Key Questions for a Canadian Cap-and-Trade System

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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. Our engaging monthly newsletter offers insights into the Pembina Institute's projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

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Introduction

Experts agree that the centrepiece of any national climate change plan should be a policy that "puts a price on emissions" broadly in the economy. The two main policies that can do this are a carbon tax and a cap-and-trade system.

The Government of Canada has committed to announce some form of cap-and-trade system for greenhouse gas emissions before the end of 2009. This paper aims to identify the key questions that should be asked to evaluate any Canada-wide cap-and-trade proposal.

A cap-and-trade system puts a mandatory cap on some portion of national emissions, and allows firms to buy and sell rights to emit within the cap. (The rights to emit may be called "allowances," "permits" or "credits".) This has the effect of putting a price on emissions because firms have to buy extra emission rights if they want to emit more. The market price of emission rights is commonly referred to as the "carbon price."

The carbon price will become a factor in all decisions affecting emissions taken by firms and households. The higher the price, the stronger the incentive to switch from high-emission options to low-emission options. The first fundamental question that should therefore be asked of any cap-and-trade system is: **is the carbon price likely to be high enough to adequately reduce Canada's emissions?**

It may seem odd to ask what the carbon price will be, rather than simply what level the emissions cap will be set at. But cap-and-trade systems commonly include mechanisms (see Sections 1.1 and 2.3) that allow real, new reductions in domestic emissions to be replaced by reductions whose reality is dubious, reductions that already happened or may only happen in the future, or foreign reductions. The expected carbon price is therefore a surer measure of effectiveness than the level of the cap, particularly when we are concerned about cutting Canada's own emissions.

The second fundamental question is: **who will receive money when someone pays the carbon price — or lose money when someone avoids paying that price?** This is critical because the total amount of money involved could be very large — in the tens of billions of dollars annually.

Each of these two questions raises important related design issues for a cap-and-trade system, such as the use of **"offsets"** or **"intensity targets."** Below we examine each of the two fundamental questions, and three key related issues for each.

We assume in this paper that there will be a federal cap-and-trade system. It is important to note, however, that provincial governments too have the power to implement cap-and-trade, and several have already taken steps in that direction. We will not comment further here on provincial action except to say that a federal cap-and-trade system should make accomodation for well-designed provincial policies that put a price on emissions, such as British Columbia's carbon tax; but if necessary a federal system should override ineffective provincial policies, such as Alberta's greenhouse gas regulations (further discussed in Section 2).

1. Will the carbon price be high enough to transform our energy system?

To avoid the worst impacts of climate change, greenhouse gas emissions need to be reduced far below current levels as quickly as possible. The national science academies of the "G8+5" countries say that "limiting global warming to 2°C" — a goal now endorsed by those countries' governments[1] and by numerous leading climate scientists[2] — "would require a very rapid worldwide implementation of all currently available low carbon technologies."[3] Since most greenhouse gas emissions come from burning fossil fuels for energy, that means an urgent transformation of our energy system.

How high would the carbon price need to be to achieve such a transformation?

- The National Round Table on the Environment and the Economy has found that Canada would need a carbon price of **$100 per tonne**[4] by 2020 to meet the federal government's current target to reduce national emissions to 20 percent below the 2006 level by 2020.[5]
- McKinsey and Company estimate that all worldwide opportunities to cut emissions at a cost of up to €100 per tonne[6] (**$158 per tonne**) would need to be implemented starting in 2010 to have a good chance of limiting average global warming to 2°C.[7] This suggests that we need a global carbon price of at least that level.
- Research commissioned by the Pembina Institute and the David Suzuki Foundation shows that Canada needs a carbon price starting at $50 per tonne in 2010 and reaching **$200 per tonne** in 2020 to cut national emissions to 25 percent below the 1990 level by 2020. This target is at the least stringent end of the range of what industrialized countries need to do for the world to have a chance of staying within the 2°C limit, according to the UN Intergovernmental Panel on Climate Change.[8]

Timing is important. We need a significant carbon price as quickly as we can manage, even if only to meet the government's relatively modest emissions target for 2020. And because a simple cap-and-trade system can be designed and brought into effect more quickly than a complicated one, simplicity is important. We will return to this point in Section 2.1.

