determine what fraction of a financial incentive program such as this one is captured by "free riders," i.e., homeowners who would have made the investments even without the incentive program. However, if the program had been allowed to reach its budgeted scale, it is plausible that the overall proportion of free riders would have been quite small.

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[121] Paul Gipe, *Renewables Without Limits: Moving Ontario to Advanced Renewable Tariffs by Upgrading Ontario's Groundbreaking Standard Offer Program* (Toronto, ON: OSEA, 2007). Also available online at www.ontario-sea.org/Storage/22/1375_RenewablesWithoutLimits.pdf.

[122] The information in this paragraph was obtained in 2005–06 from the website of NRCan's Office of Energy Efficiency.

[123] Office of the Auditor General of Canada, *Report of the Commissioner of the Environment and Sustainable Development to the House of Commons* (Ottawa, ON: Minister of Public Works and Government Services of Canada, September 2006), Chapter 3, 15. Also available online at www.oag-bvg.gc.ca/internet/docs/c20060903ce.pdf.

[124] Government of Canada, "Canada's New Government Launches $300-Million ecoENERGY Efficiency Initiative," news release, January 21, 2007. Also available online at www.ecoaction.gc.ca/news-nouvelles/20070121-eng.cfm.

[125] Office of the Auditor General of Canada, Chapter 3, 10.

Because the successor ecoENERGY Retrofit program is still in the early stages of its operation, it is not yet possible to provide an empirical assessment of its effectiveness.

Policy Experience Internationally

Germany's *Renewable Energy Sources Act*

Germany's *Electricity Feed-in Act* took effect in 1991. The Act obliged grid utilities to purchase electricity generated from new renewable energy sources, and to pay the renewable producers prices that are set by law. This system, known as "feed-in tariffs," ensures an increase in the production of renewable energy even when it is not yet economically competitive with conventional energy.

In 2000 the *Electricity Feed-in Act* was replaced by the *Renewable Energy Sources Act* (Erneuerbare-Energien-Gesetz or EEG), which was again updated in 2004. The 2004 legislation aims for 12.5% of Germany's electricity to be produced from renewable energy by 2010 and at least 20% by 2020. It specifies the prices to be paid depending on the type of renewable energy facility and the facility size; in most cases they must be paid for 20 years.[126] In June 2008, the Bundestag (federal parliament) agreed on a further update to the EEG, increasing the 2020 target to at least 30%.[127]

By 2007, renewable sources were already producing 14.2% of Germany's electricity, exceeding the 2010 target, compared to 3.2% in 1991. Hydropower accounted for 91% Germany's renewable power in 1991, but the amount produced since has remained approximately constant. The bulk of the growth in renewable power production since 1991 has come from wind energy (45% of renewable power produced in 2007) and biomass energy (27%). Solar energy accounted for 4% of renewable power produced in 2007.[128]

Assuming that the increased renewable power production since 1991 would otherwise have been generated mostly from coal, the EEG has achieved a reduction in annual CO_2 emissions of 57 Mt.[129] (Germany's total annual.GHG emissions are about 1000 Mt CO_2e.[130])

Electricity consumers supply the funding for feed-in tariffs through the price they pay for electricity. In 2007 the average cost of the EEG to consumers was 1 Euro cent per kWh, compared to an average electricity price of 21 Euro cents per kWh. The cost of the EEG to an average household was around €3 ($5) per month.[131] However, with the exception of solar

[126] An English translation of the EEG is available online at www.bmu.de/files/pdfs/allgemein/application/pdf/eeg_en.pdf.

[127] Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), *Renewable Energy Sources in Figures* (Berlin, Germany: BMU, 2008), 4. Also available online at www.bmu.de/files/english/renewable_energy/downloads/application/pdf/broschuere_ee_zahlen_en.pdf.

[128] Ibid., 16.

[129] Ibid., 23.

[130] See unfccc.int/resource/docs/2007/sbi/eng/30.pdf.

[131] BMU, 33.

power, the total annual cost premium of the electricity supported by the EEG is expected to fall from €2.3 billion ($3.7 billion) in 2006 to €2 billion in 2015 and approach zero by 2020.[132]

Under the EEG, investment in renewable power plants increased from €4 billion in 2000 to €10 billion ($16 billion) in 2006; in that year, 134,000 people were employed in the sectors supported by the EEG.[133]

Policy Assessment: The EEG has been an exceptional successful instrument for deploying renewable energy technologies in the electricity market, and has made a major contribution to limiting Germany's GHG emissions. Although the technologies supported by the EEG are more expensive than conventional technologies, the EEG has generated substantial investment and employment at a very modest cost to consumers.

California's Million Solar Roofs Initiative

In August 2004, California Governor Arnold Schwarzenegger announced an initiative to install solar photovoltaic (PV) panels on one million residential and commercial roofs in the state by 2018.[134]

Following the adoption of the necessary legislation, in January 2007 the state launched its Go Solar California campaign, which will provide US $3.3 billion in incentives over ten years. The campaign's objective is to install 3,000 MW of solar PV capacity by 2016. The California Public Utilities Commission (CPUC)'s California Solar Initiative (CSI) will provide US $2.2 billion for non-residential installations as well as installations on existing homes served by investor-owned utilities. The California Energy Commission oversees the New Solar Homes Partnership, targeting the new residential construction market (US $400 million). And beginning in 2008, publicly-owned utilities are also be required to offer incentives (US $800 million).[135]

Under the CSI, incentives began in 2007 at US $2.50/watt for residential and commercial photovoltaic systems under 50 kW, and US $0.39/kWh over five years for larger systems. The incentives are higher for government and non-profit organizations.[136] Ten percent of the funding is reserved for low-income programs.[137] In the first 18 months of the CSI, 10,500 applications were received totalling 50 MW of residential PV capacity, and over 1,100 applications were received totalling just over 200 MW of commercial capacity.[138] These figures suggest that the target of 3,000 MW by 2016 will be met with under solar 150,000 installations.

