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A Way Forward Working Paper # 2:

The Role of Market-based Opportunities in the Emerging Post-2012 Climate Regime

November 2007

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Abbreviation and Acronyms

ACT	Australian Capital Territory
APEC	Asia-Pacific Economic Cooperation
BAU	Business as usual
CCLA	Climate Change Levy Agreement
CCS	Carbon dioxide capture and storage
CCX	Chicago Climate Exchange
CDM	Clean development mechanism
CER	Certified emission reductions
CFL	Compact fluorescent light bulb
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalency
ESCO	Energy Services Company
EU	European Union
EUA	European Union Allowance
EU ETS	European Union Emissions Trading Scheme
GHG	Greenhouse gas
IEA	International Energy Agency
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
lCER	Long-term certified emission reduction
LDC	Least developed country
LFE	Large final emitter
MEPS	Minimum Energy Performance Standards
Mt	Megatonne
NAEWG-EE	North American Energy Working Group's Expert Group on Energy Efficiency
NEG/ECP	New England Governors and Eastern Canadian Premiers Group
NRTEE	National Round Table on the Environment and the Economy
NSW	New South Wales
RGGI	Regional greenhouse gas initiative
S&L	Standard-setting and labelling
tCER	Temporary certified emission reduction
UNFCCC	United Nations Framework Convention on Climate Change
WCI	Western Climate Initiative

1.0 Introduction

Successfully addressing the risk of climate change requires influencing the billions of market decisions made by consumers, industry and others. These decisions determine investments in new energy-using capital stock, changes in agricultural and forestry practices, and individual behaviour.

International efforts have emphasized the role of market-based approaches, and in particular emissions trading. The appeal of these approaches is obvious—under a global climate regime, emissions trading has the potential to significantly reduce the costs and increase the feasibility of achieving the deep long-term reductions required to address the risks of climate change.

However, governments also have a wide range of other policy tools that can be used to affect these market decisions, including tax incentives and disincentives, information programs, and prescriptive or market-based regulation.

International cooperation on market-based approaches could take many forms. This paper does not seek to provide a comprehensive treatment of issues related to emissions trading and other market-based approaches in a post-2012 climate regime. Rather, this paper examines Canadian perspectives on two separate but related aspects of international cooperation on market approaches.

(1) The potential for integrating Canada's approach to emissions trading, involving the use of price caps, into a post-2012 carbon market. We examine the implications of this approach in a broader global context and consider how it might be reconciled with other schemes.
(2) The role of market-based approaches in supporting the advancement of sustainable technology. In particular, we consider the role of a carbon price signal in the development, deployment and diffusion of technology with a strong emphasis on energy efficiency. What other market-based approaches to technology might be amenable to international cooperation? Which approaches would be most in Canada's interests?

As international and domestic efforts on climate change have evolved, so has the understanding of the potential for international cooperation on market-based approaches. Established approaches to emissions trading can be modified to address Canada's circumstances, or adapted to focus more directly on technologies. Other market-based approaches that seek to directly affect consumer choices (e.g., through labelling and standards) may benefit from greater international cooperation.

2.0 The international context

Since the adoption of the Kyoto Protocol, a variety of approaches have been implemented to reduce carbon emissions. These range from efforts by individuals and firms to reduce their climate footprints to initiatives at city, state, regional and global levels. Among these are the commitments of governments to reduce emissions through the United Nations Framework Convention on Climate Change (UNFCCC) and its 1997 Kyoto Protocol, and

Europe's carbon constraints for electricity generators and industry under the European Union Emissions Trading Scheme (EU ETS). Some jurisdictions that did not ratify the Protocol, though, are seeing activities take place at the sub-national level such as some Canadian provinces and the U.S. and Australian state governments.

Furthermore, some governments have already acted to establish long-term targets. The EU was the first jurisdiction to establish a climate change target. In 1996, the EU adopted a target of limiting the global mean temperature increase to 2°C above pre-industrial levels. In 2005, EU environment ministers proposed reduction targets of 15-30 per cent below 1990 by 2020 and 60-80 per cent by 2050. In February 2007, ministers agreed to cut emissions to 20 per cent below their 1990 levels and to increase the target to 30 per cent below the 1990 levels if other industrial countries sign on to a global effort.

Individual EU member states have also set medium and long-term GHG targets:

- The UK government has accepted the recommendation of the *Royal Commission on Environmental Pollution* that emissions be cut "by some 60 per cent by about 2050." This goal was based on the IPCC reference scenarios.
- France's 2004 Climate Plan includes an objective of emissions at 70-80 per cent below 1990 levels by 2050.
- Germany has a medium-term target of reducing national emissions to 40 per cent below 1990 levels, conditional on the EU as a whole committing to a 30 per cent reduction. The German Ministry for Environment has proposed that the country's GHG emissions be reduced by 80 per cent by 2050.
- Sweden has a long-term goal of reducing national per capita emissions to 4.5 tonnes CO_2-eq by 2050. This target is based on achieving a common global per capita level of emissions. In 2006, Sweden established a target of reducing emissions to 25 per cent below 1990 emissions by 2020.

In the United States, at the federal level, there are no medium or long-term targets for GHG emissions, but a number of U.S. legislators have indicated their intention to introduce legislative proposals in the current Congress. In general, the proposed national targets for the medium term are less aggressive than state goals. However, several of the proposals (Waxman, Kerry-Snowe, and Jeffords-Boxer) include targets that imply emissions paths similar to the 450-550 ppm scenarios.

Medium and/or long-term GHG targets have been established by a number of states:

- California has set a target of reducing state-wide emissions to1990 levels by 2020 and to 80 per cent below 1990 levels by 2050. The medium-term target was based on a detailed assessment of emissions reduction potential in California. The long-term target was based on an assessment of the global reductions required to keep global temperature increases below 2ºC (i.e., concentrations of 450-550 ppm).
- The *New England Governors and Eastern Canadian Premiers* group (NEG/ECP) has set a medium-term target of 10 per cent below 1990 levels by 2020, and a long-term target of 75-85 per cent below current (2001) levels. There is little information available on the basis for the 2020 target, but the long-term target is based on the UNFCCC and IPCC reports.

- New York, New Mexico and Washington States have adopted the NEG/ECP medium term-target (10 per cent below 2000 levels by 2020).
- Vermont, although a member of the NEG/ECP, has set stronger targets: 50 per cent below 1990 levels by 2028 and, if practicable, 75 per cent below 1990 by 2050.
- Arizona has set a medium-term target of reducing emissions to 2000 levels by 2020 and by 50 per cent below 2000 by 2050. Like California, Arizona set the 2020 target through a bottom-up analysis of emissions reduction options.

In many instances, carbon markets are a prominent part of the response to climate change and are demonstrating that they can be a credible and central tool for future climate mitigation.

According to the World Bank (Capoor and Ambosi 2007), in 2006, the carbon market grew in value to an estimated US$30 billion, three times greater than the previous year. Last year, the market was dominated by the sale and re-sale of European Union Allowances (EUAs) at a value of nearly $25 billion under the EU ETS. Project-based activities primarily through the Clean Development Mechanism (CDM) and Joint Implementation (JI) grew sharply to a value of about US$5 billion in 2006. The voluntary market for reductions by corporations and individuals also grew strongly to an estimated US$100 million in 2006. Both the Chicago Climate Exchange (CCX) and the New South Wales (NSW) market saw record volumes and values traded in 2006.

2.1 The rise of regulated emission trading systems

Emissions trading systems are already operational in member states of the EU and Norway. The United Kingdom and Northern Ireland have sources that participate in both the EU ETS and a domestic scheme. Such systems are also being envisaged outside of Europe, notably in the United States, Australia, Japan and Canada.

The **EU ETS** is by far the largest market in terms of number of participants and trading activity. Trading activity is shifting from allowances that can be used for compliance during Phase I (2005–2007) to allowances that can be used for compliance during Phase II (2008–2012). Almost all EU Member States are Annex B Parties and hence have emission limitation commitments for 2008–2012. To help meet those commitments, each Member State is required to implement an ETS covering CO_2 emissions by electricity generators and specified industrial sources. Allowances issued by a Member State can be used for compliance by an installation in any Member State. The ETS is being implemented in phases: from 2005 to 2007; from 2008 to 2012; and in five-year periods thereafter. In 2005 the ETS covered about 10,500 installations responsible for about 45 per cent of the EU's CO_2 emissions and approximately 2,088 million allowances were issued. The EU ETS is expected to expand to include Norway, Iceland and Liechtenstein in 2008, link with a Swiss emissions trading system, incorporate Turkey if it joins the EU, and cover aviation beginning in 2011.

Norway began implementing an emissions trading system, the design of which is very similar to that of the EU ETS, on January 1, 2005 for 51 onshore installations with annual emissions of about seven Mt CO_2. Actual emissions were lower than the allocations for both 2005 and 2006, and there has been little trading. On January 1, 2008, Norway's ETS is expected to be integrated into the EU ETS, with coverage expanded to 104 installations with annual emissions of about 23 Mt CO_2.

