Canada’s efforts towards greenhouse gas emission reduction: a case study on the limits of voluntary action and subsidies

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Abstract: Canada has committed internationally to several agreements to limit climate change, most recently by ratifying the Kyoto Protocol in 2002. However, its domestic climate change policy is not reflective of these international commitments. In particular, federal government climate change policy over the last decade has emphasised noncompulsory policies such as voluntarism, information provision, and modest subsidies. These policies are designed primarily to engender minimal political resistance, and have been relatively ineffective in providing the incentives and regulatory structure for the dramatic technological and behavioural change required for significant greenhouse gas emissions reductions. Without a major change in direction towards more compulsory policies, it seems unlikely that Canada will achieve significant domestic greenhouse gas reductions over and beyond the Kyoto Protocol time frame. We suggest a more compulsory policy approach dominated by market-oriented regulations. When designed appropriately, this type of policy stimulates the development and commercialisation of new technologies without dramatically affecting prices of energy or goods.

Keywords: Canada; climate change; voluntary action; policy.


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1  Canada’s international commitments on climate change

Canada has a history of multilateral engagement on international environmental issues. For example, Canada is considered a leader on acid rain abatement, protection of the ozone layer, maintenance of biodiversity, and the banning of persistent organic pollutants (Le Prestre and Dufault, 2001). The multilateral cooperative process through which many environmental agreements are negotiated offers this country an opportunity to provide diplomatic leadership and progressively shape international environmental policy.

In the early days of international negotiations to limit emissions of greenhouse gases (GHGs), Canada was also considered a leader in this field. In 1988, Canada hosted the World Conference on the Changing Atmosphere, the first scientific conference on global warming. During these talks, Canada developed a target of reducing its output of GHGs by 20% from 1988 levels by the year 2005. Later that year, Canada pushed to have climate change included in the agenda for G7 talks. During these discussions, Canada’s prime minister made an international commitment to stabilise national emissions of GHGs at 1990 levels by the year 2000. These commitments were echoed in national policy documents in 1990, and again committed to internationally at the 1992 Earth Summit in Rio de Janeiro, where Canada ratified the United Nations Framework Convention on Climate Change (UNFCCC), which came into effect in 1994. This latter agreement was superseded by the Kyoto Protocol to the UNFCCC, under which Canada committed to a 6% reduction from 1990 GHG emissions levels during the period 2008–2012. Canada signed the Kyoto Protocol in 1997 and ratified it in 2002.

With the growing unlikelihood of ratification by the USA, and recognition that its target may be the most ambitious and costly among all Kyoto signatories, Canada has put considerable negotiation effort into the development of ‘flexibility mechanisms’ that might make its burden more in line with that of other Annex I countries. These allow domestic GHG reduction to be replaced with GHG credits bought from other countries or obtained through low-GHG projects in countries not bound by the Kyoto Protocol, and credit development of forest and agricultural soil sinks which sequester GHGs. Canada has also pushed for clean energy exports to count towards its climate change goals. Specifically, it argues that exporting natural gas displaces the use of coal for electricity generation in the USA, and thus results in GHG savings of up to 70 Mt, for which it should be credited (Government of Canada, 2002).

Internationally then, Canada has been a relatively engaged participant on agreements to abate climate change. This is in contrast to domestic action on climate change by Canada’s federal government, which has emphasised voluntary action and modest subsidies as main policy tools, and appears to have had limited effectiveness.

2  Canada’s domestic action on climate change

Throughout the late 1980s and early to middle 1990s, the Canadian populace was relatively unengaged from international and domestic efforts towards GHG reduction. The agreements being discussed internationally were not legally binding, and popular support for action towards environmental protection in general was strong. However, after the Kyoto Protocol was signed by Canada in 1997, and the threat of legally binding emissions reductions was introduced, the domestic debate heated up, especially leading to the eventual ratification of the Kyoto Protocol in December of 2002. Although climate
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change abatement continued to be considered important among average Canadians, several provincial and industry lobby groups led vocal opposition to the ratification of the Kyoto Protocol. They galvanised their position around several points of concern:

- **Geographic/demographic situation** – Canada is a large country with a low population density and an extreme climate. As such, its people have developed large demands for mobility, and more energy is required for space heating and cooling than in more temperate countries. In addition, Canada has a much higher rate of population growth than most other countries that have agreed to similar GHG reductions under the Kyoto Protocol. The Kyoto Protocol targets are absolute, not based on per capita emissions, meaning that Canada has relatively more stringent targets than these other countries, and consequently faces higher marginal costs of GHG reduction than other countries in order to meet its Kyoto Protocol targets.