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[132] Jochen Diekmann et al., *Economic Analysis and Evaluation of the Effects of the Renewable Energy Act* (Berlin, Germany: Deutsches Institut für Wirtschaftsforschung, 2008), 2–4. Also available online at www.bmu.de/files/pdfs/allgemein/application/pdf/eeg_impacts_chap7_summary.pdf.

[133] Ibid.

[134] Office of the Governor, "Governor Schwarzenegger Calls for One Million Solar Energy Systems in California Homes," news release, August 20, 2004. Also available online at gov.ca.gov/press-release/2859/.

[135] CPUC, *California Solar Initiative: California Public Utilities Commission Staff Progress Report July 2008* (San Fransisco, CA: CPUC, 2008) 7–8.

[136] Ibid., 14–15.

[137] Ibid., 9.

[138] Ibid., 23.

The amount of solar PV capacity installed annually in California increased nearly linearly between 2001 and 2006. If this trend had continued, about 67 MW would have been installed in 2007. With the Go Solar California campaign, 81 MW were installed in 2007.[139]

Policy Assessment: The Go Solar California campaign is the largest solar program in the U.S. and serves as a model for other states. The program will help bring down the cost of solar electricity to California consumers, and is a significant tool in the state's effort to reduce GHG emissions. However, the program will need to be considerably expanded to achieve the governor's one million solar roofs objective.

Japan's Green Vehicle Tax Incentives

In 2002, the Japanese government began reducing taxes on the most fuel-efficient cars and commercial vehicles as well as on alternative-fuel vehicles. These tax incentives are directly linked to the achievement of Japan's fuel efficiency targets (see Section 2). The incentives for cars for fiscal year 2006–07[140] are summarized in the following table.

Automobile tax (e.g., 45,000 yen ($570) per year for a car with a 2.5 L engine	Vehicles meeting 2010 fuel efficiency target values +20%, plus electric, fuel-cell, CNG[141] and methanol vehicles	50% reduction of the tax
	Vehicles meeting 2010 fuel efficiency target values +10%	25% reduction of the tax
Acquisition tax (5% of purchase price)	Vehicles meeting 2010 fuel efficiency target values +20%	300,000 yen ($3,800) deducted from purchase price before tax applied
	Vehicles meeting 2010 fuel efficiency target values +10%	150,000 yen ($1,900) deductible from purchase price before tax applied
	Electric, fuel-cell, CNG and methanol vehicles	reduction of the tax rate by 2.7 percentage points
	Hybrid vehicles	reduction of the tax rate by 2.2 percentage point

Policy Assessment: Japan has an excellent record on vehicle fuel efficiency. This is due in part to a combination of the mandatory fuel efficiency standards (see Section 2) and the supporting tax incentives, but it is difficult to quantify the separate contribution of each of the two policies.

[139] Ibid., 32.

[140] Asia-Pacifc Economic Cooperation (APEC), *Automotive Profile — Japan*, APEC, www.apec.org/apec/apec_groups/committee_on_trade/automotive_dialogue.MedialibDownload.v1.html?url=/etc/medialib/apec_media_library/downloads/committees/cti/pubs/2006.Par.0018.File.v1.1 (accessed October 22, 2008).

[141] Compressed natural gas.

International Modelling Studies

Subsidies for Renewable Energy

Gerlagh and van der Zwaan[142] examined five policy approaches for achieving deep cuts in global CO_2 emissions:

- carbon tax based on CO_2 emissions
- fossil fuel tax based on consumption levels of fuels
- subsidies for renewable energy
- portfolio of policies to reduce the carbon intensity of energy production, including a carbon tax with revenue recycling to support deployment of renewable energy
- portfolio of policies to increase the use of renewable energy, including a fossil fuel tax with revenue recycling to support deployment of renewable energy.

The DEMETER[143] model was employed for the analysis. The model includes three main mechanisms to reduce CO_2 emissions: energy savings, a transition towards less carbon-intensive or non-carbon energy resources, and the use of CCS.

The study concluded that subsidies for renewable energy are generally the least cost-effective way to reduce CO_2 emissions. A portfolio of policies to reduce the carbon intensity of energy production, including a carbon tax, energy efficiency standards and subsidies for technology deployment, is the most cost-effective policy approach. The study found that recycling of carbon tax revenue to support deployment of renewable energy considerably reduced the costs of meeting a given CO_2 target.

Policy Assessment: This study showed that subsidies alone — while they can very be effective in deploying renewable energy — are a costly means to achieve deep GHG reductions in the absence of any incentive for energy efficiency.

[142] Reyer Gerlagh and Bob van der Zwaan, "Options and instruments for a deep cut in CO_2 emissions: Carbon dioxide capture or renewables, taxes or subsidies?" *The Energy Journal* 27, no. 3 (2006): 25–48.

[143] The DEMETER model is a widely used global energy-economic model using data from the World Bank, International Energy Agency (IEA), Organization for Economic Cooperation and Development (OECD).