The carbon price cannot, of course, be predicted with certainty in a cap-and-trade system because it depends on the actual costs of achieving the level of the cap, which are not known precisely in advance. But economic modelling can provide an indication of the expected carbon price.

In particular, the prices above are much higher than those currently expected in the U.S. The Waxman-Markey cap-and-trade bill, passed by the House of Representatives in June 2009, is a big and important step forward from past inaction. But it is projected to generate a carbon price of just US$16 per tonne by 2020.[9] Accordingly, even though it includes major energy efficiency provisions as well as cap-and-trade, the bill would make only limited progress towards transforming the U.S. energy system by that year.[10]

This matters, because it is often asserted that Canada's carbon price must stay close to that of our largest trading partner in order to maintain the competitiveness of Canadian industry. The Pembina Institute believes this view is wrong, for three reasons:

- The competitiveness impacts of varying national carbon prices tend to be exaggerated. The World Trade Organization notes that "studies to date find generally that the cost of compliance with an emission trading scheme is a relatively minor component of a firm's overall costs."[11] Accordingly, a recent C.D. Howe Institute study found that "the overall competitiveness and leakage[12] impacts associated with climate change policy in Canada are likely to be small," even in a scenario where Canada has a carbon price of $115 per tonne by 2020 and our trading partners have none.[13]
- A cap-and-trade system can incorporate measures to protect industry sectors expected to suffer substantial impacts on international competitiveness (see Section 2.2).
- To prevent the extreme consequences of global warming with little time available to act, the world desperately needs leaders: countries willing to show they can do what needs to be done without waiting for the slow-to-convince. A country as well endowed as Canada has a clear moral responsibility to do its fair share even when some of our peers have not yet started to do so. Polling suggests that Canadians agree.[14]

1.1 The trouble with offsets

The reason why the projected U.S. carbon price is so low is that the proposed U.S. cap-and-trade system relies massively on "offsets." Offsets are credits granted for reductions in emissions (or removals of carbon dioxide from the atmosphere) from projects outside the cap. Common examples include tillage practices that store more carbon in agricultural soils, and hydroelectric projects in developing countries. Firms are allowed to replace emission reductions achieved under the cap by offsets.

Offsets present two major risks. The first is that large volumes of offsets will flood the market and depress the carbon price to a point where it will become ineffective. This is what is currently expected to happen in the U.S.

The second risk comes from the fact that it is very difficult to avoid awarding offset credits for emission reductions that would have happened anyway, even in the absence of offsets. This is due partly to technical challenges, and partly to the fact that a lax offset system is in the interests of most buyers and sellers, who lobby accordingly. Some researchers who have examined the world's largest existing offset system, the Kyoto Protocol's Clean Development Mechanism (CDM), have concluded that "only a fraction of CDM projects actually reduce emissions."[15] Under the Government of Canada's draft rules for offsets (June 2009), no attempt would be made to determine whether an offset project would have happened in the absence of offsets, and a significant volume of credits would be granted to projects that have already been implemented.[16]

The result is that emissions will be considerably higher in a system with offsets compared to a system without offsets. This represents a form of fraud: the claim will be made that emissions have been reduced to the level specified by the cap, but a significant proportion of the emission reductions will not be real, new reductions.

The Pembina Institute has come to believe that these two risks created by offsets are so serious that offsets should not be included in a Canadian cap-and-trade system. Instead, industry's desire to contain costs could better be satisfied through a straightforward ceiling on the carbon price — as long as the ceiling is set at a high enough level.[17] To secure emission reductions above and beyond those achieved with the cap-and-trade system, the government could still purchase offsets from sectors like agriculture or forestry, or from developing countries, as long as the offsets met strict standards.

Linking a Canadian cap-and-trade system to another country's cap-and-trade system could present the same two risks. Importing too many cheap foreign emission rights would both depress the domestic carbon price and create greater demand for offsets if they exist in the foreign system. Linking a Canadian cap-and-trade system to a foreign system with similar stringency makes sense, but linking to a weaker foreign system does not.