- **National economic impacts** – Canada is perceived to rely on primary industries for a relatively large portion of its GDP. Many of these (e.g., production of aluminium and pulp and paper, petroleum refining) are extremely energy-intensive and have strong and vocal industry associations. Reducing GHG emissions through reducing energy consumption in these industries is perceived as expensive. In addition, these primary industries are not evenly distributed across the country. As a federal system, Canada is continually challenged about regional equity and income redistribution. Climate change policy in Canada would almost certainly have different regional impacts, which has made implementation extremely difficult.

- **International trade** – Canada derives over 40% of its GDP from exports (Curtis, 2004), and Canada’s main trading partners face comparatively less stringent GHG reduction targets than Canada. The USA, which has not ratified the Kyoto Protocol or committed to alternative binding GHG reduction targets, is the destination for 87% of Canada’s exports; Canada is likewise the largest importer from the USA (Curtis, 2004). Much of the remainder of Canada’s trade is with developing countries, which are not subject to binding GHG reduction targets under the Kyoto Protocol. Industry groups have voiced concerns that Canada’s open economy and unique commitments to GHG reduction among its trading partners will hinder its international competitiveness, possibly resulting in large job losses and out-migration of businesses.

In summary, it was argued that stringent action on GHG abatement in the short term, as prescribed by Canada’s commitments to the Kyoto Protocol, would be both harmful to the way of life of average Canadians, and harmful to the economic competitiveness of Canada’s corporations, perhaps resulting in the substantial loss of jobs to other countries.

In addition to direct opposition to major short-term GHG abatement for the reasons described, the federal government was and continues to be limited in its flexibility to implement policies for two other reasons. First, the federal government is under pressure to limit government spending. In 1998, Canada produced its first budget surplus in decades, and began to pay off its large national debt. Significant priority has since been placed on balanced budgets by the federal government, and on increasing the federal government’s contribution to healthcare and security costs.

Second, the flexibility of the federal government to develop GHG abatement policies is limited by division of jurisdiction between the provincial and federal governments.
under the Canadian constitution. Several potential sources for GHG reductions fall largely under provincial jurisdiction, including important sectors like transportation and electricity generation. Most others are at least partly under provincial jurisdiction, as the provinces have constitutional authority over “development, conservation, and management of nonrenewable natural resources and forestry resources” (Constitution Act, 1982). Despite this perceived federal weakness, the Canadian constitution does provide several avenues for a determined federal government to implement policies aimed at GHG reduction, especially when the provinces do not adequately deal with such matters.

In short, a gulf has developed between the relatively stringent international commitments agreed to by the federal government and its flexibility to implement domestic GHG abatement policies, which have thus far been characterised by an emphasis on minimising adverse impacts and controversy. The remainder of this paper is an analysis of past and present action on climate change by the federal government.

3 Policies for GHG emission reduction

3.1 Policy evaluation

A useful concept to introduce at this point is a spectrum of policy compulsoriness (Jaccard et al., 2004). We use this uncommon term because it best expresses the degree to which certain behaviour is required by an external force, an important consideration when evaluating policies. One end of the spectrum depicts policies that are completely noncompulsory – encouraging voluntary behaviour by consumers and companies – while the other end depicts policies that mandate a specific action. Figure 1 illustrates this spectrum and characterises conventional policy options along the spectrum.

**Figure 1** Spectrum of policy compulsoriness

At the noncompulsory end of the spectrum are voluntary and information programmes. With these policies, individual consumers and companies determine their level of effort for environmental protection and improvement, while government functions as information provider, facilitator, role model, and award giver.

Command and control regulations, at the other end of the spectrum, mandate specific emission levels or technology characteristics, with noncompliance incurring stringent financial or legal penalties. This type of policy generally requires equal actions of all participants, with severe penalties for inaction.
Subsidies or financial incentives such as grants, low interest loans, and tax credits improve the financial returns to businesses and consumers who take specified actions to reduce emissions. While this approach appears noncompulsory, governments must acquire their funds from various types of compulsory taxes.

In the middle of the spectrum, we group some recent policy innovations for GHG reduction. Environmental fiscal reform, also called tax shifting, combines financial incentives and disincentives in an effort to increase political acceptance. In this approach, all revenue from environmental taxes is dedicated on reducing other duties that hinder efficiency or are unpopular.

