TECHNICAL REPORT

ACHIEVING 2050:
A CARBON PRICING POLICY FOR CANADA

National Round Table on the Environment and the Economy | Table ronde nationale sur l'environnement et l'économie

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The National Round Table on the Environment and the Economy

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Emerging from the famous Brundtland Report, *Our Common Future*, the National Round Table on the Environment and the Economy (NRTEE) has become a model for convening diverse and competing interests around one table to create consensus ideas and suggestions for sustainable development.

A Solutions-Focused Mediator

The NRTEE has been focused on sustaining Canada's prosperity without borrowing resources from future generations or compromising their ability to live securely.

Since its creation in 1988, concerns about climate change, air quality, and water availability have made Canadians and their governments increasingly aware of the need to reconcile economic and environmental challenges as they have become increasingly interlinked. They are the flip sides of the same coin. That need for reconciliation—and the process of working towards it—is the National Round Table on the Environment and the Economy's raison d'être.

Our mission is to generate and promote sustainable development solutions to advance Canada's national environmental and economic interests simultaneously, through the development of innovative policy research and advice.

NRTEE ACT, 1993

We accomplish that mission by fostering sound and well-researched reports on priority issues and by offering advice to governments on how best to reconcile the often divergent challenges of economic prosperity and environmental conservation.

A Unique Convener

The NRTEE brings together a group of distinguished sustainability leaders active in businesses, universities, environmental groups, labour, public policy, and Aboriginal communities across Canada. Our members are appointed by the federal government for a mandate of up to three years. They meet in a round table format that offers a safe haven for discussion and encourages the unfettered exchange of ideas leading to consensus. This is how we reconcile positions that have traditionally been at odds.

A Trusted Coalition-Builder

We also reach out to expert organizations, industries and individuals that share our vision for sustainable development. These partners help spark our creativity, challenge our thinking, keep us grounded in reality, and help generate the momentum needed for success.

An Impartial Catalyst of Change

The NRTEE is in the unique position of being an independent policy advisory agency that advises the federal government on sustainable development solutions. We raise awareness among Canadians and their governments about the challenges of sustainable development. We advocate for positive change. We strive to promote credible and impartial policy solutions that are in the best interest of all Canadians.

A National and International Leading Force

We are also at the forefront of a prospective new international research network that will bring together some of the world's most renowned sustainability research institutes. This will build our research and capacity, giving us access to new thinking and proven solutions in other countries that could benefit Canada. Armed with a proven track-record in generating environment and economic solutions, we now seek to use our influence and credibility to move forward Canada's environmental and economic priorities in concert with the world.

An Independent Leader

The NRTEE Act enforces the independent nature of the Round Table and its work. The President and CEO is accountable to Parliament and reports, at this time, through the Minister of the Environment. The NRTEE is not an agency of Environment Canada or any other federal government department, but its financial and reporting obligations are included within the broader environmental portfolio of government.

The NRTEE's Dynamic Secretariat

A group of staff maintains our secretariat that conducts the policy research and analysis required by our members in their work. The secretariat furnishes administrative, promotional and communications support to the NRTEE. We are here to answer your questions or direct you to an expert who can. Please let us know how we can help you.

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1.0 INTRODUCTION

This Report provides technical background information and analysis in support of the NRTEE Advisory Note, *Achieving 2050: A Carbon Pricing Policy for Canada.* The Technical Report has two main purposes:

- *The report complements the Achieving 2050: A Carbon Pricing Policy for Canada*, providing additional details on the analysis underpinning the conclusions in the *Advisory Note*. By integrating the research commissioned or developed by the NRTEE, including economic modelling, it illustrates the main *Advisory Note*'s grounding in credible and original analysis; and,
- *The report provides a useful policy design framework and reference tool for policy makers*. Designing carbon pricing policy to achieve deep and long-term carbon reduction targets is multifaceted and complex. This report both identifies important design and implementation issues but also evaluates trade-offs between the main design options for addressing these issues.

The research and evidence in this report has been informed by consultations with stakeholders through the Carbon Pricing Project Expert Advisory Committee, through consultation in regional outreach sessions across Canada, and through a peer-review process. The research, analysis and findings contained in this report, and the process of its development have been informed through regular interaction with NRTEE members.