In 2002 the **United Kingdom** launched an emissions trading system with two components; Direct Entry and Climate Change Levy Agreements (CCLA). Direct Entry participants submitted bids for declining absolute emission targets for the years 2002 through 2006 in return for incentive payments. The Direct Entry component of the scheme concluded at the end of 2006 and many of those participants are now covered by the United Kingdom component of the EU ETS.

The **New South Wales–Australian Capital Territory** (ACT) Greenhouse Gas Abatement Scheme establishes a cap on GHG emissions associated with electricity consumption in New South Wales, and since January 1, 2005, the ACT. Electricity retailers and industries supplied directly by the grid (33 firms) must purchase GHG abatement certificates equal to the emissions associated with the electricity they sell/use. Abatement certificates can be generated by accredited projects that reduce emissions or enhance removal of GHG. Establishments not covered by a CCLA are eligible to offer emission reduction commitments in return for incentive payments through an auction.

Despite not ratifying the Kyoto Protocol, there is much going on in the **United States**. Musier and Melby (Point Carbon July, 2007) indicate that the landscape of the U.S. environmental markets over the next five years will be more complex and fragmented than any commodity market in U.S. history. They note this is a bold statement, but probably not an exaggeration. Multiply three new environmental commodities times dozens of states and the possibility of layered regional and federal rules, and you have quite a complex web that makes up the U.S. environmental marketplace. It is a marketplace that includes both voluntary and mandatory compliance markets. As states continue to lead the way, corporations are now also stepping forward with calls to action—and Congress is considering national market-based approaches.

At the state level, there are two major initiatives, namely the Regional Greenhouse Gas Initiative (RGGI) and the Western Climate Initiative (WCI).

In December 2005, governors from seven Northeast states agreed to a precedent-setting, bipartisan plan to reduce global warming pollution from power plants. The plan will also create new investment in cleaner, more efficient energy technology. The regional plan will establish a market-based program that rewards smart companies for outperforming the new pollution limits and lowers overall compliance costs. Known as the Regional Greenhouse Gas Initiative (RGGI), the accord takes effect in 2009, and is designed to reduce CO_2 pollution to a level 10 per cent below current emissions by 2019. The policy is expected to lower utility bills by helping consumers and business use energy more efficiently. Under careful development for more than two years, the accord includes Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont. Pennsylvania, Maryland, the District of Columbia, and five Canadian provinces have been close observers of the process. Leading companies in the Northeast, such as Bank of America, Staples, Keyspan, National Grid, Pfizer and the association of large energy users in Massachusetts known as The Energy Consortium, have all backed the plan.

On August 22, 2007, members of the WCI announced a regional, economy-wide GHG emission reduction target of 15 per cent below 2005 levels by 2020, or approximately 33 per cent below business as usual (BAU) levels. Under the memorandum of understanding developed in February 2007, WCI members (which currently include the states of Arizona, California, New Mexico, Oregon, Utah, and Washington, and the Canadian provinces of British Columbia and Manitoba) agreed to jointly set a regional emissions target, and establish a market-based system by August 2008 —such as a cap and trade program covering multiple economic sectors—to aid in meeting it. The regional target is designed to be consistent with existing targets set by individual member states and does not replace these goals. The WCI will cover the six GHGs included under the Kyoto Protocol.

Members of Congress are facing a growing body of legislation intended to address global climate change. As shown in Table 1, all of them are proposing an absolute cap with trading. Members of Congress may face votes on one or more such bills in the near future.

Table 1: Legislation in the U.S. Congress related to GHG emissions as of July 18, 2007

Title and Sponsor	Reduction Target and Timetable	Important Attributes
Climate Stewardship and Innovation Act S. 280 Senators Lieberman (I-CT) and McCain (R-AZ)	Bring emissions to 2004 levels by 2012, to 1990 levels by 2020, to 22% below 1990 levels by 2030, and to 60% below 1990 levels by 2050.	Caps electric power, industrial, commercial, and transport sectors (economy-wide). Includes provision for clean development mechanism through which U.S. companies gain credits for emission reductions they sponsor in developing countries. Provisions for expansion of nuclear power.
Global Warming Pollution Reduction Act S.309 Senators Sanders (I-VT) and Leahy (D-VT)	Stabilize global greenhouse gas concentrations below 450 parts per million: US reductions to 1990 levels by 2020 and 80% below that by 2050.	Economy-wide caps. National renewable energy quotas and energy efficiency goals with credit trading programs.
Electric Utility Cap-and-Trade Act S.317 Senators Feinstein (D-CA) and Carper (D-DE)	Caps current emissions through 2011, then at 2001 levels by 2012, thereafter cap lowers further 1% each year through 2020, subject to EPA review.	Power sector only. Specifies auctioning of credits, use of offsets. Establishes independent scientific panel to make recommendations to the EPA every four years on the reduction rate required.
Climate Stewardship Act H.R. 620 House Reps. Olver (D-MA) and Gilchrest (R-MD)	Emissions stabilize at current levels from 2012 to 2019, then are reduced 15% by 2020, 38% in 2030, 75% by 2050 (which equals 70% below 1990 levels).	Same as Lieberman and McCain's, except offset credits may account for only 15% of emissions reductions, and "early action" credits limited to 20% of cap. Does not contain Senate version's nuclear provisions.
Global Warming Reduction Act S.485 Senators Kerry (D-MA) and Snowe (R-ME)	Reduce emissions to 60% below 1990 levels by 2050, through increasing annual reductions starting at 1.5% a year for the first ten years.	Economy-wide caps. Nationwide renewable fuels standard. National renewable energy quota of 20% by 2020.
Safe Climate Act H.R.1590 Rep. Waxman (D-CA)	Emissions freeze at 2009 level in 2010. Beginning in 2011, emissions cut ~ 2% per year, falling to 1990 levels by 2020. Beginning in 2021, annual cuts of ~ 5%, falling to 80% below 1990 levels by 2050.	National renewable energy quota: 20% by 2020. Energy efficiency targets: increase gradually from 0.25% of electricity sales in 2010 to 1% of sales in 2012 and each following year through 2020.

Title and Sponsor	Reduction Target and Timetable	Important Attributes
Clean Air Planning Act S.1177 Senator Carper (D-DE)	Caps power plant CO_2 emissions at today's levels in 2012, at 2001 levels in 2015. Thereafter, annual reductions to achieve levels 25% below 1990 by 2050.	Power sector only, offsets allowed, output-based allocation, includes a new entrant reserve (carbon credits reserved for allocation to newly-built installations).
S.1168 Senators Alexander (R-TN) and Lieberman (I-CT)	Power plant CO_2 emissions capped at 2.3 billion tonnes (2006 levels) in 2011, at 2.1 billion in 2015, 1.8 billion in 2020 (1990 levels), and 1.5 billion tonnes in 2025 and beyond (~17% below 1990 level).	Power sector only, allows offsets, includes new entrant reserve of no more than 5% of the year's allowances, includes emissions performance standard for plants built after 2015 (no more than 1100 lbs. CO_2/MWh).
Clean Power Act Senator Sanders (I-VT)	Same as S.1168 for CO_2, and specifies that if no economy-wide greenhouse gas bill has been passed by 2012, then CO_2 emissions from power plants must be decreased each year by 3%.	Power sector only, CO_2 performance standards for new plants, renewable energy quota: 20% by 2020. Energy efficiency targets with credit trading system: gradual reduction of peak demand and overall electricity use.
Low Carbon Economy Act H.R. 620 Senators Bingaman (D-NM) and Specter (R-PA)	Calls for a reduction of greenhouse gases to 2006 levels by 2020 and to 1990 levels by 2030.	Limits cost of allowances to $12 per tonne CO_2-eq in 2012, rising by 5% above inflation each year after that. Allowance allocation through 2017: 53% free, 24% auctioned, rest reserved certain sectors, projects. Tariffs on goods from high-emitting countries.

Source: Point Carbon, *Carbon Market North America*, July 18, 2007.

Even with Federal legislation, a likely outcome is that the United States will end up with "tiered systems"—meaning that some states and regions will be more aggressive in their GHG standards than the federal legislation, while others will be less aggressive. Non-existing or less aggressive GHG policies will be driven by a federal program, once established. State, regional and federal programs will need to make choices regarding which GHGs (CO_2, methane, others) will be regulated, and in what industry sectors (power generation, agriculture, cement, transportation, manufacturing, and more). Current bills are not looking across all sectors, or even the same sectors. State and federal legislators may also have differing views on where emissions should be regulated—upstream or downstream, at the source or the sink or load centres. Hybrid approaches are even contemplated where some resources and industries are regulated at the source, others as a sink.

2.2 Canada and emissions trading

In March 2007, the Government of Canada (2007) released Canada's long awaited *Regulatory Framework for Air Emissions* which is expected to lead to a draft GHG regulation to be released in the spring of 2008. The Framework includes different elements: (i) mandatory GHG emission targets and compliance mechanisms applicable to large industrial emitters including the electricity, oil and gas, and mining sectors; (ii) measures targeted at emissions from the transportation sector including mandatory car and light truck fuel efficiency standards to apply in 2011; and (iii) energy efficiency standards applicable to consumer and commercial products.