The Emissions Cap and Tradable Permit (ECTP) system is included near the middle of the spectrum. Under this policy, government sets a maximum level of emissions (a cap), and then allocates tradable emissions permits to all emitters covered by the programme. Usually the permits decrease in number or value over time, gradually lowering the aggregate emissions cap. The ECTP is a form of regulation in that the aggregate emissions cap cannot be exceeded, participation is compulsory, and penalties for noncompliance are severe. Unlike traditional command-and-control regulation, however, the policy allows participants to determine their emission levels and whether they will buy or sell in the emission permit market. Because of these dual characteristics, we refer to this type of policy as a market-oriented regulation. The US government’s amendments to its Clean Air Act in 1990 applied ECTP to SO₂ emissions from electricity plants with encouraging results in terms of environmental effectiveness and economic efficiency (Stavins, 1998). Policy researchers concerned with the ‘prices vs. quantities’ debate (Weitzman, 1974) like the fact that the ECTP can be coupled with a ‘safety valve’ – an agreed upon price at which the regulatory agency agrees to sell an unlimited number of tradable permits. This safety value reduces the cost of compliance in the event that emission reduction quantities were set inappropriately (Jacoby and Ellerman, 2004).

The ECTP focuses on emissions, but the principles of the market-oriented regulatory approach have also been applied to sector-specific policies focused on creating niche markets for forms of energy or groups of technologies. In the electricity sector, some jurisdictions have experimented with the renewable portfolio standard (RPS) – a requirement that renewable forms of energy, such as wind, biomass, hydro, and solar – generate a minimum percentage of a jurisdiction’s total electricity. In the personal-vehicles area, California and now other jurisdictions have adopted the vehicle emission standard (VES) – a requirement that low- and zero-emission vehicles attain a minimum percentage of vehicle sales (the California Air Resources Board refers to these cars as low emission vehicles (LEV), super low emission vehicles (SULEV), and zero emission vehicles (ZEV)). The RPS and VES are like the ECTP in stipulating an aggregate market outcome while allowing flexibility among participants to minimise compliance costs. They differ by focusing on energy forms and technologies instead of emissions, and by creating in effect a market niche. Either form of market-oriented regulation generally increases in stringency gradually over time – providing a stable long-term signal to consumers and industry.

Regulations that establish niche markets for new technologies and energy forms are attractive because they target only a small segment of the capital stock, and so have a minimal effect on average prices. For example, RPS’s throughout the US states have requirements that between 1% (in Arizona) and 30% (in Maine) of total electricity come from renewable sources (Berry and Jaccard, 2001). However, because they set ambitious
technology goals for these niche markets, they contribute to technology development and
diffusion that ultimately lower the costs of the new technologies.

Financial disincentives like GHG taxes are also considered fairly compulsory policies
under our grouping. These policies do not specify a particular action; the business or
consumer chooses between taking no action to reduce emissions and paying taxes or
reducing emissions in order to pay less tax. However, recent attempts to impose or
increase financial disincentives, especially in North America, have not attained political
acceptance, with opponents successfully portraying these as poorly disguised attempts to
replenish government coffers (Svendson, 1998; Hammar et al., 2004).

Policies at the noncompulsory end of the policy spectrum are generally possible for a
government to implement with minimum political opposition. Since they allow a high
degree of flexibility in what types of action to take and even whether to participate, they
engender minimum resistance. However, because of this flexibility, they tend to be less
effective at reducing GHG emissions than more compulsory policies. Policies at the
compulsory end of the spectrum, in contrast, allow limited flexibility in whether or how
to participate, and therefore are effective at achieving their set goals. Because of this,
they tend to be viewed negatively by both businesses and the general population, who
resent limitations on freedom of choice.

The rest of this section outlines the Canadian government’s domestic action on
climate change through this policy evaluation lens, with emphasis on characterising the
political feasibility of policies as well as their effectiveness and economic efficiency.

3.2 Canadian policy approach to GHG emission reduction

Canadian policies on climate change have been developed over the course of a decade, in
three major increments. Shortly after ratifying the UNFCCC in 1992, Canada initiated the
‘National Action Program on Climate Change’, which included information programmes,
voluntary challenges, and modest financial incentives. Its main policy instrument for
Canadian industry was the Voluntary Challenge and Registry (VCR), under which
companies submit an action plan for GHG reduction and provide regular progress reports,
all on a voluntary basis. The VCR then issues certificates and awards to celebrate
companies who achieve emissions reduction targets. By 2000, the VCR had 757 action
plans covering 75% of all industrial emissions.8

The National Action Program on Climate Change also included other measures at the
noncompulsory end of the spectrum, including the Federal Buildings Initiative, whereby
federal government buildings would be retrofitted for energy efficiency, with a view to
developing best practices for the commercial and institutional sectors, and the
development of a National Communication Program designed to educate Canadians
about climate change.