1.2 Oil sands: the elephant in the room

Oil sands account for close to half (44 per cent) of the projected increase in total Canadian emissions between 2006 and 2020 in a "business-as-usual" scenario, and virtually all (95 per cent) of the projected increase in industrial emissions.[18] How oil sands are treated in a Canadian cap-and-trade system will therefore have a large bearing on the overall effectiveness and fairness of the system.

Most obviously, if the cap level is set so as to accommodate large growth in emissions from oil sands, then it will not likely be compatible with Canada reducing its emissions overall. On the other hand, if the cap is set at a level consistent with significant reductions in Canada's overall emissions, and if the carbon price is not kept artificially low by offsets or other means, then the carbon price will rise to a level reflecting the cost of large-scale carbon capture and storage in the oil sands. This is an expensive technology, costing as much as $100 or more per tonne of emissions reduced.[19]

In other words, the rapid expansion of oil sands production and the high cost of reducing the associated emissions are responsible for driving up Canada's "marginal cost of abatement" of greenhouse gas emissions, which translates into the need for a high carbon price to reduce them.

The Pembina Institute believes that it is unfair for the oil sands sector to create a significantly higher carbon price and consequent costs for all other sectors. To prevent this, we believe that the use of carbon capture and storage, or a technology achieving equivalent emissions levels, should be mandatory for all new oil sands operations.[20] New oil sands operations without carbon capture should be viewed as unacceptable in the same way that new coal-fired electricity generation without carbon capture is now widely seen as unacceptable in light of what we know about climate change.

The oil sands industry may argue that it cannot afford to pay a carbon price of $100 per tonne or more, or the cost of carbon capture and storage. However, even if $100 were paid on each and every tonne emitted, this would be equivalent to only about $6 per barrel of oil produced from a state-of-the-art new oil sands operation.[21] A few dollars is a small proportion of the likely future gap between the world price of oil and production costs — the profit margin or "rent" shared between the Alberta government (via royalties) and the oil companies. There appears therefore to

be no good reason to grant free emission rights or other shares of the carbon value (see Section 2) to oil sands firms in a Canadian cap-and-trade system.

1.3 The importance of a broad-as-practical cap-and-trade system

Canadian discussions about cap-and-trade often assume that the cap would only cover heavy industry (including electricity generation), which accounts for about half of Canada's emissions. However, there is a consensus among experts that a carbon price should, to the extent possible, cover the whole economy. For example, the National Round Table on the Environment and the Economy, the official advisory body to the Minister of the Environment, has repeatedly emphasized the importance of an economy-wide carbon price.[22]

It is often believed that it would be impractical to cap the numerous small emitters — small businesses, buildings and vehicles — that make up most of the other half of Canada's greenhouse gas emissions. But this is not true. These emissions mostly come from burning fossil fuels, and the amount of emissions is directly proportional to the amount of fuel burned. They can therefore be capped by regulating fuel wholesalers, who would pass on the carbon price to consumers through the price of fuel. This is the approach being pursued in the U.S., where the Waxman-Markey bill passed by the House of Representatives in June 2009 would cap about 66 percent of U.S. emissions starting in 2012, rising to about 85 percent by 2016.[23]

If the Government of Canada choses to rely solely on cap-and-trade to put a price on emissions, then there are three key reasons why a Canadian cap-and-trade system needs to be similarly broad:

- We need to transform our whole energy system, not just heavy industry's half of it. It is true that households and small businesses face barriers that prevent them from responding efficiently to a price signal, such as a lack of information or access to financing. A carbon price must therefore be complemented by policies like efficiency regulations for buildings and vehicles, financial incentives for building retrofits, and investments in public transit. But a significant carbon price will create a real incentive to cut emissions. For example, $100 per tonne is equivalent to 24 cents per litre of gasoline.
- The space left in the atmosphere to dump greenhouse gases is a scarce resource that belongs to everyone. An emitter who is allowed to use that valuable resource free of charge is therefore being subsidized by everyone else. It is unfair for whole sectors of the economy to be subsidized in this way.
- Canadians need to have confidence that their federal government is on track to meet the national emissions targets that it has committed to. Canada is much more likely to meet its targets with a cap on 85 percent of our emissions that with a cap on just 50 percent of emissions. If the government pursues a narrow cap-and-trade system, it will need to provide a very convincing explanation of how it will meet its emissions target for 2020 using policies targeting the other half of our emissions.