1.1 THE CARBON EMISSIONS PRICING POLICY PROJECT

In January 2008 the NRTEE released a report – *Getting to 2050: Canada's Transition to a Low-Emission Future* – which presented a number of key recommendations to the Government of Canada. The report recommended:

1. Canada needs to implement a strong greenhouse gas (GHG) emission price signal across the entire Canadian economy in order to successfully shift Canada to a lower GHG emissions pathway;[1]

2. The basis of such a price signal should be a market-based policy either in the form of an emission tax, a cap-and-trade system, or a combination of the two;

3. The price signal should be complemented with other regulatory policies; and,

4. Canada should establish a Canada-wide plan that leads to better coordination of complementary federal, provincial and territorial GHG emission reduction policies.

1 There are six main anthropogenic greenhouse gases, all of which can be reported in terms of 'tonnes of CO2 equivalent' or (CO2e). It has become customary to use the term 'carbon' to refer to anthropogenic greenhouse gases, and this document uses the terms 'carbon' and 'GHGs' interchangeably. See: IPCC (1996).

Getting to 2050 concluded that different carbon pricing policy instruments could deliver significant GHG emission reductions over the long-term. However, it observed that the effectiveness of each policy is a question of design and implementation, and that policy design matters. It also highlighted that there would be implications for Canada, and that policy design could help to minimize costs while ensuring emission reduction targets are achieved. Building on these conclusions, the NRTEE has undertaken the research and analysis set out in this report, in order to better understand:

- The implications of carbon pricing to achieve the Government of Canada's carbon emission reduction targets of 20% below current (2006) levels by 2020 and 65% by 2050; and,
- The design of a preferred carbon pricing policy to achieve these targets. The project also examines policies that complement carbon pricing, addresses the barriers affecting technology deployment, and considers issues of implementation.

These two broad areas provided the basis for approaching the research and formulating the carbon pricing policy presented in the *Advisory Note*. Each of these areas is discussed below.

1.1.1 Implications of Long-Term Carbon Targets

To explore a number of important implications of attaining deep and long-term targets, three research activities were undertaken by the NRTEE:

- **Competitiveness Assessment.** This research assessed how carbon pricing policy could affect the competitiveness of industries and sectors. The work then developed a framework for understanding competitiveness risks arising from climate policy;
- **A Technology and Investment 'Road Map'**. This research provided a forecast scenario for describing how a carbon price could drive the deployment of technology to achieve emission reduction targets between now and 2050. The forecast also provided an indication of the capital investments through time implied by this technological transformation.
- **The Sectoral, Regional and Household Implications of Pricing Policies.** This research provided a detailed articulation of the likely distribution of both costs and emission reductions by sector, region and for households. It revealed where instrument choice may have a role to play to address impact concern.

1.1.2 Carbon Policy Design and Implementation

The choice of the preferred carbon pricing policy is related to both the goals to be attained and the means of addressing key implications and uncertainties. The research undertaken by the NRTEE explored the following issues:

- **Assessment of International Climate Policies.** Differences in climate policy between countries can lead to competitiveness risks where Canada's domestic policy is not aligned with other major trading partners. The extent of this risk was explored through a review of other countries' policies and proposed policies;
- **Policy Certainty and Adaptability.** This research attempted to more clearly define how to strengthen carbon pricing policy through establishing "policy certainty." It also explored the importance of adapting policy through time;
- **Cap-and-Trade Systems and Carbon Taxes.** This research identified trade-offs for key cap-and-trade and carbon tax design decisions using a common set of policy assessment criteria, and then identified a set of principles to guide design and implementation;
- **The Macroeconomic Impacts of Design Options**: Economy-wide carbon pricing will have economy-wide effects and design elements such as border adjustments, international purchases and revenue recycling influence the impacts of these effects. This project used a general equilibrium model to assess a range of macroeconomic outcomes under different policy options;
- **Policy Instrument Choice Preference**. The objective of this research was to discuss with key stakeholders their instrument choice preferences and how these might change in time;
- **The Role of Complementary Regulations in Time**. This research identified how regulations can complement carbon pricing by addressing emissions that are hard to address with pricing alone. It identified when regulations are expensive relative to carbon pricing and when (and where) they can reduce costs;
- **Linkages of Provincial and Federal and International Carbon Policies**. This research focused on how trading systems might be linked, and how hybrid tax and cap-and-trade systems can interact;
- **Technology Deployment Barriers and the Role of Research and Development**. Barriers to the deployment of major technologies can impede the transition to a low carbon future. This project looked at the technology deployment forecasted by the NRTEE's modelling and then asked the question: "Is this forecast feasible?";
- **Governance**. Issues of federal-provincial-territorial governance are central to implementing an effective carbon emissions pricing policy. This research assessed issues of policy harmonization and the implications of fiscal transfers between governments.