4. Voluntary Approaches

Policy Experience in Canada

Voluntary Challenge and Registry Inc.

In the early phases of its climate policy development, Canada's federal government opted to take a voluntary approach to industrial emission reductions.

A 2002 Pembina Institute study analyzed the credibility and track record of the Voluntary Challenge and Registry Inc. (VCR), which was then Canada's flagship program to address industrial GHG emissions.[144] Through the VCR, the government encouraged private and public sector organizations to limit their GHG emissions on a voluntary basis. Pembina's study examined all the submissions to VCR made by industrial entities up to March 31, 2002 in order to identify those reporting their emissions for 2000. The main findings were:

- Most industrial firms reporting their GHG emissions to VCR had seen those emissions increase significantly since 1990, a trend that was still underway at the end of the decade. Many emission increases were due shifts to more GHG-intense activities — the opposite of what one would expect from firms making meaningful efforts to address climate change.
- Two-thirds of the largest emitters were either planning, or seemed very likely to be anticipating, keeping their emissions substantially or far above 1990 levels.
- The level of participation in the VCR, impressive at first sight, turned out on closer inspection to be mediocre. Out of 493 industrial entities registered with VCR in mid-2002, only 102 actually reported their year 2000 emissions by March 31, 2002. Entities reporting to VCR accounted for less than 55 per cent of emissions from industrial facilities in Canada. Fifty-two industrial entities designated as gold, silver or bronze "champion-level" reporters on the VCR web site failed to report their year 2000 emissions to VCR.
- There were a large number of major inconsistencies in the methodology used by firms in calculating the emissions they reported, and data reported to VCR were rarely subject to verification by independent auditors.
- Some Canadian industrial firms were quite successful in limiting GHG emissions in the voluntary context of the VCR. But their contribution was outgunned by the more numerous "free rider" companies.

Policy Assessment: The empirical evidence provided by the VCR program suggests that a voluntary approach to cutting Canada's industrial emissions is wholly inadequate.

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[144] Matthew Bramley, *The Case for Kyoto: The Failure of Voluntary Corporate Action* (Drayton Valley, AB: The Pembina Institute, 2002). Also available online at climate.pembina.org/pub/140.

Memorandum of Understanding with the Automotive Industry

In April 2005, the Government of Canada signed an MoU with Canada's two main associations of automobile manufacturers for a voluntary reduction in annual GHG emissions of 5.3 Mt below business-as-usual emission projections for 2010.[145] The targets set out in the MoU represent approximately a 25% reduction below business-as-usual emission levels for the sector. The agreement covers "light duty vehicles," a category that includes SUVs, minivans and pick-up trucks in addition to cars. The agreement also set out three interim goals — reductions of 2.4 Mt in 2007, 3.0 Mt in 2008 and 3.9 Mt in 2009, relative to a business-as-usual projection — and established a joint Industry Government Committee to monitor the agreement's effectiveness. The MoU states that "for greater clarity, the Government of Canada has the right to regulate any and all subjects within the government's purview, and will do so if it deems necessary."

The MoU also describes reporting requirements, which include reports on the 2007, 2008 and 2009 interim goals. The progress update on the 2007 interim goal due in May 2008 had not been published by mid-October 2008.[146] In the absence of this report, the precise methodology for quantifying emission reductions is not yet known.

Policy Assessment: The overdue report on the 2007 interim goal will represent the first public opportunity to assess the automotive industry's progress under the MoU. Because that report has not yet been released, it is not possible to assess the industry's compliance empirically. However, the present government has opted to replace the voluntary approach with a regulated fuel efficiency standard when the MoU expires at the end of 2010.

Policy Experience Internationally

The UK's Climate Change Agreements

The UK's Climate Change Agreements (CCAs) allow energy-intensive businesses to receive an 80% reduction on the Climate Change Levy — a tax on the use of energy in industry, commerce and the public sector — in return for meeting energy efficiency or CO_2 reduction targets.[147] The original CCAs covered 44 sectors and took effect in April 2001 when the Climate Change Levy

[145] *Memorandum of Understanding between the Government of Canada and the Canadian Automotive Industry Respecting Automobile Greenhouse Gas Emissions*, www.oee.nrcan.gc.ca/transportation/ghg-memorandum/documents/MOU-legal-signed-copy.pdf.

[146] See "Key Deliverables" in NRCan, *Automakers Agreement to Reduce GHG Emissions*, NRCan, www.oee.nrcan.gc.ca/transportation/ghg-memorandum/index.cfm (accessed October 19, 2008).

[147] Department for Environment, Food and Rural Affairs (DEFRA), *Climate change agreements*, DEFRA, www.defra.gov.uk/environment/climatechange/uk/business/ccl/index.htm (accessed October 22, 2008).

was introduced.[148] CCAs are currently in place for over 50 sectors covering approximately 16% of the UK's total CO_2 emissions; they are in effect until 2013.[149]

The CCAs allow participating firms to purchase CO_2 allowances from the UK emissions trading scheme (ETS) if they fall short of their targets, or to sell allowances if they surpass the targets. Although the UK ETS has been superceded by the EU ETS, the UK ETS market is continuing for CCAs.[150] Approximately 500 facilities covered by CCAs are also covered by the EU ETS; 330 of these were allowed to opt out of EU ETS for its first phase (2005–07), and the remainder had their CCA targets adjusted to avoid double counting of emission reductions.[151]

By 2006, it is estimated that the CCAs had reduced annual emissions from the covered sectors by 7 Mt CO2 (about 8%) relative to business-as-usual levels.[152,153]

Policy Assessment: This example demonstrates how voluntary programs are often used in combination with other types of policies — in this case, the Climate Change Levy and the UK ETS. The financial "stick" of the levy is clearly responsible for the significant emission reductions obtained by the CCAs. The introduction of the EU ETS a few years after the inception of the CCAs also illustrates the shift over time to more mandatory policies as governments take climate change more seriously.