After signing the Kyoto Protocol in 1997, the federal government launched ‘Action
Plan 2000 on Climate Change’, a set of initiatives designed to reduce domestic emissions
of GHGs by 49 Mt CO2e by 2010 (Government of Canada, 2000). As Table 1 shows,
most of these initiatives continue the noncompulsory policy approach. The analysis and
literature cited in the following sections suggests that voluntary measures are frequently
ineffective, indicating that the actual magnitude of emissions reductions that will result
from these measures may be much less than the projected 49 Mt.
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Table 1 Primary policies for GHG reduction under Action Plan 2000

<table>
<thead>
<tr>
<th>Sector</th>
<th>Initiative</th>
<th>Policy type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>Partnerships with automotive manufacturers and ethanol producers</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Information provision through <em>EnerGuide for Vehicles</em></td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Demonstration projects for hydrogen distribution infrastructure and efficient urban transportation</td>
<td>Information</td>
</tr>
<tr>
<td>Energy sector</td>
<td>Demonstration project for carbon sequestration</td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Information provision and moral suasion through the <em>Canadian Industry Program for Energy Conservation</em></td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Voluntary agreements with industry</td>
<td>Voluntary</td>
</tr>
<tr>
<td></td>
<td>Financial incentive for renewable energy</td>
<td>Subsidy</td>
</tr>
<tr>
<td></td>
<td>Purchase of green power by government</td>
<td>N/A</td>
</tr>
<tr>
<td>Industry</td>
<td>Information gathering and benchmarking</td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Energy-efficiency audits for small and medium enterprises</td>
<td>Subsidy</td>
</tr>
<tr>
<td>Buildings</td>
<td>Information provision to encourage retrofits in commercial sector</td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Information provision through <em>EnerGuide for Houses</em></td>
<td>Information</td>
</tr>
</tbody>
</table>

Prior to ratifying the Kyoto Protocol in December 2002, the federal government released the ‘Climate Change Plan for Canada’ Government of Canada (2002), which outlines policies for achieving a further 100 Mt CO\textsubscript{2}e of emission reductions. The primary programme proposed in the Climate Change Plan is a system of negotiated covenants with large industrial emitters (including electricity generators), backed up with an emissions (intensity) cap and tradable permit system. This particular policy would deviate from the voluntary approach that has characterised federal government action on climate change, and as such is anticipated to generate significant emissions reductions. However, the policy has not yet been implemented as negotiations with industries are underway, and with each year of negotiations and policy uncertainty, more opportunities for GHG abatement within the Kyoto time frame are lost.

Other policies in the Climate Change Plan for Canada continue the focus on voluntary action complemented with modest government subsidies. These noncompulsory policies include some financial support for public transit; encouraging high efficiency insulation standards by commercial building developers; a voluntary target of 10% renewables for new electricity generation; and a voluntary target for improved vehicle efficiency. Many of the policies targeting GHG emissions from households fall under the ‘One-tonne Challenge’, in which the Government of Canada hopes to encourage each Canadian to reduce GHG emissions by one tonne by providing “education and public outreach initiatives to provide Canadians with better information on how they can contribute” (Government of Canada, 2002).

Subsidy programmes for GHG abatement were introduced in the 2003 Budget to support the Climate Change Plan including $131 million for residential building shell and heating system improvements; $250 million for research and development of energy-efficient technologies; $303 million for industrial energy-efficiency actions; $321 million for improvements to federal government buildings, vehicles, and infrastructure; and financial support for a demonstration plant that would capture and sequester carbon (Department of Finance, 2003).
4 Evaluation of Canadian policies for GHG emission reduction

Overall, it is possible to characterise the current Canadian domestic approach to GHG emission reduction as mostly voluntary with some modest subsidy programmes, apart from the possible development of an emissions trading programme for large industrial emitters. This section will discuss the ramifications of the Canadian approach from several perspectives. First, we outline other literature on the effectiveness of voluntary measures and subsidy programmes. Next, we discuss the effects of certain Canadian GHG reduction programmes in particular. We then turn to a discussion of the aggregate trends in GHG emissions in Canada. Finally, we consider the effects of the current approach to GHG reduction from the perspective of long-term technological change.

4.1 General discussion of policy approach

Voluntary approaches to environmental protection, including climate change mitigation, have expanded widely in recent years, particularly in North America. However, while the growth of voluntary programmes has been dramatic, and participating industries offer much anecdotal evidence of voluntary actions to improve the environment, we know little about the aggregate effectiveness of such programmes (Harrison, 1999). In a recent survey of voluntary approaches to environmental protection, Khanna noted that only a few empirical studies have tried to estimate the actual environmental impact of such programmes, and these have not found much effect attributable to the voluntary programmes (Khanna, 2001). Similarly, the OECD recently concluded that the “environmental effectiveness of voluntary approaches is still questionable”. It added: “The economic efficiency of voluntary approaches is generally low” (OECD, 2003).