1.2 STRUCTURE OF THIS DOCUMENT

Based on the suite of research identified above, the NRTEE developed a framework for planning the design and implementation of carbon emissions pricing policy in Canada. The framework and issues surrounding design and implementation are presented in eight chapters in this report:

- **Chapter 2** provides the foundation for the analysis in this report. It explains the context of the NRTEE's new analysis and provides an overview of the broad methodological approaches used to generate this analysis.

- **Chapter 3** defines the goals of carbon pricing policy. It establishes that the purpose of the NRTEE's carbon pricing policy should be to achieve the Government of Canada's emission reduction targets at lowest cost. The chapter then defines costs and develops a principle of cost-effectiveness.

- **Chapter 4** identifies the essential elements of the carbon pricing policy. These elements are 1) a unified pricing policy with a uniform emissions price applied broadly over all emissions and jurisdictions, and 2) a robust policy that sends a long-term price signal but that can be adapted through time as required. The chapter then broadly lays out a policy framework for achieving these objectives to cost-effectively achieve the target reductions. The policy includes a carbon pricing instrument, complementary regulations, and international purchases, as well as a strategy for the implementation of these policies.

- **Chapter 5** describes the possible elements, mechanisms and trade-offs for pricing policy design. Options for instrument choice, revenue use and permit allocation, border carbon adjustments, point of regulation, and offsets are evaluated.

- **Chapter 6** explores design decisions pertaining to interactions between a Canadian pricing system and international markets. Linkages, and government purchases of international emission reduction credits are assessed.

- **Chapter 7** evaluates the role of other policies that can complement pricing policy. Specifically, the chapter assesses complementary technology policies to enable the diffusion of low-carbon technologies; complementary regulations that broaden the scope of pricing policy; and approaches to engaging Canadians in the transition to a low-carbon economy through education and information.

- **Chapter 8** explores the outcomes of a cost-effective pricing policy using economic modelling. It illustrates that a broad, long-term pricing policy can drive the deployment of low-carbon technologies so as to achieve Canada's emission reduction targets. However, it also identifies potentially adverse outcomes of pricing policy – distributional issues and risks to competitiveness – that must be addressed by the details of policy design and implementation.

- **Chapter 9** addresses issues of implementing carbon pricing policy. This analysis of implementation explores ideas for developing institutions and processes to manage a pricing policy over long periods of time. Issues related to the design of institutions, processes and approaches to adaptive policy are addressed.

2.0 THE BASIS OF THE NRTEE'S CARBON PRICING POLICY ANALYSIS

In this chapter, the policy and analytical foundations upon which this project is based are presented.

2.1 THE POLICY BASIS OF THE NRTEE'S ADVICE

Two main considerations influenced the NRTEE's new work on carbon pricing policy, both in this document and in the *Advisory Note*: (1) building on *Getting to 2050*; and (2) recognizing short-term uncertainties, but planning for the long-term. These considerations provide important context for this report, and are intended to ensure that the NRTEE's research will remain credible and relevant to policy makers for years to come.

2.1.1 Building on *Getting to 2050*

Getting to 2050 established the need for carbon emissions pricing policy in Canada to meet the government's targets of reducing emissions relative to 2006 levels by 20% by 2020 and 65% by 2050. *Getting to 2050* also identified the policy stringency, or the strength of the policy, required to meet the targets as the *fast and deep* emissions pathway. Under this pathway, the economy-wide price of carbon would start at $15 per tonne of CO_2e (CO_2 equivalent) and gradually rise to a long-term price of $300/tonne, as illustrated in Figure 1.[2]

2.1.2 Recognizing Short-term Uncertainties, but Planning for the Long-term

While uncertainty underscores any forecasts of the future, 2008 provides a sharp reminder of just how rapidly events change and how inaccurate forecasts can be. In 2008 there were significant shifts in virtually all major drivers that influence climate policy and emissions growth: record high oil prices dropping to less than a third of their high-point value; major swings in economic growth forecasts; and large revisions to Canada's national GHG inventory.