[148] DEFRA, *Climate Change Agreements — Results of the Third Target Period Assessment* (London, UK: DEFRA, 2007), 1, 4. Also available online at www.defra.gov.uk/environment/climatechange/uk/business/ccl/pdf/cca-jul07.pdf.

[149] DEFRA, *Consultation on the Recommendations of the Climate Change Simplification Project* (London, UK: DEFRA, 2007), 6. Also available online at www.defra.gov.uk/corporate/consult/cc-instruments/consultation.pdf.

[150] Ibid., 4, 6.

[151] DEFRA, *Climate Change Agreements — Results of the Third Target Period Assessment*, 3.

[152] Ibid., 7.

[153] The 8% figure is calculated using the 16% coverage of UK's CO_2 emissions, which are about 550 Mt per year (see unfccc.int/resource/docs/2007/sbi/eng/30.pdf).

5. Investments in Infrastructure

Policy Experience in Canada

Federal Public Transit Investments

In Budget 2008, the federal government set aside up to $500 million of 2007–08 funds for a third-party public transit trust. To obtain the funding, which was notionally allocated on a per capita basis, provincial and territorial governments had to make public commitments before March 31, 2008 for investments in capital infrastructure for public transit. Eligible investments include rapid transit, rail, buses, and high-occupancy vehicle and bicycle lanes. The budget states that the beneficiaries "are encouraged to report publicly on the expenditures financed and outcomes achieved."[154]

Budget 2006 made use of a similar trust fund mechanism, the Public Transit Capital Trust, to allocate $900 million over three years (2006–07 to 2008–09) to public transit funding.[155] The previous government dedicated a portion of the federal excise tax on gasoline to municipal infrastructure, including public transit, and also created a $400 million public transit fund.[156] A portion of other federal infrastructure funding may also be used for transit projects.

Policy Assessment: In a February 2008 background paper,[157] the Canadian Urban Transit Association (CUTA) notes that the federal government has "greatly expanded" its transit funding efforts in recent years. However, CUTA also notes that a survey of its members (which include most of Canada's urban transit systems) revealed $20 billion in unmet infrastructure requirements from 2008 to 2012. The association concludes "Without greater investment, the ability of communities to maintain transit systems and respond to growth will be at risk. Canada remains the only OECD nation without a federal policy of predictable, long-term support for transit — a situation that will only be remedied through a permanent program of direct federal investment in transit infrastructure expansion and renewal."

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[154] Department of Finance Canada, *Responsible Leadership: The Budget Plan 2008* (Ottawa, ON: Department of Finance Canada, 2008), 132. Also available online at www.budget.gc.ca/2008/pdf/plan-eng.pdf.

[155] Department of Finance Canada, "One-Time Funding to Provinces and Territories," backgrounder, September 25, 2006. Also available online at www.fin.gc.ca/news06/data/06-048_1e.html.

[156] Infrastructure Canada, *Public Transit*, Infrastructure Canada, www.infrastructure.gc.ca/ip-pi/ptf-ftc/ptf-ftc-eng.html (accessed October 19, 2008).

[157] CUTA, *An Evolving Picture: Federal Transit Investments Across Canada* (Ottawa, ON: CUTA, 2008). Also available online at www.cutaactu.ca/sites/cutaactu.ca/files/Issue_Paper_27E1.pdf.

Policy Experience Internationally

U.S. Government Investments in Carbon Capture and Storage

In February 2003, Energy Secretary Spencer Abraham announced that the federal government would fund up to 80% of the estimated US $1 billion cost of constructing "FutureGen," the world's first coal-fueled, near-zero emissions power plant. The plant would use integrated gasification combined cycle (IGCC) technology, allowing CO_2 generated by the plant to be captured and sequestered underground, and would have a capacity of approximately 275 MW.[158] An agreement to build the plant, with a planned start-up date of 2012, was signed with an industry consortium in December 2005.[159]

In April 2007, the Department of Energy (DOE) announced that the total estimated cost of the FutureGen project had risen to US $1.7 billion through 2016, with the agreed DOE portion of the net total project cost now expected to be slightly over US $1 billion.[160]

In January 2008, Energy Secretary Samuel Bodman announced that the government was abandoning the project, and would instead provide funding to add CCS technology to multiple IGCC plants to be operational by 2015. Secretary Bodman stated: "This restructured FutureGen approach is an all-around better investment for Americans."[161]

Policy Assessment: This example illustrates the fact that building major infrastructure using new technology is susceptible to cost escalation and delay. Instead of using public funding to deploy CCS technology, with the attendant problems of "picking winners," a carbon pricing policy would allow private industry to choose the most cost-effective ways to cut emissions. However, the carbon price would need to be relatively high to make coal-fueled power using CCS economic; the resulting costs might be unmanageable for the private sector.

International Modelling Studies

Research on infrastructure spending has focused mainly on the timing of investment and capital stock turnover. In this regard, there is a variety of opinions on how jurisdictions should proceed in regard to the rate and scale of investments in emissions-reducing infrastructure. Rationales for delaying investments include:

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[158] DOE, "Abraham Announces Pollution-Free Power Plant of the Future," news announcement, February 27, 2003. Also available online at www.fossil.energy.gov/news/techlines/2003/tl_futuregen1.html.