The Framework constitutes a significant signal for domestic and international carbon markets where there is large uncertainty about Canadian demand for carbon credits under the Kyoto Protocol. Specifically, the Framework indicates that Canada's absolute GHG emission reductions target to be achieved through an intensity-based standard is a 150 MT (20 per cent) decrease from 2006 GHG levels by 2020. This continues the move toward a 'made-in-Canada' approach to climate change, which is a marked departure from Kyoto Protocol commitments that require Canada to effect a 220 MT reduction from estimated 2006 GHG levels by 2012. Nonetheless, the defined GHG targets and provisions for the use of emission trading and offsets to achieve compliance with such targets may increase emission reduction activities in the near term.

The framework establishes new targets for GHG emission reductions; an 18 per cent drop in intensity by 2010 from the 2006 level. Each year thereafter, the regulations will mandate a 2 per cent improvement in GHG intensity.[1] The framework stipulates that compliance can be attained through different mechanisms:

- in-house intensity reductions;
- domestic trading (i.e., with other regulated facilities);
- offsets (i.e., credits generated by approved non-regulated operations);
- payment to a climate change technology fund at a rate of $15/tonne from 2010 to 2012, $20/tonne in 2013, and thereafter indexed to GDP. Contributions to the "deployment and infrastructure" component of the fund—the major element—are capped at a sliding percentage of total regulatory obligations: starting at 70 per cent in 2010 and falling to zero in 2018; and
- Certified Emission Reduction (CERs) credits from CDM are allowed, up to 10 per cent of an individual firm's target.

The framework also introduces a credit for early action (1992–2006), up to a total ceiling of 15Mt. The Government is holding consultations on the specific sector-based emission intensity targets to apply to each of the thermal electricity, oil and gas, forest product, smelting and refining, iron and steel, cement, lime, chemical production and certain mining sectors. The emission intensity limit for individual facilities will be elaborated upon in the draft regulations due to be released in spring 2008.

2.3 Alberta and emissions trading

In Canada, Alberta is the only province to have put in place a regulation implementing a cap and trade system. Effective March 31, 2008, the 100 or so plants in the province that produce more than 100,000 tonnes of GHG emissions have to take action to cut their carbon intensity by 12 per cent, retroactive to July 1, 2007. The deadline was set by the province under new GHG legislation that came into effect July 1, 2007.

The big operations, led by electricity generating plants that burn coal and oilsands producers, can choose to:

- cut emissions by becoming more efficient;
- pay $15 a tonne for emissions above the new efficiency target, with the money going to an Alberta fund that will invest in projects or technology to cut emissions in the province; and/or
- buy an offset in Alberta to apply against their emissions total.

[1] For comparison, we have calculated that the average annual U.S. rate of energy intensity reduction between 1997 and 2003 was 1.9 per cent.

The Alberta system is really a GHG levy on emissions above targets. The targets are there to provide a cost impact (of $1.80/tonne of total emissions) that is lower than the $15/t price signal. There is no intention to link the system with systems in other countries.

In comparison, the federal framework's planned phase out of the Technology Fund compliance mechanism turns what is a GHG levy on emissions above targets, with revenue going into the Technology Fund, into an emission trading system. The proposed Alberta plan is not primarily an emission trading system; it is a carbon levy on emissions above targets, with a side option of offset credits.

The federal framework of targets, emissions trading and compliance mechanisms is likely to result in considerable overlap with provincial GHG trading regulatory schemes: Alberta has a levy system; British Columbia and Manitoba have joined the WCI and Ontario is considering it; and Quebec is observing the RGGI and the WCI. In this regard, the federal framework specifically contemplates the use of provincial equivalency agreements that set standards that are at least as stringent as the proposed federal standards. Further, the framework indicates that the federal government may stand down the federal requirements if such an agreement is reached with a province.

2.4 Links among emissions trading systems

Although there are a number of different carbon markets, they can be, and to a limited extent are, linked. At present the trading systems are linked as follows:

- The national systems that comprise the EU ETS are fully linked with each other and all allow the use of CERs, but not temporary CERs (tCERs) or long-term CERs (lCERs), and, beginning in 2008, to use of ERUs.
- Norway's ETS allows the use of Phase I EU allowances and CERs, but not tCERs or lCERs, for the period 2005–2007. It is expected to become part of the EU ETS in 2008.
- The NSW–ACT greenhouse gas abatement scheme has no links to other systems.
- The United Kingdom domestic scheme has no links to other systems.
- The CCX allows the use of CERs and EU allowances for compliance, but suspended imports of Phase I EU allowances in December 2006.
- The Canadian Framework plans to allow compliance through a limited use of CERs.

With so many countries and jurisdictions having adopted or planning to adopt cap and trade instruments to reduce emissions, there is a widely held assumption that international linking of emission trading markets is the key to coordinated global action. This tendency should not lead to the conclusion that there are no difficulties with the implementation of this market based instrument.

In fact, implicitly, when considering the targets they are imposing on themselves and their industries, the acting countries are facing difficult choices regarding the strength of the targets and the allocation of burden between different sectors. Major countries are now admitting that costs should be incurred to reduce GHG emissions and that serious constraints aiming at emission reductions of 50 per cent or higher by 2050 are needed.

The world is still far from agreement on how fast to step up the costly effort and who should bear what share of the global effort to address the global problem. That means there is little chance of agreement on seriously binding national targets to deliver significant emission reductions by 2020. Attempting to negotiate such a set of targets would likely delay action by many important countries. The issue for countries remains the same; balancing economic impacts and environmental integrity. As each country steps up domestic efforts to reduce emissions, a key issue will be the impact of costs on domestic industry relative to the costs being imposed on trade competitors. In fact, all countries will be reluctant to undermine the competitiveness of their trade-exposed sectors in any significant way.

In such a context, a critical policy question is: which market based instruments can best deal with the necessity of aggressively reducing GHG emissions, taking into account the different economic realities of all countries and trade issues arising from different responses to the issue?

2.5 Hydrocarbon royalty in Quebec

A very significant market-based approach to reducing emissions is the carbon tax in the province of Quebec. In the *2006-2012 Action Plan, Québec and Climate Change: A Challenge for the Future*, announced on June 15, 2006, the Québec government set out a plan aimed at reaching emission reduction and adaptation goals. This plan is composed of 24 actions that implicate various sectors in Québec, but particularly focus on the energy sector (also transport and industry). The government aims to achieve GHG emission levels that are 1.5 per cent below the 1990 level by 2012.

The action plan presents some economic instruments as tools to achieve emission reductions. A hydrocarbon royalty will be used to target hydrocarbon use in transportation and the heating of buildings, as these are responsible for 72 per cent of GHG emissions in Québec. The amount charged will depend on the hydrocarbon concentration of the heating oil, gas, natural gas or propane sold. The targeted industries are refineries and importers of heating oil, gas, natural gas or propane. Royalties are placed on all sales made in the province of Québec.

The carbon emission royalty will amass approximately $200 million in a Green Fund, which was initiated in the Sustainable Development Act (April 2006) and funds the actions proposed by the Ministry of Sustainable Development, Environment and Parks. The royalty fund will support actions to reduce GHG emissions, with half going to public transportation, particularly in the Montreal area; and the other half allocated to other measures.

Bill 52 was presented by the Québec government on November 23, 2006 and would allow for changes to be made to the Loi sur la Régie de l'énergie (L.R.Q., chapitre R-6.01) giving it a new mandate, thus permitting the above strategies to be implemented (It would give the Loi sur l'Agence de l'efficacité énergétique (L.R.Q., chapitre A-7.001) more jurisdiction to develop energy efficiency programs). The Bill provides opportunity for the Régie and the Agence to collect royalties on hydrocarbon sales in the province to fund climate change and energy efficiency programs. The Régie has not yet detailed the exact mechanism for the application of the royalties; however, the following preliminary steps will probably be used.

- The Régie will determine the value of the royalty to be paid for each fuel type (e.g. in ¢/litre of gasoline and ¢/m^3 of natural gas).
- The Régie will firstly calculate, each year, the overall price to pay per tonne of CO_2 (only CO_2, excluding other GHGs) in the province of Québec, in order to obtain $200 million. To do this the Régie will probably ask companies to provide their total sales for the previous 12 months. Consequently, this price will vary every year based on energy consumption and total CO_2 emissions to obtain the total revenue of $200 million.
- Calculate the royalty for each fuel (oil, gas and coal) using specific emission coefficient. These coefficients are used to calculate CO_2 content (not CO_2 equivalent) (e.g., in grams of CO_2 per litre of gasoline or m^3 of natural gas). Royalties are higher for more polluting fuels, such as heating oil.
- Based on the literature, as well as our own estimates, the royalty could be approximately 0.7-0.8¢ per litre of gasoline and 10 times less for natural gas, as it is a cleaner fuel (our estimates are 0.76 ¢/litre of gasoline and 0.07 ¢/m3 of natural gas) or between $3 and $3.50 per tonne of CO_2.