2. Will the value of carbon be distributed rationally and fairly?

In a standard cap-and-trade system, firms have to hold a government-issued allowance for every tonne they emit, and the cap is set by the total number of allowances. If Canada had a cap-and-trade system covering most of its emissions, roughly 600 million allowances would be issued each year. If the carbon price reached $100 per tonne, the allowances would have a total annual "carbon value" of $60 billion, or about $2,000 for every Canadian.

As noted above, the dwindling space left in the atmosphere for greenhouse gases is a resource that belongs to everyone. So the value of that resource — the carbon value — also belongs to everyone. This means that the carbon value should be distributed among citizens, firms and governments in the best interests of society as a whole. Since we could be talking about tens of billions of dollars every year, the way this is done is of the utmost importance.

Governments can distribute the carbon value in two forms — by handing out allowances free of charge, or by auctioning off allowances and handing out the proceeds in dollars. People tend to think of these two options quite differently, but they are financially equivalent, because allowances can be converted into dollars — on a carbon exchange or through a broker — at any time. If a firm receives carbon value in the form of free allowances, this is just as much a subsidy as if it receives carbon value in the form of dollars, as a grant or a tax break.

Satisfying the best interests of society as a whole means carbon value should be distributed to meet transparent policy objectives, not to reward those who are the best at lobbying or to seek narrow political advantage. **Any cap-and-trade proposal should be accompanied by a clear statement and justification of the uses to which the carbon value will be put.**

The Pembina Institute believes that the carbon value should be used for the following priority purposes:[24]

- To protect specific industry sectors that would otherwise be expected to suffer substantial "carbon leakage"— a transfer of production to foreign competitors with similar emissions levels, which would be counterproductive because it would not reduce emissions. The potential for carbon leakage is, however, often exaggerated. Protection should be targeted at sectors that are independently shown to have a high likelihood of suffering a substantial impact.
- To protect low-income Canadians. Just as it is widely agreed that tax changes should not result in an increase in the cost of essential goods and services for those on low incomes, so any increase in energy prices resulting from a cap-and-trade system should be compensated for the same people.

- To ensure regional balance. Carbon value should be distributed so as to prevent excessive net financial flows from one region of Canada to another as a result of the cap-and-trade system. Excessive financial flows are unlikely to be seen as fair.
- To ensure adequate public spending on greenhouse gas reductions. An effective federal climate plan will need to include substantial public investment in areas where infrastructure is publicly owned (e.g., transit, electricity grids), where it is difficult to regulate (e.g., building retrofits), or where the carbon price may not initially be high enough to produce needed results (e.g., renewable electricity).
- To help developing countries combat climate change. There is a strong legal, moral and pragmatic case for rich countries to provide substantial financial support to assist with emission reductions in emerging economies and to help the most vulnerable cope with the impacts of climate change.[25]

Carbon value that is left over after these objectives have been met could be distributed to Canadians through tax cuts (or public debt repayments) or equal per capita rebates.

It should be noted that governments can put a price on greenhouse gas emissions through alternative regulatory approaches that may further obscure the question of who will get the carbon value. Sometimes these approaches are described as "cap-and-trade" even though no allowances are issued. Alberta's greenhouse gas regulations are one example. They set a target for an industrial facility, at a level quite close to the facility's business-as-usual emissions, and require the owner to pay a carbon price for any tonnes emitted above that target. Because the owner pays nothing if the facility meets its target, this is analogous to a cap-and-trade system where the facility receives free allowances up to the level of its target. Most of the carbon value is therefore being distributed straight back to the industrial emitters. We will revisit Alberta's regulations in Section 2.3.

2.1 The importance of auctioning emission allowances

The best way to ensure transparency and accountability about who gets the carbon value is to have a cap-and-trade system in which 100 percent of the allowances are auctioned off by the government. In this case the full carbon value would be obtained as proceeds of the auction, and it could be put to legally mandated purposes that would naturally be subject to a thorough public debate — rather than be concealed in complex rules for allocating allowances or setting emissions targets.