[159] DOE, "FutureGen Project Launched," news announcement, December 6, 2005. Also available online at www.fossil.energy.gov/news/techlines/2005/tl_futuregen_signing.html.

[160] DOE, "DOE Signs FutureGen Cooperative Agreement," news announcement, April 10, 2007. Also available online at www.fossil.energy.gov/news/techlines/2007/07019-DOE_Signs_FutureGen_Agreement.html.

[161] DOE, "DOE Announces Restructured FutureGen Approach to Demonstrate Carbon Capture and Storage Technology at Multiple Clean Coal Plants," news announcement, January 30, 2008. Also available online at www.fossil.energy.gov/news/techlines/2008/08003-DOE_Announces_Restructured_FutureG.html.

- Delay allows extra time for research and development (R&D) to make low-emission technologies available at lower costs.[162]
- Delaying the replacement of capital stock avoids the costs associated with premature replacement.[163]
- The marginal productivity of capital will be higher in the future.

However, Mark Jaccard and Nic Rivers[164] explored the relationship between the turnover rate of capital stocks and delay decisions and found support for taking early action. Indeed, if capital planning decisions do not take into account society's objectives related to GHG reductions, then the added costs of meeting those objectives in the future will more than outweigh the costs of acting earlier: "Although these costs would be incurred several decades in the future, their magnitude may be such that even when discounted to the present they exceed the more immediate costs of beginning now to slowly adjust toward a less energy-intensive urban form."

For shorter-lived capital stocks (smaller buildings and equipment), Jaccard and Rivers support previous research that has found it to be economically optimal to invest in new infrastructure at the end of assets' life and not before.

Policy Assessment:

- The timing of infrastructure investments is an important consideration in the context of GHG emission reductions.
- It is justifiable to replace longer-lived GHG-intensive capital stocks before the end of their life. This category includes industrial facilities and transportation systems.

[162] Lawrence Goulder and Koshy Mathai. "Optimal CO_2 abatement in the presence of induced technological change," *Journal of Environmental Economics and Management 39,* no. 1 (2000): 1–38.

[163] Mark Jaccard and Nic Rivers, "Heterogeneous capital stocks and the optimal timing for CO_2 abatement," *Resource and Energy Economics* 29, no. 1 (2007): 1–16.

[164] Ibid.

6. Improvement of Government Operations

Policy Experience in Canada

Carbon-neutral Public Sector Commitment in British Columbia

British Columbia's *Greenhouse Gas Reduction Targets Act*, which came into force in January 2008, requires the province's public sector to be carbon-neutral each calendar year from 2010 onwards.[165] The legislation requires public sector organizations — a category that includes schools, universities and hospitals in addition to government departments — to track their emissions, make efforts to reduce them, and offset the remainder. The legislation also creates an obligation on the Minister of the Environment to prepare and table an annual report detailing the government's emissions, the actions it has taken (and plans to take) to reduce its emissions, and an account of any offsets purchased to reach carbon neutrality.

In August 2008, the Ministry of Environment issued an "intentions paper" outlining the proposed regulation that will set the rules for offsets used to meet the public sector carbon neutrality commitment.[166,167]

Policy Assessment: Because the requirement for carbon neutrality only takes effect in 2010, it is not possible to provide an empirical assessment of the policy's effectiveness at this time. A key factor determining environmental effectiveness will be additionality — the extent to which purchased offsets represent emission reductions that are beyond "business-as-usual," as opposed to emission reductions that would have occurred without the carbon-neutral commitment. The Ministry's intentions paper proposes relatively strong rules to ensure additionality, although their effectiveness will depend on how they are applied in practice.

Government of Alberta Renewable Energy Procurement

In March 2003, the government of Alberta announced that more than 90% of the electricity used in government-owned facilities would come from renewable and alternative sources, starting in

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[165] The act is available online at www.leg.bc.ca/38th3rd/3rd_read/gov44-3.htm.

[166] British Columbia Ministry of Environment, *Emission Offsets Regulation under the Greenhouse Gas Reduction Targets Act — Policy Intentions Paper for Consultation* (Victoria, BC: Ministry of Environment, 2008). Also available online at www.env.gov.bc.ca/epd/codes/ggrta/pdf/eor-ip.pdf.

[167] The Pembina Institute has commented on the intentions paper: Pembina Institute et al., *Comments on BC's Proposed Emission Offset Rules* (Drayton Valley, AB: The Pembina Institute, 2008). Also available online at www.pembina.org/pub/1708.

2005.[168] At the time of the announcement, only 0.5% of the power used in government-owned facilities came from renewable energy sources.

In 2005, Alberta Infrastructure fulfilled the government's 90% objective through purchase agreements with two Alberta-based energy providers, ENMAX and Canadian Hydro. ENMAX provides its share of the renewable power from a wind farm at McBride Lake, while Canadian Hydro provides power through biomass combustion at a facility in Grande Prairie.[169] Both projects have been certified under the EcoLogo environmental standard.

Policy Assessment: Although GHG emissions from Alberta's government operations account for only a small proportion of the province's total emissions, the government's commitment to meet over 90% of its electricity needs from green power sets an example to other Canadian governments. The government's objective also helped to stimulate the development of new renewable energy projects in the province.