Subsidies to encourage GHG emission reduction are likewise criticised for their ineffectiveness. It is difficult to design subsidy programmes to exclude free-riders – participants who qualify for the subsidy even though they would have undertaken the action anyway. Sutherland conducts a simple analysis of subsidy programmes using comparative statistics, and shows that the greatest benefit of subsidy programmes, as measured by consumer surplus, accrues to free-riders who change their behaviour the least (Sutherland, 2000). In addition, he finds that the cost of subsidy programmes is at least twice as great as the benefit of the subsidy, again measured by changes in consumer surplus (assuming a linear demand curve for the subsidised technology). He concludes that “The simple, but unfortunate principle is that rebates (subsidies) have their greatest appeal to exactly the wrong participants. An implication of this principle is that rebates (subsidies) are unlikely to be cost-effective” (Sutherland, 2000).

There is empirical evidence to support this claim. Loughran and Kulick show, in a survey of demand side management programmes in the USA, that the cost of subsidy programmes is often higher than expected (Loughran and Kulick, 2004). By comparing relative changes in electricity consumption over a decade in jurisdictions with demand side management (usually subsidy) programmes to those without, they find that the benefits of these programmes are systematically overestimated, often because the electric utilities ignore the effects of free-riders. After correcting for free-riders, they find that the cost of reducing electricity demand through demand side management is US$0.06–0.22/kWh, substantially higher than the cost of increasing electricity supply.
Using an alternative micro-economic approach that models programme participation on an individual basis, Train and Waldman and Ozog find that subsidy programme free-riders greatly reduce programme effectiveness (Train, 1988; Waldman and Ozog, 1996). In particular, they find that about 70% of electricity demand reductions attributed to the subsidy programmes would have occurred in absence of the subsidy programme. These free-riders greatly increase the cost of a subsidy without contributing to its effectiveness.

Newell and Fisher criticise subsidy programmes for stimulating the growth of renewable energy in particular because they do not contribute to reducing overall demand for electricity, instead simply focusing on energy sources (Fisher and Newell, 2003). This stands in contrast to other policies like renewable portfolio standards, energy taxes, or a tradable permit systems, which all raise overall energy prices, therefore stimulating both a switch towards renewable energy sources as well as stimulating electricity demand reductions. They conclude that subsidies are among the least effective policies at stimulating renewable energy, a conclusion that applies equally more widely to other energy technologies.

In summary, theory and significant empirical evidence point to the conclusion that both voluntary and subsidy programmes are relatively ineffective at changing behaviour.

4.2 Studies of Canadian GHG emission reduction programmes

In Canada, only a small number of studies have attempted to empirically measure the GHG reductions that can be attributed to the ongoing policies and programmes. This is partly due to the immaturity of Canada’s climate change policies, and partly due to the difficulty of isolating the effects of voluntary programmes without panel data. However, those studies that have been conducted have produced similar results as the broader studies described above.

The Voluntary Challenge and Registry (VCR) programme has been the subject of several studies. The VCR is a voluntary programme that encourages industrial firms to reduce their GHG emissions. Firms participating in the VCR must submit a letter of intent that confirms intentions to limit GHG emissions, followed by an action plan, which defines specific ways in which the commitment will be met. Firms are also required to submit bi-annual updates on their GHG emissions to the VCR.

The VCR measures its success in large by the number of participants in the programme. As of April 2004, almost 1250 entities were signed on as participants to the VCR (not all of these are industrial emitters). However, Bramley shows that reporting firms represent only about 50% of the emissions from the industrial sector, leaving the other half unaccounted for by what was, for almost a decade, Canada’s flagship programme to encourage GHG emission reduction by the industrial sector (Bramley, 2002). A firm participating in the VCR is supposed to make bi-annual submissions consisting of an emissions inventory, actions taken to reduce GHGs, and future GHG emission projections. Participation without these elements is essentially meaningless. Bramley finds that only 20% of the firms participating in the VCR actually made these submissions. When coupled with the 50% participation rate, this implies that the VCR only targets about 10% of industrial sector GHG emissions.

There are no mandatory emission reduction requirements for participation in the VCR, but one would expect that participation would signal intent to reduce emissions.
However, Takahashi et al. (2001) found that voluntary actions reported by firms in the VCR rarely go beyond business as usual practices in those firms (Takahashi et al., 2001). Indeed, they found no difference between GHG emission trends reported by participating firms and those of nonparticipating firms, suggesting that involvement in the VCR represents a political signal by a firm, rather than an endorsement of meaningful action towards GHG abatement. Bramley similarly finds that over 60% of the large industrial emitters (over 5 Mt CO₂/yr) participating in the VCR have seen significant increases in GHG emissions since starting participation in the VCR, and have forecasted further increases in the future.