To our knowledge, the province of Quebec is the only jurisdiction in North America that has implemented a carbon tax. Norway is the first country at the world level to have taxed carbon.

2.6 Other market measures

The 2005 G8 meeting at Gleneagles highlighted energy efficiency as a key area for G8 action. In particular, the Plan of Action on Climate Change, Clean Energy and Sustainable Development made a number of specific commitments on energy efficiency. The plan states that "to encourage co-ordination of international policies on labelling, standard setting and testing procedures for energy efficiency appliances, we will:

(a) promote the application of the International Energy Agency (IEA) 1 Watt Initiative[2];
(b) ask the IEA to undertake a study to review existing global appliance standards and codes, building on its existing capacity on energy efficiency in appliances;
(c) extend the use of clear and consistent labelling to raise consumer awareness of energy consumption of appliances;
(d) work nationally and in co-operation with other countries to seek improvements in the efficiency and environmental performance of products in priority sectors; and
(e) explore the potential to co-ordinate standards with other countries, building on the examples provided by existing international bodies (G8 2005).

The St. Petersburg Plan of Action on Energy Security agreed to at the 2006 G8 Summit reiterates the commitment to energy efficiency, calling for "a comprehensive approach

[2] A program backed by the IEA to encourage manufacturers to reduce to 1 watt the amount of "standby" power that appliances use. Standby power is the electricity that appliances consume when they are not in use, accounting for an estimated 5-10 per cent of all power consumption. All appliances with remote operating devices or external power supplies use standby power.

within the international community to energy saving, energy efficiency and the extension of relevant efforts, including sharing best practices" (G8 2006).

Furthermore, there are a wide variety of other market-based approaches that are now proposed in many climate action plans to support the deployment of technology, including:

- fiscal incentives, such as reduced taxes on biofuels and investment tax credits;
- capital grants for demonstration projects and programs (clean coal programs in the United States, photo voltaic programs in the United States, Germany and Japan);
- feed-in tariffs which provide a fixed price support mechanism for renewable energy;
- quota based schemes, such as the renewable portfolio standards in 23 U.S. states and the vehicle fleet efficiency standards in California;
- tradable quotas: the Renewables Obligation and Renewable Transport Fuels Obligation in the UK;
- tenders for energy from specific sources (sometimes called set-asides) with increased output prices subsidized out of the revenues from a general levy on electricity tariffs;
- subsidy of the infrastructure costs of connecting new technologies to networks; and
- procurement policies of national and local governments and/or government monopolies.

3.0 The Canadian approach: a price cap coupled with a technology fund

Canada finds itself once again at a crossroad in its efforts against climate change. Emissions continue to grow and it is critical that Canada define a post-2012 path that is ambitious, yet realistic, and also offers a potential alternative to the deadlock in which the international community finds itself regarding its approach for action against climate change.

This paper analyzes one particular element of the current Canadian approach: price caps. The objective is two-fold: 1) to evaluate the Canadian approach (the price cap coupled with the technology fund) within the international context; and 2) to identify modifications to the Canadian approach in order to make it acceptable to the international community bearing in mind Canadian interests.

In this examination, issues of importance to Canada in the price cap and technology fund are viewed as; price certainty, reduced cost of compliance, integration into the international market and related political international credibility.

This section begins with a discussion of the respective merits of the so-called quantity approach and price approach before turning to an analysis of the hybrid approach with an emphasis on price cap. The Canadian approach is then evaluated in light of the literature and the international context. This will be the basis of the next step consisting of looking at ways to modify the Canadian approach in order to make it acceptable and suitable to the international community.

3.1 Price measures vs. quantity controls

In an ideal world, where the cost of limiting emissions is known with certainty and the benefits of reduced emissions are likewise known, the price and quantity approaches are perfect policy substitutes for each other. However, when abatement costs or benefits are uncertain the situation is quite different. Policy instruments chosen should be designed to address the highest relative risk concerning damages due to the shock or the economic cost of the quantity restriction. On the one hand, quantity restrictions can be beneficial when incremental damages increase rapidly with a rise in emission levels or when marginal costs are relatively flat and predictable. In this case, quantity restrictions are preferred because they prevent emissions from rising above a "safe" level without the risk of cost surprises. On the other hand, when health or environmental damages are not sensitive to short-term emission levels or when there are concerns about potentially high costs, the undesirable side effects of quantity restrictions may prevail. In that case price based instruments are preferred.

Which of these situations best reflects the reality of GHG control? Concerning the benefit side of the equation, Pizer (2002) notes two things; first, damage caused by climate is presumed to be a gradual phenomenon where minor temperature changes have few consequences. Second, damages depend on the accumulated *stock* of GHGs in the atmosphere and not the annual *flow*. "Emissions in any single year, such as the 8.5 GtC emitted in 1990, represent a small fraction of the extra 190 GtC accumulated since the beginning of industrialization. This damage relation contrasts with traditional pollutants, such as particulates, SO, NO, etc., whose damages depend on the annual emission level because they dissipate rapidly in the environment" (Pizer 2002: 420).

Concerning the cost side of the equation Metz and van Vuuren (2006) note that on GHG emission control, "Cost estimates are uncertain. This uncertainty is a consequence of uncertainty in baseline trends, effectiveness of policies, flexibility of economies to adjust to higher energy prices, technology development and assumed international policies." U.S. Senator Bingaman explains that "Some assert that technology will develop quickly once a market-signal is in place, enabling low-cost compliance. Others take a more pessimistic view of technology progress and assert that any mandatory reduction regime will have devastating economic impacts. As this is a disagreement about different projections of the future, no side can ever 'win' this argument" (in Philibert 2006: 15). But one has to admit that this is a sizeable concern. Recent debates in many Annex I countries (Canada, US, Japan, Australia and New Zealand) indicate a clear concern that mandatory carbon mitigation policies may become quite costly—even those involving modest targets. Part of the cost uncertainty arises from uncertainty about the level of future baseline emissions that would occur in the absence of new policies (Morgenstern 2004).

Newell and Pizer (2003) state: "As long as the existing stock is large relative to the annual flow, marginal benefits will tend to look very flat over the range of annual emissions, since the reductions that could be taken in a given year will never be enough to significantly alter the stock. This generic characteristic weighs heavily in favour of price instruments."

As a result of this characteristic, strict adherence to a short-term emissions cap is less important from an environmental perspective than the long-term effort to reduce emissions more substantially. Stemming from that perspective, many researchers have come to the conclusion that taxes should be the preferred instrument to address the climate change problem.

Theoretically, carbon taxes also offer the advantage of simplicity. As emphasised by Nordhaus (2006), unlike the quantitative approach under the Kyoto Protocol, with taxes there are no country emission quotas, there is no emissions trading and there are no base period emission levels. Furthermore, the approach would be spatially efficient among countries that have a harmonized set of taxes.

Despite those numerous theoretical advantages, when applied to climate change, carbon taxes have, notwithstanding, been politically unacceptable to some developed countries in an international context—even less so than quantified objectives. Furthermore, it seems clear that developing countries would be unwilling to adopt such an instrument because of the costs of action it would impose on them in comparison to the actual situation in which they do not face any constraint. If harmonized at the international level, taxes also raise sovereignty concerns. Moreover, taxes also meet opposition at the domestic level from various vested interest groups in virtually every country (Philibert and Pershing 2003). In fact, as emphasized by Jacoby and Ellerman (2004) the argument for the use of a price instrument for controlling GHG emissions is very strong. However, economic reasoning notwithstanding, the dominant choice almost everywhere in the world still seems to be the quantity instrument.

In response to this apparent contradiction between efficiency and political reality a wide variety of hybrid options have been proposed. They include various forms of indexed or dynamic targets, and the introduction of caps on the price of carbon traded internationally, often also called "safety valves". In fact, as explained by Philibert (2006), a hybrid framework could evolve from a quasi-tax to a quasi-pure quota, if Parties appropriately manage their targets and the price cap level over time. Indexed targets would adjust assigned amounts to the evolution of some economic variables. Price caps would relax the emission objectives if the international carbon price reaches some agreed level. Jaccard (2006: 309) suggested that the price cap could even be designed to climb over time in conjunction with a reduction in the emission cap so that the environmental effectiveness of the policy increases at a pace consistent with the time needed for innovation and commercialization of new technologies, and the natural turnover rate of equipment, buildings and infrastructure. Thus, these options would by design reduce the uncertainty on the cost encountered by countries.

Among these different hybrid approaches, Canada should naturally be interested in seeing the ideas of indexed or dynamic targets and price cap advancing since those proposals have been at the core of the different Canadian plans. Canada has struggled with the concept of intensity targets for large final emitters (LFEs) for many years now and a strong commitment by Prime Minister Chrétien, never officially challenged since, has been made toward industry. This commitment guarantees a $15/tonne cap on the cost of compliance to the Canadian target. Philibert and Pershing (2003) note that while dynamic targets might help deal with cost uncertainty driven by economic growth and other factors, price caps might help deal more broadly with abatement cost uncertainty. In particular, price caps could also accommodate uncertainties in future technology developments and relative energy prices.