Policy Experience Internationally

UK Government Sustainable Procurement Action Plan

In March 2007, the UK government released a plan to make its purchases more environmentally responsible. The UK Government Sustainable Procurement Action Plan describes actions the government will take to "ensure that government supply chains and public services are increasingly low carbon, low waste and water efficient while respecting biodiversity and deliver wider sustainable development goals."[170] The plan is expected to directly influence about £60 billion ($120 billion) of the £150 billion total annual public sector procurement expenditure.[171]

The plan includes the following climate-related targets:[172]

- reduce CO_2 emissions from offices by 12.5% by 2010/11, and by 30% by 2020, relative to 1999/2000 levels
- offset 100% of CO_2 emissions from the "Central Government's office estate" by 2012
- reduce CO_2 emissions from road vehicles used for government administrative operations by 15% by 2010/11, relative to 2005/06 levels
- offset around 100,000 tonnes of CO_2 per year by 2009 through an air travel offsetting scheme (to which all Departments have signed up).

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[168] Government of Alberta, "Alberta leads country in purchase of green power," news release, March 12, 2003. Also available online at www.gov.ab.ca/acn/200303/14035.html.

[169] Ibid. and Alberta Ministry of Infrastructure, *Environmental Initiatives*, Ministry of Infrastructure, www.infrastructure.alberta.ca/501.htm (accessed October 19, 2008).

[170] HM Government, *UK Government Sustainable Procurement Action Plan* (London, UK: HM Government, 2007), 2. Also available online at www.defra.gov.uk/sustainable/government/publications/pdf/SustainableProcurementActionPlan.pdf.

[171] Ibid., 6.

[172] Ibid., 40, 7.

The UK government purchases most of its GHG offsets centrally through a Carbon Offsetting Fund which invests principally in CDM projects in developing countries that "are small-scale, involve renewable energy and/or energy efficiency, and have additional sustainable development benefits."[173]

Policy Assessment: Given the government's major role in the economy, the implementation of the action plan is expected to help increase significantly the demand for and hence markets for environmentally responsible goods and services. It remains to be seen whether the plan will change actual procurement decisions sufficiently for the targets to be met.

[173] DEFRA, *Carbon offsetting: Government emissions*, DEFRA, www.defra.gov.uk/environment/climatechange/uk/carbonoffset/government.htm (accessed October 22, 2008).

7. Indirect GHG Reduction Policies

Policy Experience in Canada

Investments in Technology Development: ecoENERGY Technology Initiative[174,175]

In January 2007, the Government of Canada announced $230 million in R&D funding for "technology solutions in clean energy." The ecoENERGY Technology Initiative is intended to "accelerate the development and market-readiness" of clean energy in Canada.

After consultation with stakeholders, the government selected eight priority areas for investment:

- cleaner fossil fuels
- clean coal and CCS
- distributed electricity generation
- next-generation nuclear energy technologies
- bio-based energy systems
- low-emission industrial systems
- clean transportation systems
- built environment.

The fund will be allocated in two ways: through a competitive bidding process on "theme-based" project proposals, and to federal laboratories. The first "theme-based" project proposal competitions (covering cleaner fossil fuels and clean coal/CCS) closed on May 2, 2008. A shortlist of proponents have been asked to submit full project proposals. NRCan expects to announce its final project selections by the end of November 2008.

Policy Assessment: Because the ecoENERGY Technology Initiative is still in its initial stages, it is too early to provide an empirical assessment of its effectiveness.

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[174] NRCan, "Canada's New Government launches ecoENERGY Technology Initiative," news release, January 17, 2007. Also available online at www.nrcan-rncan.gc.ca/media/newcom/2007/200701-eng.php.

[175] Office of Energy Research and Development, *ecoENERGY Technology Initiative*, NRCan, www2.nrcan.gc.ca/ES/OERD/english/View.asp?x=1603 (accessed October 19, 2008).

Investments in Public Awareness: One Tonne Challenge[176]

Starting in the 1998 budget, the Government of Canada allocated funds for public education and outreach related to climate change. The flagship outreach program, which was publicly launched in March 2004, was the "One-Tonne Challenge" (OTC). This program received net funding of $37 million over the three years from 2003 to March 2006.

The program aimed to encourage and motivate Canadians to take personal action to reduce their GHG emissions. "One tonne" represents an approximate 20% reduction in the annual emissions from the personal activities of an average Canadian, which are about 5 tonnes. The program encouraged energy conservation, energy efficiency, the increased use of public transit and other measures through public education and outreach, including a national marketing initiative and partnerships with key sectors of Canadian society. Most notably, the program was responsible for TV commercials that encouraged Canadians to "take the challenge," featuring comedian Rick Mercer.

The government released an updated climate plan in April 2005, which included a commitment to strengthen and extend the OTC program through to the 2012–13 fiscal year with an additional investment of $120 million. In April 2006, the current government announced the cancellation of the OTC program,[177] stating that a "different approach [is] required."[178]

Policy Assessment: Environment Canada (the department that co-managed the OTC program, along with NRCan) completed an audit of the program in July 2006. The department concluded that:

> *The OTC was found to be on track to achieve its public education outcomes. The level of awareness of the OTC increased significantly from 2004 to 2005. The OTC was generally understood by Canadian citizens as a program designed to reduce emissions and/or energy use, and Canadians supported the Challenge, including an expressed willingness to take personal action to reduce GHG emissions. It is not clear, however, whether the OTC was on track to achieve its emission reduction target. The evaluation found that the Program was faced with a number of measurement issues which challenged it in delivering clear and attributable GHG emission reductions. Moreover, the evaluation also found that a majority of Canadians believe that it will be difficult to personally meet such a Challenge.*

The evaluation also concluded that:

> *To achieve GHG emission reductions, national public education and outreach (PEO) programs like the OTC need to be complemented by additional tools (e.g., economic instruments, regulations) to assist Canadians in reducing the GHG emissions that they produce.*

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[176] Environment Canada, *Audit of the One-Tonne Challenge Program* (Gatineau, QC: Environment Canada, 2006). Also available online at www.ec.gc.ca/ae-ve/default.asp?lang=En&n=E0530F2A-1.