One hundred percent auctioning, when combined with an avoidance of offsets, would have the benefit of resulting in the simplest possible cap-and-trade system. As noted in Section 1, we need a significant carbon price as quickly as we can manage, and a simple system could be brought into effect more quickly than a complex one. There is a risk that the complexity of allocating allowances free of charge could show up as equal complexity in the distribution of auction proceeds. But with 100 percent auctioning we expect that the transparency of the debate over the distribution of carbon value would produce a quicker and simpler outcome.

One hundred percent auctioning would also automatically reward early action — emission reductions achieved before a cap-and-trade system takes effect — because those who have already reduced their emissions would have fewer allowances to buy.

It is often suggested that to avoid an economic shock, most allowances should be allocated free of charge when a cap-and-trade system starts up. This argument is bogus, because the financial impact of the system depends only on the carbon price and the distribution of the carbon value. As long as a firm receives a given amount of carbon value, it makes no difference financially whether that value is distributed in the form of allowances or dollars.

Business associations' tendency to oppose auctioning of allowances may be due to a misunderstanding of this point. But another possible explanation is that the lack of transparency over the distribution of carbon value when allowances are handed out free of charge increases business lobbies' opportunities to secure a larger portion of that value for themselves.

It is true that many will be uncomfortable with the idea of entrusting governments with billions of dollars of extra annual revenue from the auctioning of allowances. Hence the importance of clearly specifying the uses of the revenue in legislation.

2.2 The trouble with intensity targets

In the past, both Liberal and Conservative federal governments have proposed regulatory approaches that set greenhouse gas "emissions intensity" targets for all heavy industry; Alberta's greenhouse gas regulations do the same. Emissions intensity is the amount of emissions divided by the amount of production, e.g., emissions per barrel of oil. So if a firm has met an intensity target, it can emit extra emissions without penalty if it expands its production volume.

Since there is a chance that intensity targets could live on in future Canada-wide cap-and-trade proposals, we need to examine what they mean, particularly for distribution of the carbon value.

In a standard cap-and-trade system based on allowances, a firm that receives free allowances in proportion to its actual production level is effectively being given an intensity target, because if the firm expands its production, it can emit extra emissions free of charge.

Since free allowances are a financial subsidy, intensity targets are a subsidy for increased industrial production. If oil sands producers are given intensity targets, we are subsidizing an expansion of oil sands production. The subsidy reduces the effective carbon price for new production. If a firm has an intensity target set, say, 10 percent below the intensity of its new production, then it will pay only 10 percent of the carbon price for the extra emissions.

There is only one justification for using carbon value in this way to subsidize production in high-emitting industries: prevention of carbon leakage. If the carbon price would cause a transfer of production to foreign competitors with no reduction in emissions, then the only way to prevent it is indeed to reduce the effective carbon price through some form of production subsidy.

Intensity targets can, therefore, be justified only for sectors that can be independently shown to have a high likelihood of suffering substantial carbon leakage — and only as long as the targets are set at a level no more generous than needed to prevent the worst of that leakage.[26] Otherwise, intensity targets are an unfair diversion of carbon value to firms that meets no justifiable policy objective.

However, even if there is a justification for intensity targets in some sectors, the policy will be more transparent and simpler if this production subsidy is provided in dollars instead (see Section 2.1).

A more familiar objection to intensity targets is that they create uncertainty about the level of actual emissions, because if future industrial production is higher than expected, emissions will be higher too. This is an important objection if some (or all) sectors receive intensity targets and no adjustments are made to maintain a fixed overall cap on emissions. The resulting policy will provide certainty neither about the carbon price nor about the overall level of emissions.

However, use of intensity targets for certain sectors is no reason not to have a fixed overall cap. In some cap-and-trade systems allowances are set aside to be allocated free of charge to firms that build new facilities; this is equivalent to an intensity target because firms receive free allowances in response to increased production. But the overall cap level is preserved by adjusting the number of allowances available for other firms.