In the context of a mandatory cap and trade system, a price cap also referred to as a 'safety valve' or 'trigger price' would specify a maximum market price at which additional emission allowances would become available to prevent the price from rising any further. This would ensure that emission reductions only occur if they were cheaper than this price cap; otherwise one would buy these additional allowances.

A price cap is not a policy innovation; it has close and well established relatives. It is similar to a per-unit penalty found in cap and trade systems where the penalty is set at a high enough level that it is unlikely to be triggered. If the price is set sufficiently low so that emissions commonly exceed the quantity limit, it resembles an emissions tax (Jacoby and Ellerman 2004: 481).

Issues and implications in emissions trading that will be discussed here include the question of environmental integrity, the process for setting the price cap, how it links with regimes with different price caps and the provision of revenue if an international body sells price cap allowances.

3.2 The environmental integrity issue

It has been argued that reliance on a "safety valve" would undermine mitigation efforts because additional permits to release GHGs could be issued beyond those that would otherwise be available. Of all the arguments against the safety valve, this is probably the strongest. However, support for this view depends partly on how the issue is framed and, specifically, whether a safety valve is an absolute political prerequisite to implementation of an ambitious cap and trade system in the United States and in the largest developing countries. It also depends on how the environmental integrity objective is defined. It could be argued that for climate change, the environmental integrity issue is whether the world is on a path to fundamentally changing the global energy system capital stock to low and zero CO_2 energy.

As argued by Morgenstern (2004), if one starts with the proposition that an ambitious fixed target system is attainable in the United States and other countries in the near term, then it is certainly true that the sale of any safety valve credits represents a weakening of the environmental goal. Alternatively, if one acknowledges that uncertainty about future costs associated with a fixed target system is a major deterrent to a new policy, then adoption of a safety valve may not represent a weakening. In fact, it may actually be seen as pro-environmental, since the proper comparison would be either to the status quo—that is to no mandatory system at all—or to a very weak system. Compared to no binding controls or to a weak policy, almost any non-zero carbon price would be pro-environmental (Morgenstern 2004).

3.3 The price cap level issue

Even if one is concerned that a safety valve would undermine the environmental integrity of a GHG control program, there are several possible responses. The actual level of the safety valve is clearly an issue and more importantly the level over time of the safety valve price matters a great deal. Most proposals involving a safety valve would have the trigger price ratchet up in real terms at a healthy rate, typically at 3-7 per cent per annum. At these escalation rates even a low initial trigger price would provide a relatively strong incentive effect after only a few years (Morgenstern 2004: 8). Another effect of a system with an increasing price cap is that it will allow experimentation and learning to take place, in order to understand the real world equilibrium between supply and demand. At the moment, this is only estimated from secondary information, with a fair degree of uncertainty.

On this subject, Jacoby and Ellerman (2004) recall that cap and trade systems often impose a penalty for uncovered emissions in the form of a per-unit fee, set at a level far above expected marginal cost. According to them, although the motivation is different, this penalty is formally analogous to the pure safety valve in that: (1) the quantity limit can be exceeded upon payment of the requisite fee; and (2) marginal costs and allowance prices will be no higher than the level set by the "escape" mechanism. The main difference is that the penalty is set at a level that has a low probability of being invoked; the quantity constraint is binding in nearly all instances (Jacoby and Ellerman 2004: 483).

Economists express two different opinions on the notion of the price cap level applied to GHG emissions. Most of them seem to think that it should be set at quite a high level. As Aldy *et al.* (2001) notes, "the safety valve is not intended to set an inefficiently low carbon price over time. Indeed, the safety valve may allow a higher price of carbon than would otherwise be the case, because it provides assurance that the costs will not exceed that level. ... The cost insurance provided by the safety valve could thus have environmental benefits, once the political economy of the emission reduction effort is taken into account." Morgenstern (2004) states that a safety valve as described here is a price cap that reflects the society's willingness to pay for carbon mitigation. It is not intended solely as a punitive measure.

Other economists have put forward proposals for a low safety valve price emphasising that the growth rate of the safety valve price matters a great deal, even more then the initial level. They envisage increasing the level over time, perhaps at some point to a level high enough to achieve the original quantity target. [3] A number of arguments have been made to highlight the advantages of such a pattern of gradually rising emission prices, including the value of early price signals in setting expectations of needed change, and the avoidance of restrictions that force premature and expensive turnover of capital stock. Some proponents even anticipated that a safety valve price might eventually converge to a pure quantity system, as cost uncertainties are reduced with time and experience. According to Nordhaus (2006: 11), studies of efficient prices find that the real carbon prices would rise by between two and four per cent per year depending upon the objective. Morgensten (2004: 8) expressed a slightly different view. According to him, most proposals involving a safety valve would have the trigger price ratchet up in real terms at a healthy rate, typically at three to seven per cent per annum. He adds that at these escalation rates even a low initial trigger price would have relatively strong incentive effects after only a few years. Of course, all safety valve proposals involve the collection of revenues by government, and the level of the price cap will impact the scale of revenues. The disposition of revenues is dealt with in section 2.6 below.

[3] See for example, Nordhaus, 2006; Kopp *et al.*, 1998, 1999; Pizer, 1999; and Jaccard 2006.

3.4 Linking to the international market

Since the beginning of the political process to build a Canadian plan on climate change, Canadian policy analysts and economists as well as representatives of LFEs have argued that by itself the Canadian CO_2 market would be too small to sustain the volume of exchanges needed to assure the lowest reduction of emission prices and that participation to the international market is a must.

Under the Kyoto Protocol quantity targets are fixed, the marginal costs of control will differ among the parties. Thus, just as trade among individual emitters can lower the costs of a national emissions cap, cross-border trade can reduce the costs of compliance. A question that needs to be addressed, therefore, is whether the existence of a safety valve in one or more of the trading partners may create barriers to international market development.

The concept of the price cap may take three different forms in an international agreement:

- governments implement the price cap at the domestic level, issuing supplementary permits at an agreed upon international price (IEA 2002: 126);
- economic agents (or countries) buy allowances at a fixed maximum price from an international body; or
- economic agents within countries buy price-cap allowances from their own governments.

In the two first cases, countries would have to agree on a single price cap. The second option goes further and implies an acceptance of the possibility of some international transfers, in addition to trading. Skeptics have argued that reaching an agreement on a single price cap among industrialised countries would be "a nightmare" (Mueller *et al.* 2002). However, according to Philibert and Criqui (2003), such an agreement does not seem that impossible because negotiations of a single price cap would not so much be about accepting the same marginal costs, as it would be an agreement on a tax level. It is even less an agreement about a uniform level of effort, for this would be defined by the size of the assigned amount with respect to unabated emission trends. Under a single price cap system, countries can still exert different levels of effort, because they have appropriately differentiated assigned amounts.

Regarding the third case, critics have argued that the introduction of a price cap would make the international market less efficient. According to those critics, if the global market price rises above the price cap, the country with the price cap would give out additional allowances, while other countries would have to continue to reduce emissions at higher costs. Of course, some entities could take advantage of these discrepancies and endanger the environmental integrity of the system. The international market would, in this case, bring the international carbon price down to the level of the lowest price cap. In response to this critique, Philibert and Reinaud (2004) have argued that if there are several price caps, trading remains possible (provided overselling is prevented). Only countries with actual emissions below their original assigned amounts should be net sellers. Buying supplementary permits should be made incompatible with being a net seller. If the price cap were implemented at a domestic level, only national entities would be allowed to buy supplementary permits, and only in proportion to their emissions over the target.

However, Philibert and Criqui (2003) admit that having many different levels of price caps in a single regime augments the risk of efficiency losses. In their view a possible compromise between efficiency and political reality might be to institute three price cap levels in the international regime. The highest level would be for industrialised countries. A lower level would be for most-advanced developing countries and some economies in transition. A very low or zero level—which could then be assimilated to a non-binding target as discussed below—would be for low-income developing countries.

3.5 Usefulness in presence of other flexibility mechanisms

The main objectives of introducing a price cap would be to overcome the political barriers to implementing stringent binding targets. Political barriers are based on the uncertainty of economic growth or of abatement costs. But critics state that the CDM already serves essentially the same purpose. Hence, a price cap would complicate the system and would not add any significantly new aspects. With the CDM, additional allowances can be introduced into the system.

This issue has been widely debated in both the environmental and the economics communities and there seem to be two views on the matter. According to Morgenstern (2004) the environmental view, bolstered in part by an article written by Jacoby and Ellerman (2002), is that either a phased-in program or a banking provision could provide the necessary flexibility to implement a mandatory cap and trade system.

The alternative view, espoused by other experts, is that offset or banking systems cannot reasonably adapt to unexpected events such as higher energy demand or inadequate technology as effectively as a safety valve (Hubbard and Stiglitz 2003, in Morgenstern 2004). According to this view offsets can reduce the expected cost of a particular goal, but they cannot address concerns about unexpected events. In fact, if the system becomes dependent on such offsets, their inclusion can actually increase uncertainty about program costs if the availability and cost of the offsets themselves is not certain.