[177] Government of Canada, "First Steps Taken Towards a Made-in-Canada Approach," news release, April 13 2006. Also available online at www.nrcan-rncan.gc.ca/media/newcom/2006/200609-eng.php.

[178] Government of Canada, "Climate Change Programs," backgrounder, April 13, 2006. Also available online at www.nrcan-rncan.gc.ca/media/newcom/2006/200609a-eng.php.

Targets: Legislated Targets for Total Emissions

British Columbia's *Greenhouse Gas Reductions Targets Act* came into force in January 2008.[179] The act sets the following targets for reductions in BC's total GHG emissions:

- a reduction to 33% below the 2007 level by 2020
- a reduction to 80% below the 2007 level by 2050
- a carbon-neutral public sector in 2010 and each calendar year thereafter.

The legislation also requires public reporting on its targets once every two years and the publication of a 2007 baseline "as soon as reasonably practical."

Manitoba has also set a 2012 target in law. The *Climate Change and Emissions Reductions Act*, which received assent in June 2008,[180] sets a 2012 target of reducing Manitoba's emissions to 6% below the 1990 level (a "Kyoto-level" target, although Canada's Kyoto target covers the average emissions of the 2008–2012 period, not just 2012). Manitoba's law, like British Columbia's, requires public reporting on progress toward the target. It also includes provisions for energy efficiency in buildings, equipment and vehicles; in all cases, the details are left to future regulations.

A third approach to legislated targets is the *Kyoto Protocol Implementation Act*,[181] a private member's bill that became federal law through the support of opposition MPs in a minority Parliament. The law, which entered into force on June 22, 2007, requires the Government of Canada to achieve Canada's Kyoto Protocol emission reduction target through regulatory or other policy measures. The Act includes extensive accountability provisions, including a requirement for an annual Climate Change Plan and an assessment of the plan by the independent NRTEE. The law has not, to date, altered the federal government's position that Canada's Kyoto Protocol target is unachievable, but it has resulted in the publication of two federal climate change plans,[182,183] which both contained previously unpublished information, and two relatively critical NRTEE assessments of those plans.[184,185] In 2009 the federal Environment Commissioner will also be required to audit the government's progress in implementation its climate change plans.

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[179] The act is available online at www.leg.bc.ca/38th3rd/3rd_read/gov44-3.htm.

[180] The act is available online at www.canlii.org/mb/laws/sta/c-135/20080818/whole.html.

[181] The act is available online at laws.justice.gc.ca/en/ShowFullDoc/an/2007_30///en.

[182] Environment Canada, *A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act — 2007* (Gatineau, QC: Environment Canada, 2007). Also available online at www.ec.gc.ca/doc/ed-es/p_123/CC_Plan_2007_e.pdf.

[183] Environment Canada, *A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act* (Gatineau, QC: Environment Canada, 2008). Also available online at www.ec.gc.ca/doc/ed-es/p_124/CC-Plan-2008_eng.pdf.

[184] NRTEE, *Response of the National Round Table on the Environment and the Economy to its Obligations under the Kyoto Protocol Implementation Act* (Ottawa, ON: NRTEE, 2007). Also available online at www.nrtee-trnee.com/eng/publications/KPIA-2007/NRTEE-C288-Response-2007-eng.pdf.

[185] NRTEE, *Response of the National Round Table on the Environment and the Economy to its Obligations under the Kyoto Protocol Implementation Act* (Ottawa, ON: NRTEE, 2008). Also available online at www.nrtee-trnee.com/eng/publications/KPIA-2008/kpia-2008.pdf.

Policy Assessment: British Columbia's and Manitoba's legislated targets are too recent to provide empirical evidence of their effectiveness, but because they do not require that the respective governments take steps to ensure the targets are met, and have only modest reporting requirements, they are unlikely to differ significantly from targets that are stated merely as political commitments. The federal Kyoto law has more "teeth:" it does not seem to be achieving its stated purpose of meeting Canada's Kyoto target, but has nonetheless provided a basis for the government to be taken to court on that point.[186] The law has also already shown itself to be an effective tool for promoting accountability around the effectiveness of federal GHG reduction policies.

Transfers: Trust Fund for Clean Air and Climate Change

In February 2007, Prime Minister Harper announced a national fund for climate and clean air initiatives in Canada's provinces and territories. Initially called the Canada ecoTrust for Clean Air and Climate Change, the fund received just over $1.5 billion over three years in Budget 2007.[187] The budget plan states that the fund will "provide support to those provinces and territories that identify major projects that will result in real reductions in greenhouse gas emissions and air pollutants." The funding is allocated on an approximately per-capita basis, with minimum funding of $15 million per province and $5 million per territory.