4.3 Aggregate GHG trends in Canada

Figure 2 shows the aggregate GHG emission trend in Canada. The trend supports the conclusion that past Canadian government GHG emission reduction policies have been relatively ineffective. From 1990 to 2000, Canada’s GHG emissions have grown almost 20% from about 600 Mt to over 700 Mt (Environment Canada, 2003). Interestingly, Canada’s GHG emissions actually grew faster during the 1990s (by 20%), when GHG reduction programmes were in place, than during the 1980s (by 6%), when no such programmes existed. Obviously other factors, notably energy prices and economic activity, are responsible for this trend, but it still offers some insight into the overall effectiveness of the past GHG reduction programmes in Canada.

Figure 2 also shows the divergence between Canada’s international stance and domestic action on climate change. Since 1988, when Canada first made international commitments on climate change, it has failed to meet three of its international commitments, and seems likely to fail on the fourth (the Kyoto Protocol).
The most recent forecast for GHG emissions available predicts that business as usual emissions will reach 810 Mt in 2010, over 30% greater than 1990 emissions, and about 40% greater than the Kyoto Protocol target (Environment Canada, 2003). Only three to four years remain before the start of the commitment period in 2008, a very narrow window for such substantial change, especially given the limited nature of GHG abatement policies so far implemented.

Nevertheless, the Canadian government remains optimistic that the Kyoto Protocol target can be reached, with a substantial amount of the emissions reductions occurring domestically. The latest Climate Change Plan estimates that current policies will reduce emissions by approximately 126 Mt CO₂e domestically (Government of Canada, 2002). In addition, through the use of agricultural and forest sinks, Canada hopes to gain credit for a further 30 Mt CO₂e of emissions reductions.

About 55 Mt CO₂e of the estimated emissions reductions are projected to be achieved through the proposed large industrial emitters trading programme. Because this programme is intended to be toward the compulsory end of the policy spectrum, greater confidence exists in these emissions reductions. However, the large industrial emitters trading programme is based on emissions intensity rather than absolute emissions, meaning that if the output of Canadian firms grows more than forecasted, emissions will also be higher. Further, the programme design allows for an unlimited number of permits to be purchased from the government at a price to be set (government reports have consistently used $15/t CO₂e as a probable value for these permits, but the official value has yet to be released). Consequently, if emissions reductions turn out to be more expensive than government forecasts predict, less emissions reductions will actually occur. Our work with CIMS, an independent hybrid energy-economy model, projects that if the large industrial emitters policy were implemented in 2005 (which seems optimistic) with a $15/t CO₂e permit price cap, less than 20 Mt CO₂e of (annual) emissions reductions would result by 2010 (Jaccard et al., 2003). The limited reductions are a reflection of the short time frame and the low permit price. For comparison, Finland has a CO₂e tax equivalent to $69/t and Sweden’s is equivalent to $132/t (Eurogas, 2003).

Many of the remaining emissions reductions estimated by the government are predicted to come from the voluntary and subsidy programmes described above. However, because of the propensity of governments to overestimate the effect of this type of programme by ignoring free-riders (Loughran and Kulick, 2004), the emissions reductions predicted by the Government of Canada should be treated as a maximum. It is likely that the actual domestic emissions reductions from these subsidy and voluntary programmes will be much lower.

4.4 Long-term effect of current GHG emission reduction policies

The Kyoto Protocol represents a tentative first step by the international community to address the global challenge of GHG accumulation in the atmosphere. However, this is not a challenge that can be dealt with significantly in the short time frame of the Kyoto Protocol. Such policies should be designed to ensure that strong incentives exist today for innovators, private investors, corporations, and individual consumers to pursue opportunities to develop and adopt technological innovations that over the long run will ease the transition towards a low-GHG economy.
Jaffe and Stavins assert that “In the long run, the development and widespread adoption of new technologies can greatly ameliorate what, in the short run, sometimes appears to be overwhelming conflicts between economic well-being and environmental quality” (Jaffe and Stavins, 1995). This statement, which is consistent with the majority of analyses of the relationship between technological change and environmental quality, outlines the importance of developing policies today with long term technological change in mind.

In particular, analyses point to the importance of learning-by-doing and research and development of new technologies as the major drivers for long-term low cost environmental protection (Loeshel, 2002). Learning-by-doing suggests that the production costs of low-GHG technologies fall as cumulative production increases. To stimulate this cycle, policies are required to encourage adoption of the low-GHG technologies, whose capital costs are often higher than higher emitting technologies that provide a similar service. Similarly, firms will only undertake research and development of new low-GHG technologies when incentives exist for commercialisation of such technologies in a reasonable time frame. Most Canadian government policy does not create significant incentives for commercialisation of low-GHG technologies by companies, and does not provide a regulatory environment that significantly encourages the diffusion of low-GHG technologies. As such, current policy does little to eliminate the conflict between economic well-being and GHG reduction in the future.