These short-term shifts highlight the uncertainty in any long-term analysis. However, if an attempt were made to fully reflect these events in this long-term advice, a highly reactive and myopic focus on the short-term would be the result. Instead, this report focuses on the need to influence long-term investment and behavioural decisions in

2 Throughout this documents, all financial figures are expressed in $2006 unless otherwise indicated.

THE *FAST AND DEEP* EMISSION PRICING TRAJECTORY FROM *GETTING TO 2050*

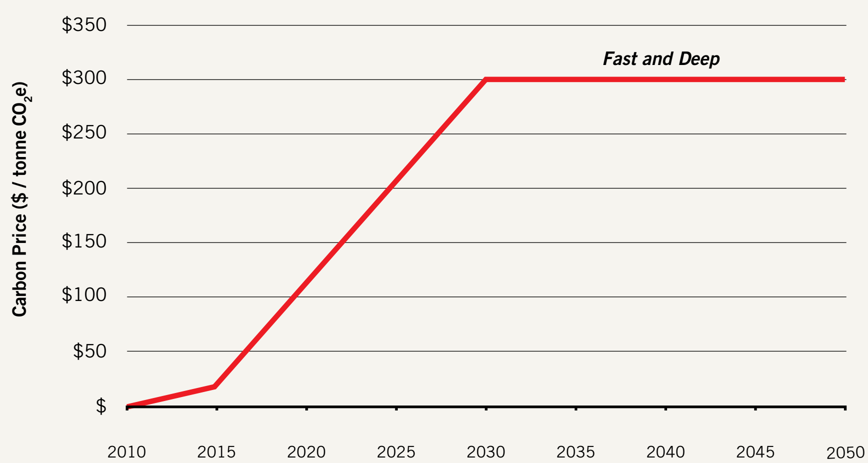

FIGURE 1

Fast and deep was the only pricing trajectory explored in *Getting to 2050* that allowed Canada to achieve both its 2020 and 2050 emission reduction targets in the model forecast. Forecasts of the effects of other trajectories, such as *slow and deep* pricing, for example, met the 2050 targets but not the 2020 targets. For this reason, the focus in this report is on *fast and deep* pricing.[3]

the pursuit of the Government of Canada's long-term targets. *Getting to 2050* highlighted the need for a long-term transition, necessitating a long-term view of climate policy. Some factors that influenced this report, and how the issues were addressed, are discussed in detail below.

Changing Carbon Policies

The political landscape for carbon pricing policy in Canada has changed since the publication of *Getting to 2050*:

- In recent statements, it would appear the Government of Canada is re-assessing its original focus in the *Regulatory Framework on Air Emissions*, moving from intensity-based targets to "hard caps";
- Canada's largest trading partner, the United States, has signalled its intention to establish a cap-and-trade system to reduce emissions;
- The province of British Columbia has introduced a carbon tax;
- The provinces of British Columbia, Manitoba, Quebec and Ontario have joined the Western Climate Initiative; and,
- Carbon taxes played a prominent role in the 2008 federal election campaign.

3 For further detail see NRTEE (2007).

These events have implications for the short-term political appeal of alternative carbon pricing policies, and longer term implications for carbon pricing in North America. The NRTEE has taken these changing political conditions into account in its consideration of long-term carbon pricing policy for Canada, and believes that the case for carbon pricing in Canada is stronger now than it was when *Getting to 2050* was published. Specifically, thought needs to be given to how these emerging carbon policies will interact and possibly integrate.

Changing Economic Conditions

The global economic outlook has also changed since the publication of *Getting to 2050*. The global economic slow-down will likely lead to short-term emission reductions, as output and economic activity contracts. However, the short-term downturn does not reduce the urgency of carbon pricing. Business continues to make investment decisions, and these should be guided by an expectation of a long-term price on carbon if they are to reflect society's need to reduce emissions.

The modelling work underpinning the NRTEE's policy uses long-term forecasts of economic growth to 2050. In doing so, it assumes that periodic downturns will take place, as well as periodic booms. As a result, the conclusions of this work are robust in the face of short-term economic uncertainty.