2.3 The trouble with the technology fund mechanism

Another feature of past federal regulatory proposals has been the option for firms to comply with emissions intensity targets by making payments at a fixed carbon price into a "technology fund" with a mandate to invest in technologies to reduce greenhouse gas emissions. There is no certainty about when or by what amount emissions will be reduced as a result of these investments.

There are two major problems with the effectiveness of this mechanism. First, the proposed fixed carbon price has been far too low to represent an adequate direct incentive to reduce emissions. Second, like a lax offset system (see Section 1.1), the technology fund mechanism results in a form of fraud: the claim will be made that emissions have been reduced to the level specified in regulations, but a significant proportion of the "emission reductions" will, in fact, be investments in an unknown amount of future reductions occurring at an unknown date.

Technology funds also have major implications for the distribution of the carbon value, because they could hold a significant share of it. In the most recent federal proposals, the technology funds would be "at arms-length from government"[27] and include industry representatives as board members.[28] But carbon value belongs to society as a whole. Giving the corporate sector a seat on a body that distributes carbon value is like giving the corporate sector a seat at the cabinet table when the government decides how to spend tax revenues.

Alberta's greenhouse gas regulations allow unlimited payments into a technology fund as a compliance option. It was noted above that they distribute most of the carbon value straight back to the industrial emitters through the use of emissions intensity targets set at a level close to business-as-usual emissions. Of the remaining carbon value, most is paid into the technology fund. Since a majority of the fund's board members represent or have recently retired from heavy industry interests,[29] distribution of this value is likely to be dominated by those interests.[30]

Conclusion

The world's governments will gather in December 2009 in Copenhagen to finalize the negotiation of a new global climate treaty. The Copenhagen deal will cover the critical years up to 2020 during which the industrialized world has to start achieving deep emissions cuts if the worst climate impacts are to be prevented.

Canada's Minister of the Environment, Jim Prentice, calls 2009 "truly… a pivotal year" for action on climate change, and has promised to "outline the full suite of policies that relate to all major sources of emissions… by the time we reach the international table at Copenhagen."[31] The centrepiece of those policies will be some form of Canada-wide cap-and-trade system. The proposed system will be a crucial determinant of Canada's credibility in Copenhagen — and a key test of whether the government now recognizes the scale and urgency of the threat of climate change.

Canada has a choice: show real leadership with a cap-and-trade system that puts an adequate price on emissions and distributes carbon value fairly and rationally — or muddle along with a system that fails to urgently transform our energy system and gives billions of dollars of carbon value to those who are best at lobbying. Time is short and we need to get it right now, not be forced back to the drawing board later.

Simplicity is a key feature of a strong, fair cap-and-trade system — and a recurring theme in this paper. Auctioning 100 percent of allowances and avoiding or minimizing offsets, intensity targets and the technology fund mechanism will increase the strength and clarity of the carbon price signal, speed the system's implementation and help ensure that it serves the public interest, not narrow private interests.

There is no need for Canada to imitate the weaknesses of the current U.S. approach to cap-and-trade (see Section 1), nor its complexity. And talk of the need to "balance" the environment and the economy is dangerously misleading: the projected human, ecological and financial costs of climate change far outweigh the costs of curbing it.[32] The world desperately needs leaders on climate change, and Canada is well equipped to be one. History will surely judge us harshly if we fail.

Endnotes

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[16] See Pembina Institute submission to Environment Canada, to be published in August 2009. Will be available online at http://climate.pembina.org.

[17] For more details on this proposal, see *Comments to the Government of Ontario on the Development of a Cap-and-Trade System for Reducing Greenhouse Gas Emissions in Ontario* (Vancouver, BC, Drayton Valley, AB and Toronto, ON: David Suzuki Foundation, Pembina Institute and WWF-Canada, 2009), 9. Available online at http://climate.pembina.org/pub/1797.

[18] *Turning the Corner: Detailed Emissions and Economic Modelling* (Ottawa, ON: Government of Canada, 2008), 42. Available online at http://www.ec.gc.ca/doc/virage-corner/2008-03/pdf/571_eng.pdf. We include electricity and heat generation in "industrial emissions."