5 Alternative GHG reduction policies

Alternative GHG reduction policies could be applied in Canada more effectively than current policies, and without imposing dramatic costs on Canadian consumers or industry. We propose an alternative policy strategy dominated by market-oriented regulations because we believe that these perform better against our policy evaluation criteria when it comes to the particular challenges of GHG policymaking. Having an aggregate regulatory requirement improves their performance against the effectiveness criterion. Stimulating new technology development and commercialisation without significantly increasing average prices improves the likelihood of political acceptability, as does the flexibility offered to those affected by the policy. Indeed, this latter characteristic reduces the short-run economic impact while stimulating innovations that should lower long-run costs.

Our proposed package of policies includes a vehicle emissions standard, renewable portfolio standard, residential energy efficiency standard, combined heat and power standard, and carbon sequestration standard; all niche market regulations focused on technologies. In conjunction with these policies, we also support the development of the emissions cap and tradable permit policy for the large industrial emitters proposed by the Canadian government in its most recent climate change plan. This policy is designed to capture the low-cost opportunities for GHG reduction throughout the industrial sector. When coupled with a modest safety valve to mitigate against high costs, it increases the potential for political acceptability. Finally, we propose increased stringency in Canada’s commercial building codes with a focus on energy efficiency.
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The specific details of our proposed policy package are described in Table 2. We use the CIMS model to predict the costs and effects of our policy package (Jaccard et al., 2003). Our policy approach and results are described in more detail in Jaccard et al. (2004).

### Table 2 Description of proposed policy package

<table>
<thead>
<tr>
<th>Policy</th>
<th>2010 requirements</th>
<th>2030 requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large industry carbon cap and trade system</td>
<td>$15/t CO₂e permit price cap; 35 Mt emissions reductions</td>
<td>$50/t CO₂e permit price; 55 Mt emissions reductions</td>
</tr>
<tr>
<td>Combined heat and power standard</td>
<td>9% of electricity from CHP</td>
<td>15% of electricity from CHP</td>
</tr>
<tr>
<td>Renewable portfolio standard</td>
<td>7% of electricity from renewables</td>
<td>25% of electricity from renewables</td>
</tr>
<tr>
<td>Vehicle emissions standard</td>
<td>30% LEV</td>
<td>23% LEV</td>
</tr>
<tr>
<td></td>
<td>25% ULEV</td>
<td>65% ULEV</td>
</tr>
<tr>
<td></td>
<td>1% ZEV</td>
<td>12% ZEV</td>
</tr>
<tr>
<td>Sequestration requirement</td>
<td>8 Mt CO₂ in upstream oil and gas</td>
<td>28 Mt CO₂ in upstream oil and gas; 30 Mt CO₂ in electricity generation</td>
</tr>
<tr>
<td>Residential energy efficiency standard</td>
<td>25% of new homes R-2000</td>
<td>100% of new homes R-2000</td>
</tr>
<tr>
<td>Commercial building energy code</td>
<td>–</td>
<td>100% of new commercial buildings meet improved energy efficiency code</td>
</tr>
</tbody>
</table>

Our model runs, shown in Figure 3, show that the policy package achieves GHG reductions of 72 Mt CO₂e in 2010, and 220 Mt CO₂e in 2030. Neither of our proposed policy packages is stringent enough to fully comply with Kyoto Protocol commitments of 240 Mt CO₂e, a goal that we feel is well beyond reach domestically in the short time remaining until 2010. Both policy packages have a small effect on prices of energy and goods seen by final consumers – on average prices for energy and other goods increase by 1–10% throughout the period of analysis.

### Figure 3 GHG emissions reductions from our proposed policy package
Throughout the analysis period, our proposed policy package imposes relatively small short-term costs on Canadian consumers and businesses, which contributes to the political acceptability of our approach. With their mandatory nature, the policies also provide greater confidence that significant GHG reductions will occur in the Kyoto time frame when compared with an approach dominated by voluntary initiatives. Because our package only contains a few policies, it should be administratively feasible. Our policy package is likely to be less economically efficient than a single economy-wide programme, such as a GHG tax or an economy-wide ECTP, but our ECTP covers all industries, including oil and gas production and electricity, and it passes on energy production cost increases to consumers through energy retail prices. As a result, a generally consistent price signal spreads throughout the economy, albeit at a low level. Politicians may decide that the modest economic efficiency cost is a reasonable trade-off for attaining political acceptability, and they should appreciate the fact that under this package, there are no government subsidies to R&D or technology acquisition. Private-sector research and development is instead triggered by the market niche regulations, which provide a higher implicit price signal in these market niches than the more broadly applied ECTP.