Similarly, when oil prices are high, some people feel that efforts to price carbon are unnecessary, because fuels like gasoline are already expensive and further price rises will do nothing to change behaviour and investment decisions. However, experience shows that high oil prices are not enough to drive emission reductions. There are three main reasons for this:

- First is that high oil prices are not always expected to last, and it is expectations about future prices that drive investment decisions now. 2008 saw record high oil prices; it also saw a significant price crash. This price volatility means that while prices are high, investors and consumers cannot be sure that they will remain high, and that investments in energy efficient capital stock, vehicles and so on will pay back. Volatility weakens the impacts of high oil prices on emissions;
- Second, high oil prices do not provide an incentive for emission reductions across all emissions in the economy. High oil prices provide an incentive to use less oil-based fuels like gasoline, but they do not provide an incentive on all fuels. For example, high oil and natural gas prices encourage increased use of coal for industry and electricity generation.[4] Only carbon pricing provides economically efficient incentives in this way, because it puts the same price on carbon emissions regardless of where they arise;
- Third, high oil prices provide greater incentive for oil extraction, which is becoming a major component of Canada's overall GHG emissions. Forecasted expansion of the oil sands, for example, is sensitive to the price of oil, with less expansion expected under lower oil prices.[5]

4 Vielle and Viguier (2007).
5 Footitt (2007).

Nevertheless, oil prices do have an impact on investment decisions and consumer behaviour. In order to take account of revised long-term oil price expectations since the publication of *Getting to 2050*, the analysis in this report used the US Energy Information Administration's forecast world oil price of $68/barrel (compared with $50/barrel used in *Getting to 2050*).[6]

Evolving climate science

The science of climate change is robust: there is a high degree of scientific confidence that climate change is occurring, and anthropogenic emissions are a major cause of that change. It is this strong level of confidence in climate science that makes the case for the reductions in greenhouse gas emissions to which Canada is committed. However, there is uncertainty in the rate of climate change, and the potential mechanisms that will slow or accelerate warming.

In 2007, the Intergovernmental Panel on Climate Change (IPCC) provided a major synthesis of scientific knowledge about climate change in its Fourth Assessment Report (AR4).[7] In this report, it provided ranges of likelihood for various climate change outcomes, and noted the potential for feedback mechanisms that could lead to more rapid warming. Since the publication of the AR4, further scientific evidence has emerged that suggests more rapid warming is possible, and that as a result deeper emission reductions may be necessary. Lenton et al (2007) have identified a number of possible 'tipping points', at which warming would lead to major changes in natural systems.[8]
Examples include:

- Methane release from permafrost (recent reports highlight unexpectedly rapid methane release in the Arctic)[9]
- Dieback of boreal and/or Amazon forests
- Melting of the Greenland ice-sheet

New evidence on all or any of these could substantively change society's assessment of the risks of climate change, and may mean that deeper targets are necessary. It is also possible that climate change may occur more slowly than current scientific knowledge suggests, and that Canada and the world can decrease efforts to reduce emissions.[10] Carbon pricing policy must be adaptive to such changes, while maintaining the short-term certainty that is essential if low carbon investments are to be made. Importantly, while the NRTEE's recommendations for carbon pricing policy design were developed to meet the Government of Canada's current targets, the design recommendations remain relevant for more or less stringent levels of mitigation targets.

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6 EIA (2008).

7 IPCC (2007).

8 Lenton et al. (2007).

9 The Independent (2008)

10 However, the risks of more rapid warming are catastrophic, while the benefits of slower warming are marginal (that is, climate change will never result in benefits as great as the potential risks). As a result of this asymmetry, we might expect that further scientific knowledge will be more likely to make the case for deeper emission reductions, because avoiding catastrophic losses is more important than unnecessary mitigation. Weitzman (2007).

2.2
THE ANALYTICAL BASIS OF THE RESEARCH

Extensive quantitative and qualitative analysis was commissioned or carried out by the NRTEE under the auspices of the Carbon Emissions Pricing Policy Project. This combination of both qualitative and quantitative research provides a strong evidence base and reference for carbon pricing policy design in Canada. Three core methods were followed in developing the research for this report:

- A common set of policy evaluation criteria were used across all commissioned and internal work;
- Quantitative modelling and analysis was undertaken; and,
- Qualitative assessments were used to supplement the quantitative analysis.

Each of these is discussed below.