Regarding the banking or borrowing of emissions, Morgenstern (2004: 10) paraphrases other critics when arguing the following:

> … offsets or banking systems can reduce the seriousness of the problem but they may not be sufficient to address all the uncertainties arising from unexpected spurts in economic growth or other events. While there is not yet complete agreement within the economics profession on these different views, the size of the emission reductions to be undertaken is clearly a critical factor. If only modest reductions are undertaken, a system of banking and offsets is likely to be adequate in preventing price spikes.

3.6 The use of the revenues

If costs turn out to be higher than expected, supplementary permits would be thus delivered either by governments or by some international entity. The question then arises as to how to use the revenues, which may be substantial but also unpredictable. Options include the promise to reduce distorting taxes, financing of more adaptation to compensate for higher emissions, or financing more research and development to help bring abatement costs down to the price cap level.

In a context where the world economies will have to invest large amount of money, probably trillions of dollars, to convert the global energy system to a low CO_2 system, the use of the revenues could become a highly contentious issue of environmental integrity. As mentioned by Willems and Baumert (2002), for example, governments might recycle price cap revenue back to the very entities that paid for the supplementary permits, thereby circumventing the price cap's intended purpose. If the price cap is part of an international agreement, this could be considered to be a form of manipulation by governments, which would have the unfortunate implication of loosening the collective environmental target of the treaty.

Thus, in this case, due to institutional considerations, Willems and Baumert (2002) suggest vesting any future price cap permit-issuer at the international rather than the domestic level. According to them, this would relieve national governments of this burden, while affording all countries the same level of access to a price cap administered by an international entity. They also argue that a single issuer might avoid unnecessary duplication and give governments wider discretion in designing domestic policies. This idea would probably not be popular in Canada, the United States or other countries for the reasons mentioned above. So other solutions have to be put forward. One obvious possibility would be to reach an agreement that revenues will not be returned to those from whom it was collected.

3.7 A long term price signal for carbon

One of the benefits often attributed to emissions trading is that it provides an incentive for innovation and the development of new technology. Economic theory suggests that, in the absence of any other market failure, introducing a fully credible carbon price path over the whole time horizon relevant for investment should be enough to encourage suitable technologies to develop. Profit-maximising firms would respond to the creation of the path of carbon prices by adjusting their research and development efforts in order to reap returns in the future (Stern 2006). In reality, of course, many market failures and barriers exist. These barriers, discussed in more detail in Chapter 4, prevent private investment in technology at socially optimal levels, particularly in the energy sector.

As a result, a carbon price signal—especially if short-term—is unlikely to have a significant impact on innovation. This conclusion is borne out by the experience to date on emissions trading and environmental innovation. While emissions trading has a number of benefits, in particular the overall reduction in compliance costs, it has a limited role in innovation.

Experience in the United States with two major emissions trading schemes, the Acid Rain Program and California's RECLAIM program, indicated that these programs were less effective in promoting technological innovation than traditional environmental policy approaches. For example, while national performance-based standards and public R&D supported innovation in lower cost, lower removal alternative technologies, such as dry flue gas desulfurization and sorbent injection systems, the SO_2 trading program effectively provided a disincentive for their use since they were not as cost-effective as low sulphur coal use. Experts involved with the California RECLAIM program state that it delayed the implementation of Selective Catalytic Reduction technology in California by 10 years, when compared to what would have taken place under the performance-based standard, rule 1135 issued in 1989 by the South Coast Air Quality Management District (Taylor *et al*. 2006).

One of the main criticisms with regard to the EU ETS has been that it discourages rather than encourages investment in new and low-carbon technologies in the long-term. To an extent this is result of international indecision, which in return reduces predictability. Some of the causes however are closer to home. They include short-term allocation periods and allocation methodologies, notably including new entrants and closure rules. In addition, fuel-specific allocation may have negative effects on investment in a carbon perspective as they do not discriminate necessarily between high and low-carbon fuels (Egenhofer *et al*. 2006).

Of course, these are not arguments against emissions trading, but an argument in favour of a hybrid system involving an increasing long term price cap that has the potential to send a clearer long term signal to market players.

3.8 Path forward for Canada

When the rules for non-compliance under the Kyoto Protocol were discussed in The Hague in 2000, a price cap and a possible level had already been discussed. They were rejected in the end, because countries were unable to agree that this was a credible approach and noted the potential for gaming of the system through the level of the price cap. It is not a given, therefore, that this system would be advantageous or an easy sell to the international community.

Currently negotiators find themselves in a deadlock with some signatory counties not reaching their targets, others (e.g, the United States) being 'out' despite their significant contribution to the problem, and the large developing countries stating they will not take on targets, although perhaps being favourable to the examination of alternative measures. In this context, if Canada adopts a credible approach, it may be able to present specific principles and approaches that can help to reduce the burden of climate change efforts. Canada may find an interested audience in other countries in similar circumstances; rapid growth, concerns targeted at a particular economic sector and a desire to avoid drastic increases in reduction costs. In light of the analysis produced in this report, there are compelling and favourable arguments for a price cap to the extent that necessary measures are in place to ensure the environmental integrity of the system.

Thus, if Canada is set on a price cap system, we should be ready to consider and discuss:

- a relatively high starting level, perhaps $20 or more;
- different cap levels negotiated internationally that vary according to a country's economic prosperity;
- a path for the safety valve price to increase at an annual rate of about four to seven per cent;
- the agreement that revenues not be returned to those from whom it was collected; and
- a mechanism to take into account trade issues; for example, rebate levies on exports and levies on imports.

If set within the upper range of cost expectations associated with a given quantified objective, the price cap may help narrow the range of expected costs put forward by various interest groups and various governments. The use of this approach, while ensuring measures are in place to ensure environmental integrity, might allow Canada to salvage a little international credibility and limit the impact of its efforts to reduce climate change on the Canadian economy.

4.0 Market-based approaches for technology

In order for the international carbon market to have any impact on investment decisions related to long-lived capital stock, and support the diffusion and broader use of climate-friendly technologies, the price signal must extend beyond a few years. This is the central challenge in establishing a post-2012 carbon market.

The above discussion on the issue of the long-term price signal is a reminder that a broad suite of measures is required to support technological innovation, and that a price signal is far more effective at later stages of the innovation process. In fact, it can be argued that a price signal alone, either as a tax/levy or fluctuating permit price, will not drive the development and deployment of technology to effect the transformation at the speed needed.

A comprehensive review of opportunities to advance climate-friendly technology, with an emphasis on the role of technology cooperation agreements, has recently been conducted by IISD. The conclusion of the analysis is that technology cooperation offers significant potential benefits to Canada—and the rest of the world—and that realizing these benefits will require that Canada enter into a range of technology cooperation agreements (e.g., bilateral or regional on a specific technology basis; research and development agreements with developing countries; sectoral agreements; and technology transfer agreements with LDCs).

This section briefly explores the potential for other market-based approaches to support the development, deployment and diffusion of sustainable technologies.

4.1 The particular case of energy efficiency

A long-term price signal for carbon is critical to encouraging investments in clean technology, energy efficiency and emissions reductions. However, there many other barriers to these investments that cannot be addressed solely by pricing, including information and a range of incentive barriers. There is a wide range of other policy tools that can be used to address these barriers, and this section explores the potential for international cooperation in other areas beyond carbon markets.

While there are a number of areas in which market-focused policies can be applied to address greenhouse gas emissions, the focus of this section is on energy efficiency. The rationale for focussing on energy efficiency is the:

- very large potential for emission reductions in the post-2012 period;

- importance of the billions of individual market decisions on appliances, equipment, vehicles and other energy-using capital stocks;
- wide range of policies that can be used to increase energy efficiency; and
- importance of international cooperation in certain key areas—principally standards and labelling.

4.1.1 Opportunities in energy efficiency

The potential for energy efficiency improvements to reduce greenhouse gas emissions is very large. The Alternate Policy Scenario developed by the IEA for the 2006 World Energy Outlook demonstrates both the environmental and the economic benefits of energy efficiency. Increased energy efficiency provides over half of the net carbon savings. At the same time, the incremental cost of the extra energy-efficiency investments in the Alternative Policy Scenario are half the magnitude of the avoided investments they stimulate in electricity generation, transmission and distribution. These investments in energy efficiency therefore pay for themselves in terms of capital investments alone, regardless of the additional fuel costs that they avoid (IEA 2006).

Energy efficiency offers a similar opportunity in Canada. The "wedge" analysis carried out by the National Round Table on the Environment and the Economy (NRTEE) in 2006 demonstrated that it is feasible to reduce energy-related greenhouse gas emissions in Canada by 60 per cent by 2050 with existing technology. Fully 40 per cent of the reductions could be achieved through increased energy efficiency (NRTEE 2006).

Similar analyses by utilities across North America have identified the potential for investments in energy efficiency that are less costly than supply-side resources, and have led to the introduction of utility-funded conservation and demand management programs in many jurisdictions.