Our modelling shows that in the period after 2010, our policy package will become even more effective by promoting the kind of technological change that makes it possible to dramatically reduce GHG emissions without sacrificing economic growth. In particular, a gradual increase in severity of each of our policies provides a strong and predictable long-term signal to producers and consumers about the value of reducing GHG emissions, yet allows time for capital stocks and consumer and business preferences to adjust. Furthermore, the technology-specific nature of our policies allows us to target directions in innovations that analysts predict to have the greatest potential for long-term cost reductions, such as carbon sequestration, low- and zero-emission vehicles, and renewable electricity generation, without involving the government in the risky business of selecting preferred technologies. The policy does not choose which form of carbon capture and sequestration; it does not choose between battery and fuel cell for zero emission vehicles, it does not favour any particular form of renewable electricity and, aside from the modest market allocation for renewables, it does not favour one low-emission form of electricity generation over another.

Although it is generally nonspecific with respect to technologies, our policy package positions Canada to keep pace with fundamental technological innovations likely to emerge in the post-Kyoto period. The requirement for zero emission vehicles could result in the development, especially after 2010, of a growing domestic market for fuel-cell-driven trains, which will benefit technologies where Canada already enjoys an edge. The carbon-sequestration requirement should foster Canadian production of hydrogen by whichever process proves superior, providing the growing supplies required by the hydrogen-driven fuel-cell vehicle market – and securing Canada’s case for expanding energy production from our plentiful oil sands and coal resources.
6 Conclusion

Canada has played an active role internationally in promoting agreements to abate anthropogenic climate change. However, Canada’s weak domestic action has lagged significantly behind its international position, such that its international commitments have been broken or seem likely to be broken in the future.

Canada’s weak domestic action on climate change is a result of a well-organised and vocal opposition to new environmental charges and regulations, coupled with a limited federal budget and uncertain federal jurisdiction over sources of GHG emissions. For these reasons, the Canadian government has relied on noncompulsory policies like subsidies and voluntarism in order to meet its Kyoto Protocol targets. However, with high marginal costs of GHG abatement in Canada, these policy instruments have been unable to provide the strong signals necessary to stimulate major technological change.

Instead, the required policy approach should have elements at the more compulsory end of the policy spectrum, possibly including taxes, command and control regulations, and recent policy innovations like the cap and tradable permit system, renewable portfolio standard, vehicle emissions standard, and tax shifting. Such policy instruments would not only begin to limit GHG reductions in the Kyoto time frame, they would also create the required market environment for stimulating the profound technological change necessary for addressing the long term nature of the climate change problem at a reasonable cost.

Although time is too limited for Canada to achieve a significant reduction of GHGs in the Kyoto time frame, adoption of such policy instruments now would ensure that future GHG abatement is achieved at a cost that is palatable to groups in Canada concerned about the economic trade-offs.

References


Notes

1 Polls conducted in June and October of 2002 by Ipsos Canada found that ratification of the Kyoto Protocol was supported by 86% and 74% respectively of the Canadian public (www.ipsos-na.com/news/pressrelease.cfm?id=1641).

2 These groups were led by the provincial government of Alberta, the Canadian Council of Manufacturers, the Canadian Coalition for Responsible Environmental Solutions, and the Canadian Chamber of Commerce.
Canada’s efforts towards greenhouse gas emission reduction


US Census Bureau (2004) ‘Global population profile: 2002’, *International Population Reports*, WP/02, Washington: US Government Printing Office. The US Census Bureau report shows that Canada’s population growth of 1.0% (mostly due to immigration) is much greater than that of Germany (0.1%), France (0.5%), the UK (0.4%), or Italy (0.3%).


Statistics Canada (2003) ‘Gross domestic product at basic prices, by North American Industry Classification System’, Table 379–0017. Canada derived just over 6% of its GDP from primary industries in 1999. This is not significantly higher than other developed countries, but energy-intensive industry has a strong lobby in Canada.

The province of Alberta in particular is richly endowed with fossil fuel reserves and strongly opposed ratification of the Kyoto Protocol.

www.vcr-mvr.ca. By the end of 2004, the VCR will be eliminated, as government intends to replace it with other policies aimed at GHG reductions in the industrial sector.

Unless otherwise noted, all monetary values in this paper are in SCDN (CDN$1 ≈ US$0.75).