2.2.1 Policy Evaluation Criteria

A common thread throughout all the work was the use of a standard set of policy evaluation criteria. These criteria form the basis for assessing and ultimately selecting the elements of the policy. The five evaluation criteria common throughout this report are consistent with those used by Finance Canada, and have been used by the NRTEE in a number of climate change and energy-related projects including *Getting to 2050*:

- *Environmental Effectiveness* is a measure of how a design choice affects whether a policy will achieve the emission reduction targets;
- *Economic Efficiency* is a measure of how a choice affects the cost-effectiveness of a policy; efficiency means meeting emission reductions at least cost;
- *Distributional Effects* is a measure of impact on equity and the extent to which some stakeholders are affected more adversely than others;
- *Political Acceptability* is a measure of likely support politicians would find to implement a policy option; and,
- *Administrative Feasibility* is a measure of the burden of implementing and reporting, monitoring, and enforcing a policy over time.

By employing a standard set of policy evaluation criteria across all of the research undertaken for this project, the NRTEE arrived at a better understanding of the implications of alternative policy design options as revealed by the diverse research initiatives.

2.2.2 Quantitative Analysis and Economic Modelling Tools

Quantitative analysis in this report relies on three different economic models: CIMS, D-GEEM, and TIM. Results from these analyses corroborate each other. Given the inherent uncertainty associated with economic modelling, consistency between models provides credibility for the overall analysis. Further, different models have different strengths; for example, CIMS provides a good representation of technology and investment in technology, while D-GEEM and TIM can provide better projections of macroeconomic costs and trade impacts. Short summaries of the three models follow:

- The **CIMS** model provides a good representation of technology change and how it might respond to carbon emissions pricing policy. It simulates the evolution of technology stocks (such as buildings, vehicles, and equipment) and the resulting effect on costs, energy use and emissions. Technology in use is tracked in terms of energy service provided (e.g., m^2 of lighting or space heating) or units of a physical product (tonnes of market pulp or steel). Forecasted market shares of technologies competing to meet new stock demands are determined by financial factors as well as consumer and business technology preferences.[11]
- **D-GEEM** is a computable general equilibrium model of the Canadian economy.[12] It aggregates Statistics Canada data into eight energy producing and using sectors, namely crude oil production and extraction, gas extraction and transmission, refined petroleum product manufacturing, coal extraction, electricity generation, energy intensive manufacturing, other manufacturing, and the rest of the economy. As a dynamic general equilibrium model, D-GEEM provides a better representation of macroeconomic feedbacks and of consumer behaviour than technology models such as CIMS. Alone, however, it does not provide a good representation of technological responses to carbon policy.
- **TIM** is also a macroeconomic model and thus useful for modelling likely trade and macroeconomic impacts of policy to the Canadian economy as whole. In TIM, approximately 70 categories of foreign trade are identified (separately for exports and imports) in 285 industries. Among other factors, changes in the cost of operating an industry due to policy will be reflected in both exports and imports.[13] Changes to the shipments of any industry impacts all other industries indirectly. Changes to real incomes of households and businesses will induce further changes to spending (consumption and business investment) to provide a full “multiplier” impact on overall, and industry-specific, impacts.

The models informed different elements of the report. CIMS modelling was used to inform the assessment of distributional impacts, to develop the technology forecast scenario, and to assess options for complementary

11 See Bataille et al. (2006) for a more detailed explanation of CIMS.

12 Specifically, it is a multi-sector, open-economy computable general equilibrium model. In the model, a representative consumer is the owner of the primary factors (labour and capital). The consumer rents these factors to producers, who combine them with intermediate inputs to create commodities. These commodities can be sold to other producers (as intermediate inputs), to final consumers, or sold to the rest of the world as exports. Commodities can also be imported from the rest of the world. Canada is assumed to be a price taker for internationally traded goods. D-GEEM assumes that all markets clear – that is, prices adjust until supply equals demand. All markets are assumed to be perfectly competitive, such that producers never make excess profits and that supply equals demand. Likewise, factors of production are completely employed, so that there is no involuntary unemployment and no non-productive capital. The version of D-GEEM used for this project adopts a dynamic framework. In a dynamic framework, consumers are assumed to maximize utility over multiple time periods by choosing an appropriate rate of investment and consumption in each time period.