[19] *Accelerating Carbon Capture and Storage in Alberta, Interim Report* (Edmonton, AB: Alberta Carbon Capture and Storage Development Council, 2008), 22. Available online at http://www.energy.gov.ab.ca/Org/pdfs/CCSInterimRept.pdf.

[20] The Pembina Institute intends to more fully specify the types and vintages of the operations to which this would apply, as well as the required emission levels, at a later time.

[21] For example, Shell's current Alberta oil sands operation generates about 65 kg of greenhouse gas emissions per barrel of bitumen, which is equivalent to less than 65 kg of emissions per barrel of synthetic crude oil. See *2006 Sustainable Development Report* (Calgary, AB: Shell Canada Limited, 2007), 30. Available online at http://www.shell.com/static//ca-en/downloads/society_environment/sd06.pdf.

[22] *Getting to 2050: Canada's Transition to a Low-emission Future* (Ottawa, ON: National Round Table on the Environment and the Economy, 2007), 51. Available online at http://www.nrtee-trnee.com/eng/publications/getting-to-2050/Getting-to-2050-low-res.pdf.

[23] H.R. 2454, Section 721.

[24] Another commonly proposed use for carbon value, not included here, is to compensate firms that have not yet recouped their investment in high-emitting operations that will suffer a large reduction in profitability under a cap-and-trade system. However, the need to reduce greenhouse gas emissions has been clearly understood and enshrined in international law for 15 years now. Our view, therefore, is that any investor in new industrial operations since the mid-1990s should reasonably have anticipated the imposition of a carbon price within a few years, and does not merit compensation. Older operations are likely to have already paid off most or all of their initial investment.

[25] For a full analysis, see Clare Demerse, *Our Fair Share: Canada's Role in Supporting Global Climate Solutions* (Drayton Valley, AB: The Pembina Institute, 2009). Available online at http://climate.pembina.org/pub/1815.

[26] Border carbon adjustments (tariffs on the emissions associated with the production of imported goods and rebates of the carbon price paid on exported goods) are sometimes proposed as an alternative way to address carbon leakage. The Pembina Institute does not support border carbon adjustments for several reasons, notably the fact that they would likely be applied without reference to a sector's actual vulnerability to carbon leakage. For a more detailed discussion, see Clare Demerse and Matthew Bramley, *Choosing Greenhouse Gas Emission Reduction Policies in Canada* (Drayton Valley, AB: The Pembina Foundation, 2008), 43–46. Available online at http://climate.pembina.org/pub/1720.

[27] *Turning the Corner: Regulatory Framework for Industrial Greenhouse Gas Emissions* (Ottawa, ON: Government of Canada, 2008), 3. Available online at http://www.ec.gc.ca/doc/virage-corner/2008-03/pdf/571_eng.pdf.

[28] *Regulatory Framework for Air Emissions* (Ottawa, ON: Government of Canada, 2007), 12. Available online at http://www.ecoaction.gc.ca/news-nouvelles/pdf/20070426-1-eng.pdf.

[29] Climate Change and Emissions Management Corporation, "Climate Change and Emissions Management Corporation: Board Named to Manage the Use of Provincial Climate Change Funds," news release, July 13, 2009. Available online at http://www.marketwire.com/press-release/Climate-Change-And-Emissions-Management-Corporation-1016143.html

[30] For a critique of Alberta's regulations, see The Pembina Institute, "Polluters Exploit Alberta Government Loopholes to Increase Greenhouse Gas Pollution," news release, April 22, 2009. Available online at http://climate.pembina.org/media-release/1822.

[31] Environment Canada, "Notes for an address by the Honourable Jim Prentice, P.C., Q.C., M.P., Minister of the Environment, on Canada's climate change plan," speech, June 4, 2009. Available online at http://www.ec.gc.ca/default.asp?lang=En&n=6F2DE1CA-1&news=400A4566-DA85-4A0C-B9F4-BABE2DF555C7.

[32] See, notably, Nicholas Stern, *Stern Review: The Economics of Climate Change* (London, UK: HM Treasury, 2006). Available online at http://www.hm-treasury.gov.uk/stern_review_report.htm.