4.1.2 Barriers and policy approaches

There a number of reasons why consumers and business do not make cost-effective investments in energy efficiency when purchasing appliances, equipment, vehicles, houses and buildings. A typical list of barriers to energy efficiency includes:

- Lack of information and hidden costs - Information on energy consumption and possible savings from more efficient appliances is often difficult to obtain, making comparisons between products on the basis of energy efficiency almost impossible. Purchase decisions are typically made on the basis of a number of factors, including price, technical features, size, and color. The true cost of the product also includes the lifetime operating costs, and this information is rarely available.
- Higher up-front costs - Even if information is available and the consumer is aware of the life cycle cost and is interested in obtaining the lowest available total cost, the most efficient appliances may be somewhat more expensive. The consumer may not be able to afford the purchasing price of the optimal choice appliance. If many consumers are in this position, the market for efficient appliances would simply not develop, and their price would remain high.
- Split incentives - The investor may not pay the energy bill, as in the case of a rented apartment, and so may have little interest in purchasing a slightly more expensive

appliance that would save the user huge amounts of energy. A similar issue arises in manufacturing. As long as energy efficiency and the operating costs of appliances are not well known by users, there is no basis for the demand for more efficient appliances. Manufacturers may use the cheapest components to save a few cents even if this induces much larger running costs for final consumers. Manufacturers have limited interest in improving the efficiency of their products since they do not bear the cost of the induced electricity consumption.

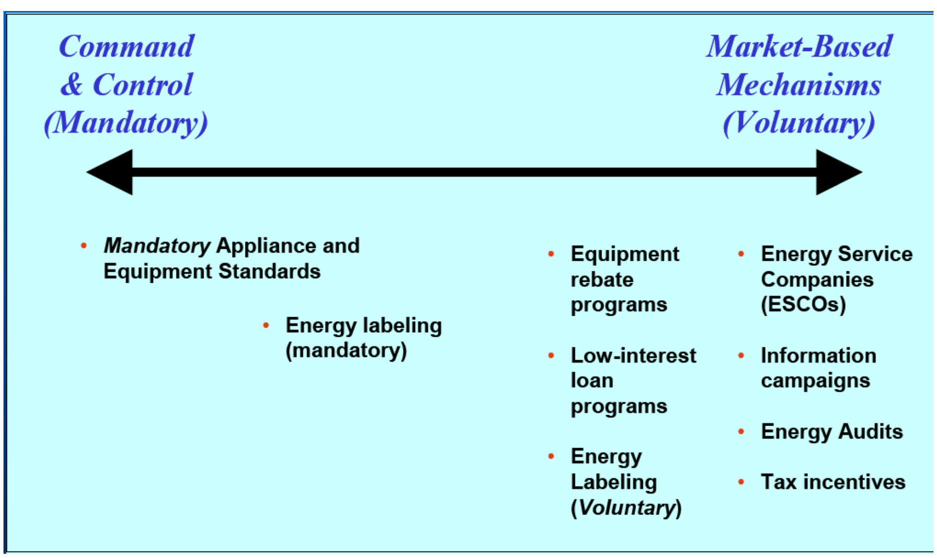
- Perceptions of risk - Consumers may view the performance of new, more efficient products as uncertain in the absence of proven reliability. This translates to a risk premium that reduces the willingness to pay for more efficient products.

These barriers affect billions of individual market decisions. The challenge for policy-makers is to address these barriers in the least-intrusive possible manner. A wide range of policy approaches have been developed to address energy efficiency, including:

- energy information and education;
- energy audits and advisors;
- promotion of energy services companies (ESCOs);
- energy performance labelling;
- minimum energy performance standards (MEPS);
- building energy codes;
- public procurement programs;
- equipment rebate programs;
- low-interest loan programs; and
- tax incentives.

These measures span the spectrum from prescriptive regulation to voluntary approaches:

Figure 1: Spectrum of Policy Approaches



The most successful countries have used a comprehensive set of policies including labels, MEPS and awareness campaigns (Geller and Attali 2005). The combination of different policies can have a powerful effect, and promote the rapid transformation of markets for energy-using products. For example, incentives for the purchase of high-efficiency products, coupled with information and labelling programs, can help to shift purchases to the most-efficient 15 to 25 per cent of the product range. At the same time, minimum energy performance standards can eliminate the least efficient products from the market. Over time, these approaches can be combined to transform the market to a higher level of energy efficiency. Successful market transformation efforts depend, however, on a high level of cooperation between governments, utilities, industry and other players.

This kind of market transformation strategy has been used successfully in a number of jurisdictions, including the Canadian market. In British Columbia, BC Hydro and the provincial government used this strategy successfully in the mid-1990s to increase minimum energy performance standards for electric motors and refrigerators. BC Hydro provided incentives through its Power Smart program for the purchase of the most energy efficient products. This reduced the market share of inefficient products to a point where it was feasible and cost-effective to bring in minimum energy performance standards. The incentives could then be re-targeted to a higher performance level, and the process ratcheted up energy efficiency over time. More recently this approach has been applied to windows and gas furnaces.

4.1.3 The role of standards and labelling

Energy efficiency standards are a set of procedures and regulations that prescribe the energy performance of manufactured products. Energy efficiency labels are informative labels affixed to manufactured products indicating energy performance and efficiency in a way that allows for comparison between similar products or endorses the product's use.

When governments invest resources in energy efficiency standard-setting and labelling programs (S&L), they prompt manufacturers to market and consumers to buy products that are more energy efficient in the aggregate. Although consumers may pay extra for efficiency features, their savings in electricity and fuel over the life of the product are typically four to five times the initial investment.

S&L efforts can be the most cost-effective means to help countries reduce energy demand while stimulating economic growth. The implementation of standards and labels results in the reduction of required investments in additional power plants and reduces total fuel consumption for electricity generation. The resulting reduction of peak demand improves electric grid reliability, affording better and more stable power to marginal users. Harmonization of S&L in the face of appliance globalization reduces trade barriers, thereby making energy services more affordable to poorer people. The overall result is economic gains (e.g., freeing up capital for investments in non-energy social infrastructure like schools, roads or hospitals) and environmental benefits (e.g., avoiding carbon emissions).

The payback to the government is typically $400 in net economic benefit to the economy and four tons of carbon emissions reduced for each taxpayer dollar it spends over the lifetime of the products. For example, the U.S. experience with S&L programs clearly demonstrates the economic benefits. By the year 2020, efficiency standards will have helped avoid 20 per cent of the country's planned new power generation with expected savings of more than $100 billion, a cumulative net saving of $1000 per household (APEC 2006).

Most importantly, standardized test methods and labelling/reporting requirements provide the basis for almost all other energy efficiency programs. Without publicly available information on performance, it would be impossible to design and implement incentive and information programs to promote increased energy efficiency.

4.2 Other market-based approaches

As mentioned above, there are a wide variety of other market-based approaches that are used to support the deployment of technology. Those are:

- fiscal incentives, such as reduced taxes on biofuels and investment tax credits;
- capital grants for demonstration projects and programs (clean coal programs in the United States, photo voltaic programs in the U.S., Germany and Japan);
- feed-in tariffs which provide a fixed price support mechanism for renewable energy;
- quota-based schemes, such as the renewable portfolio standards in 23 U.S. states and the vehicle fleet efficiency standards in California;
- tradable quotas: the Renewables Obligation and Renewable Transport Fuels Obligation in the UK.;
- tenders for energy from specific sources (sometimes called set-asides) with increased output prices subsidized out of the revenues from a general levy on electricity tariffs;
- subsidy of the infrastructure costs of connecting new technologies to networks; and
- procurement policies of national and local governments and/or government monopolies.

Some analyses suggest that the most successful of these approaches have involved price-based rather than quantity-based mechanisms. Comparisons between deployment support through tradable quotas and feed-in tariff price support suggest that feed-in mechanisms achieve larger deployment at lower costs (Stern 2006). Central to this is the assurance of long-term price guarantees. For example, the German feed-in tariffs provide legally guaranteed revenue streams for up to twenty years if the technology remains functional. The levels of deployment are much greater in the German scheme and the prices are lower than comparable tradable support mechanisms (e.g., the UK Renewable Obligation Certificate scheme). The result is not surprising—these emerging technologies are already subject to considerable price uncertainty and quantity-based approaches that allow trading simply increase the level of uncertainty. A guaranteed price, however, offsets some of the technology price risk.

The approaches listed above would not generally benefit from international coordination or cooperation. However, in some cases regional coordination would be beneficial, especially where products are traded internationally or between jurisdictions. In the United States, where renewable portfolio standards fall under the jurisdiction of state regulatory authorities, there have been some efforts to link systems. A better example, for Canada in particular, is vehicle emissions or fuel economy standards. Because of the integration of the North American auto market, there are substantial benefits to harmonization of standards. This does not preclude individual jurisdictions (such as California) from moving ahead; it just means that over time there will be strong pressure to harmonize and avoid a patchwork of regulation.