13 In the model, an increase in unit costs of production of a commodity in Canada will increase imports and reduce exports, with the scale of the effect and timing of impact varying from category to category. In turn, changes (from a base case) to these commodities (and services) directly affects (through fixed input-output relations) the shipments (gross output) of 285 industries.

regulations. CIMS outputs were also linked to the TIM and D-GEEM models which were used to assess macroeconomic implications for pricing policy and to empirically assess competitiveness and leakage issues. D-GEEM was also used to evaluate policy options for revenue recycling, border adjustments, and international purchases.

Limitations of Economic Modelling

Economic models can be very useful tools for understanding complex systems like the Canadian energy-economy system and the likely impacts of policy. In the analyses in this report, the best modelling available has been used. Combining models with different strengths and weaknesses has allowed the NRTEE to generate more improved forecasts than those resulting from one model or another. Comparing forecasts from different models leads to greater confidence in the conclusions drawn from modelling. Finally, using stakeholder and expert elicitation processes to test the results of modelling improves the credibility of the results.

It is important to remember that all model forecasts are inherently uncertain. They should not be considered as exact predictions of what will occur. These complex models depend on assumptions about technology, consumers, trade, and the economy. Uncertainty in the forecasts, however, does not preclude the usefulness of the models. Forecasts can provide a directional indication of the likely impacts of policy and can be very useful in comparing relative impacts of different policy options. In an effort to be as transparent as possible, throughout this report the assumptions and different combinations of models underlying each of the different modelling analyses are described.

2.2.3 Qualitative Analysis

The NRTEE undertook and commissioned substantial qualitative analysis and research to inform and test its conclusions. This qualitative research included:

- *Qualitative analysis of carbon pricing instruments*. In addition to the rigorous economic modelling of carbon pricing options, consultants provided qualitative analysis of carbon pricing policy instruments. This analysis assessed the *administrative feasibility* and *political acceptability* of carbon pricing design options, and supported the economic evidence on their cost-effectiveness.[14]
- *Analysis of technology policies and innovation frameworks*. Two consultant reports were commissioned to assess barriers to the deployment of carbon abatement technologies, and the technology policies that may be required within the context of a broader carbon pricing policy framework. Consultants also conducted an expert stakeholder review and 'ground-truthing' of the technology scenario projected by the NRTEE's quantitative modelling.[15]
- *Consultations with expert stakeholder groups concerning the interests and needs of regions and sectors*.[16] Consultations and meetings with stakeholders took place throughout the project. This included consultations with industry and business interests, environmental experts and groups, academics, public sector experts, economic modelling experts and financial interests. Regional outreach sessions were held in Montreal, Ottawa, Toronto,

14 Hall and Fischer (2008).

15 Ecoressources Consultants (2008); Fischer (2008).

16 See Appendix C for expert and stakeholder consultations.

Calgary and Vancouver, and three expert advisory meetings took place in Ottawa. Consultants were also commissioned to assess stakeholder views of various carbon pricing policy options[17].

- *Analysis of international policy developments*. In-house research reviewed developments in jurisdictions implementing or moving towards carbon pricing and in Canada's major trading partners, particularly Europe, the US and Australia.
- *Analysis of governance frameworks and institutions to implement carbon pricing policy*. In-house analysis was supplemented with an expert workshop on carbon pricing and governance issues.

The next chapter discusses the main elements of the carbon pricing policy, starting with its goals.

17 The Delphi Group (2008).

3.0
THE GOALS OF THE NRTEE'S CARBON PRICING POLICY

The NRTEE's carbon pricing policy has two main goals:

- First is the goal of *cost-effectiveness*, which is to attain the Government of Canada's medium and long-term emission reduction targets at least cost. The central goal of the carbon pricing policy then becomes one of balancing criteria of *environmental effectiveness* and *economic efficiency,* or in other words to balance the quantity of emission reductions with abatement costs in time; and,
- Second is the goal of *minimizing adverse impacts*, which has implications for the criteria of *political acceptability, distributional effects,* and *administrative feasibility* of the policy. The challenge is to then design the policy to address and hence avoid, where possible, adverse outcomes.

Throughout this document the goal of carbon pricing policy is to deliver cost-effective emission reductions to meet the Government of Canada's targets in 2020 and 2050. In Chapter 4.0, the essential requirements to achieve this goal are discussed, whereas Chapter 8.0 identifies adverse impacts that flow from these essential elements and that need to be addressed through policy design. The details of the policy in Chapters 5.0, 6.0, and 7.0 are then designed to satisfy both goals.