The agreement governing the fund[188] makes very little effort to prescribe the types of investments that provinces can make with this funding. Instead, the agreement document offers an illustrative list of "Possible areas of investment," which include energy efficiency, renewable energy, "deployment of strategic new technologies to abate air pollution and greenhouse gas emissions," expansion of electricity transmission infrastructure and CCS. However, the document states that provinces also have the flexibility to use the funding for "their respective needs and priorities, based on their own schedules, which they can modify as they deem appropriate." Under the heading "Accountability and Reporting to Canadians," the document states: "Provincial and territorial governments are encouraged to report directly to their residents on the expenditures financed and outcomes achieved as a result of funding provided through the Canada ecoTrust for Clean Air and Climate Change."

Policy Assessment: Because the federal government appears to have attached no firm conditions or reporting requirements to the use of this funding, there is no assurance that provinces and territories will use it to reduce emissions beyond business-as-usual or cost-effectively. Environment Canada has estimated that the trust fund will deliver a 16 Mt reduction in annual emissions below business-as-usual levels, starting in 2008.[189] However, this is virtually impossible given both the amount of the funding and the short time since it was granted. The

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[186] Friends of the Earth Canada, "Friends of the Earth Takes Federal Government to Court over Kyoto Failure," news release, June 18, 2008. Also available online at www.foecanada.org/index.php?option=content&task=view&id=364&Itemid=2.

[187] Department of Finance Canada, *Aspire to a Stronger, Safer, Better Canada: The Budget Plan 2007* (Ottawa, ON: Department of Finance Canada, 2007), 63, 135. Also available online at www.budget.gc.ca/2007/pdf/bp2007e.pdf.

[188] Department of Finance Canada, "Operating Principles for the Canada ecoTrust for Clean Air and Climate Change" (memorandum obtained by the Pembina Institute through communication with the department).

[189] Environment Canada, *A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act*, 22.

NRTEE has concluded that the emission reductions from the trust fund are "likely overestimated," or else have already been counted elsewhere in the government's plans and thus cannot be attributed to the fund without double counting.[190]

Policy Experience Internationally

EU Directive on Labelling of New Cars

The EU's Directive on labelling of new cars, which came into effect in 2001, ensures that information on the CO_2 emissions of all new cars offered for sale or lease in the EU is made available to consumers prior to purchase.

The directive requires:[191]

- a fuel economy label for all new cars to be displayed at the point of sale
- a poster (or a display) showing the official fuel consumption and CO_2 emissions data of all new car models to be displayed or offered for sale or lease at the point of sale
- a more detailed guide on fuel economy and CO_2 emissions containing data for all new car models to be available at any point of sale free of charge
- all promotional literature to contain the official fuel consumption and specific CO_2 emission data for the car models to which it refers.

Policy Assessment: This directive ensures consistent standards throughout the EU for informing consumers about the CO_2 emissons of new cars. On its own, labelling is not expected to lead to significant emission reductions but does help consumers who wish to reduce their emissions to make informed decisions. A 2005 study of the effectiveness of the directive, commissioned by the European Commission, found that "economy and environmental impact are in general no major factor in vehicle purchase decisions" and that "the major factors influencing consumer decisions are in general car reliability, safety qualities, comfort and cost/price. But also vehicle size, engine power and manufacturers' image are quite important."[192]

[190] NRTEE, *Response of the National Round Table on the Environment and the Economy to its Obligations under the Kyoto Protocol Implementation Act* (Ottawa, ON: NRTEE, 2007), 35–36.

[191] European Commission, *Objective of the Directive relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars*, European Commission, ec.europa.eu/environment/air/transport/co2/co2_directive.htm (accessed October 22, 2008).

[192] ADAC, *Study on the effectiveness of Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars* (Munich, Germany: ADAC, 2005), 27–28. Also available online at ec.europa.eu/environment/air/transport/co2/report/final_report.pdf.

International Modelling Studies

Research and Development

A significant amount of research has examined the role of R&D as part of a portfolio of climate policies. According to Popp,[193] subsidies for R&D alone cannot spur the innovation required to induce effective amounts of GHG emission reductions, relative to other policy options such as carbon pricing. However, Fisher and Newell show that R&D subsidies can be an effective means to lower the marginal cost of technology deployment, i.e., the required carbon price.[194]

Research on the role of R&D in reducing GHG emissions has concluded that private firms will, as a rule, under-invest in R&D for two main reasons:[195]

- Emissions are an environmental externality and, in the absence of government policy, private firms have no incentive to reduce emissions.
- Knowledge "spillovers" resulting from the "public goods" nature of knowledge provide little benefit to private firms.

Popp reviewed research on the social and private returns from investments in R&D and found that the marginal social rates of return for investments in R&D are between 30–50%, whereas private marginal returns range from 7–15%.

In its Fourth Assessment Report (2007), the IPCC examined the role of R&D in reducing GHG emissions and found that "government funding in real absolute terms for most energy research programs has been flat or declining for nearly two decades… and is now about half of the 1980 level."[196]

Policy Assessment:

- Public investment in R&D provides relatively higher rates of return on investment than private investment in R&D due to spillover effects.
- R&D is complementary to, not a replacement for other policy instruments for reducing GHG emissions.

[193] David Popp, "R&D Subsidies and Climate Policy: Is There a Free Lunch?," *Climate Change* 77 (2006): 311–341.

[194] Carolyn Fisher and Richard Newell, "Environmental and technology policies for climate mitigation," *Journal of Environmental Economics and Management* 55, no. 2 (2008): 142–162.

[195] Popp.

[196] IPCC, 20.