Sector-specific performance standards (like vehicle emissions standards and renewable portfolio standards) target the deployment of particular technologies and as a result are much more likely to support innovation than a broad price signal. In some cases, these standards can be stringent enough to be technology-forcing (for example, California's Low Emissions Vehicle regulation). Another example is the EU's Large Combustion Plant Directive, which places emission limit values on large plants with increasing stringency over time. It specifies different treatment depending on the age of the plant. It will ensure that by 2015 all European power stations conform to a common standard for air pollution emissions.

Jaccard (2005) suggests that technology-forcing performance standards be applied to a number of sectors (vehicles, power generation) and that the approach include a price cap or off-ramp to ensure that the costs of the program are not excessive. This is analogous to the price cap approach discussed in the second section of this chapter. The price cap introduces a trade-off, however, because although it limits upside costs, it also reduces the incentive for innovation.

Several authors (Edmonds and Wise 1998, Jaccard 2005, Stern 2006) suggest that this approach could be applied to carbon capture and storage (CCS). A CCS portfolio standard could require that a certain proportion of power supplied by generation companies is from plants fitted with CCS technologies. The requirement could begin with a very low proportion (e.g., 0.5 per cent), consistent with the establishment of demonstration plants by one or two operators in a market. Other operators would share the risk of these projects through long-term contracts to purchase power from these plants to meet the CCS portfolio standard, and would pass the incremental cost through to all electricity consumers. Governments could set out a timetable for a strong increase in the level of the portfolio standard provided that the demonstration projects showed that key criteria could be met. The approach could include both a trading element and a price cap.

Stern (2006) suggests that this approach could be regionally or internationally coordinated. Trading would allow efforts to be pooled and costs minimized across larger markets, and differentiated responsibilities could be applied to countries at different stages of development.

4.3 Canadian interests and path forward

Energy efficiency standards and labelling initiatives have been highlighted by the G8 and in other fora as essential for both developed and developing countries. For developing countries with currently low but rising energy intensities, it is far more cost-effective in the long run to build their economies on an infrastructure using efficient appliances, equipment and lighting products.

Beyond the cost savings for individuals and businesses, energy efficiency standards reduce dependence on energy imports and limit demands on foreign currency reserves. They also prevent the 'dumping' of inefficient appliances and equipment that can no longer be sold in industrialized countries. Of course, dumping of inefficient appliances can also flow the other way. For example, a number of countries in Southeast Asia were early adopters of energy efficiency standards for air conditioners. Product that could no longer be sold in those countries was then shipped to Australia, which at the time had no minimum performance standards for air conditioners.

The number of nations worldwide adopting energy efficiency S&L is growing rapidly, from nine in 1984 to 36 in 1994 to 56 in 2004. The number of regulations worldwide on individual appliances and equipment is growing even more rapidly, increasing from 543 to 878 between 2000 and 2004. There is a need among these countries for harmonized test facilities and protocols, mutual recognition of test results, common comparative energy label content, harmonized endorsement energy labels, harmonized minimum energy performance standards for some markets, shared learning of the labelling process, and shared learning of the standard-setting process. Such an approach allows countries, companies, and consumers to avoid the costs of duplicative testing and non-comparable performance information, while benefiting from a reduction in non-tariff trade barriers and access to a wider market of goods. Such an approach reduces the aggregate cost among the world's governments of designing and implementing the energy-efficiency S&L.

The International Compact Fluorescent Light bulb (CFL) Harmonisation Initiative began with an international benchmarking exercise for compact fluorescent lamps. This international comparison identified the existence of several similar CFL testing methodologies, and more than 30 performance standards in use throughout the world; hence the potential cost benefits from harmonisation were clear (APEC 2006).

International coordination of S&L programs offers benefits where products are traded in global or regional markets. Good candidates for harmonization are lighting products, electronics, and electric motors. Stern (2006) notes a number of possible benefits of harmonization, including:

- influence conditions within larger markets: create stronger incentives to innovate by influencing conditions within a larger market, and encouraging greater competition between manufacturers of efficient products;
- increase transparency across markets: improve the capacity of consumers, producers and vendors to compare the performance of products and components across different markets, and provide policy makers and utilities with better information about the capabilities and limits of particular technologies;
- reduce compliance costs: decrease design and production costs for manufacturers arising from differences in national or regional compliance requirements. Coordinated standards, labels and endorsements can reduce policy design and management costs by employing economies of scale; and
- removal of trade barriers: international cooperation to harmonize or increase the compatibility of test protocols can discourage protectionism and enhance competition for international technology procurement contracts.

A number of regional initiatives have begun to address the need for cooperation, including the APEC Experts Group on Energy Efficiency and Conservation, the North American

Energy Working Group's Expert Group on Energy Efficiency (NAEWG-EE) and the European Union Standards and Labelling Program. Harmonization efforts have focused on:

- harmonized test facilities and protocols;
- mutual recognition of test results;
- common comparison energy label content;
- harmonized endorsement energy labels; and
- harmonized MEPS for some markets.

However, there is likely a need for a broader, higher-level framework. S&L initiatives, despite their obvious benefits, are simply not of sufficiently high priority to succeed on their own. Each of the regional harmonization initiatives has been an outgrowth of a broader collaborative effort. For example, NAEWG-EE (which focuses on S&L) grew out of NAEWG (which focuses on all aspects of energy policy), which grew out of NAFTA (which focuses on all aspects of trade). The APEC Experts Group on Energy Efficiency and Conservation (which includes S&L harmonization) grew out of the APEC Energy Working Group (which focuses on all aspects of energy), which grew out of APEC (which focuses on economic cooperation). The EU S&L program is just one aspect of a broad economic alliance.

The European Commission has proposed an overall framework agreement on energy efficiency involving both developed and developing countries, including Brazil, China, India, Japan, Russia and the United States. This will be done in collaboration with the United Nations, IEA, G8 (Gleneagles Dialogue on Climate Change), the World Trade Organisation, the World Bank, the European Bank for Reconstruction and Development, European Investment Bank and other institutions. The aim is to develop closer co-operation on energy efficiency measurement and evaluation, minimum performance requirements for goods and services, labelling and certification, energy audits, stand-by losses, codes of conduct, and more.

Another issue requiring international cooperation is capacity development in developing countries. S&L programs are complex and require both technical and policy capacity. Without support from industrialized countries, developing countries are unlikely to be able to implement effective standards and labelling programs, and run the risk of distorting markets and increasing costs.

While not a global leader, Canada has considerable experience with S&L. More than 35 products in Canada are subject to minimum energy performance standards and all major household appliances, and heating and cooling systems are subject to labelling and rating programs. More than 80 per cent of the energy consumed in Canadian households is consumed by a product that is subject to an energy efficiency performance requirement, and more than 50 per cent of the energy consumed in the commercial/institutional sector is similarly covered. These initiatives have been highly effective— primarily as a result of standards and labelling programs the unit energy consumption of new refrigerators sold in Canada declined by 49 per cent from 1990 to 2003.

International harmonization of test standards is critical to the continued success of Canadian initiatives. Canada is simply too small a market to impose unique requirements on multinational manufacturers. Due to industry rationalization, there are now only two major appliance manufacturers left in Canada. CFLs are manufactured elsewhere, as are electronic products.

Canada acting alone is unable to affect these markets; international cooperation is critical. Canada has considerable experience with international harmonization of S&L, primarily with the United States and Mexico, and can draw on this experience to support international efforts. Canada may also be able to play a significant role in supporting capacity building in developing countries through training initiatives and the transfer of technical, institutional and policy expertise.

At a high level, Canada's interests are dictated by the fact that it is a small open economy, exposed to arbitrary protectionist trade restrictions from the United States and dependent on technology imports. Therefore, Canada needs an approach that deals with trade effects and advances major energy technologies in an internationally cooperative way.

To a great extent, Canada is a technology taker, so Canadian interests are best served when there are appropriate market-based incentives for both the import and adaptation of technology developed elsewhere, and also the domestic development of technologies. Thus there is a need for a mix of instruments, such as:

- Instruments to promote technology cooperation across international borders will help ensure that technologies being developed meet Canada's specific needs. The instruments would foster collaborative activities by Canadian companies.
- Instruments to facilitate the necessary investment to adapt internationally available technologies to Canadian circumstances will be helpful. Canadian circumstances might include issues such as cold winters, smaller markets, geographic dispersion, and so on.
- The development and adaptation of renewable energy technologies can be facilitated through the use of 'feed-in tariffs', whereby a utility guarantees to buy the renewably generated energy at a rate that will encourage investment in the technology. This has been successfully used for wind power and other sources.
- Internationally, Canada can promote the adoption of policies to encourage research and development by many other countries, in order to expand the set of technologies available in the market. It can also promote the adoption of mechanisms that take into account trade issues.
- In addition, Canada might also explore international cooperation on technology-forcing sector-specific technology standards. This has been under discussion for the automotive sector, for example.

Policies will still be needed to encourage the development of domestic technologies, of course. The existing set of policies can be strengthened to provide appropriate incentives.

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