3.1
GOAL ONE: ACHIEVE THE GOVERNMENT OF CANADA'S TARGETS AT LEAST COST

In this report, the identification of preferred policy design options rather than assessing alternative emission reduction targets is a primary focus. This focus on design allows the NRTEE to step away from the discussion of "which target" and instead address questions of policy design. It is then possible to make an informed contribution as to how best the federal government can achieve its targets.

The NRTEE's research suggests that policy design has two main drivers:

- *Environmental effectiveness*, which implies that the policy achieves a given target; and
- *Economic efficiency*, which means the policy should deliver those reductions at least cost.

In other words, carbon pricing policy must balance economic costs with environmental outcomes in time. This observation has important implications for the carbon pricing policy the NRTEE is recommending. It implies that whatever policy is supported, it will have to recommend design elements that enable costs to be stable within a predictable bandwidth, but at the same time drive down emissions to levels consistent with the stated emission reduction targets.

In this report, as in *Getting to 2050*, the NRTEE adopts the Government of Canada's medium and long-term GHG targets as announced in *Turning the Corner*: 20% below 2006 levels by 2020; and 65% below 2006 levels by 2050. In *Getting to 2050*, the NRTEE's advice was that to achieve these deep carbon reductions sought by the Government of Canada, the policy must deliver least cost reductions by placing an economy-wide price on carbon. The preferred time path that minimized costs was recommended as the *fast and deep* emission pathway requiring emissions to peak at 570 Mt in 2020 and then drop steadily to 235 Mt in 2050. Figure 2 provides the time path of reductions based on the NRTEE's forecast of future emissions. This pathway identifies the time profile of emissions upon which this current report is based.

Implicit in that recommendation of the reduction pathway to the targets, and carried forward now, is the principle of cost-effectiveness. An indicator of cost-effectiveness is the dollar value of the additional abatement costs per tonne of CO_2e reduced or the *carbon price*.

FAST AND DEEP **EMISSION REDUCTIONS PATHWAY TO GOVERNMENT OF CANADA TARGETS**

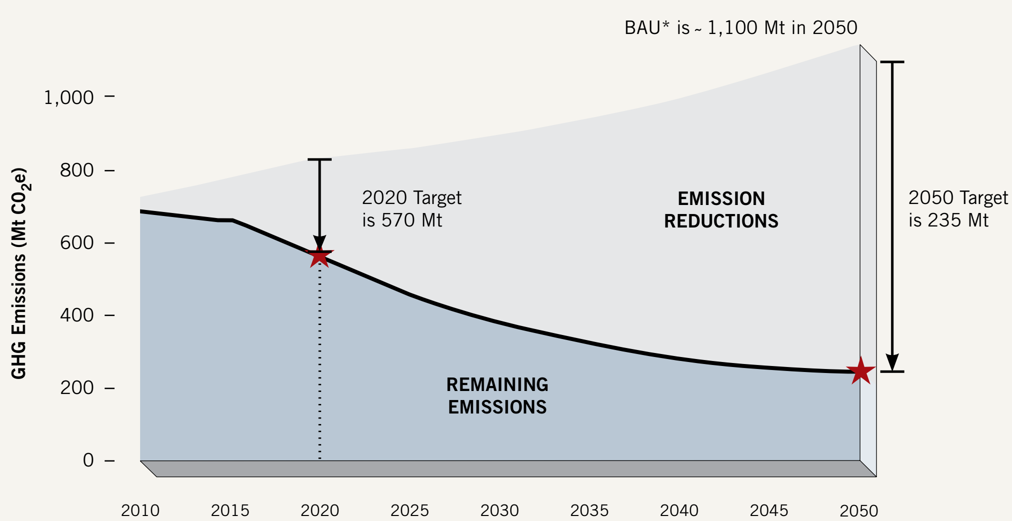

FIGURE 2

* Business as usual ★ Government of Canada Emission Reduction Targets in 2020 and 2050

There are two parts to this indicator: the first is an emission reduction and the second is the cost of abatement. While the emission reduction is straightforward and defined as the quantity of carbon emissions reduced at a point in time, the cost of abatement needs some discussion. The abatement cost is defined as the incremental change in annual capital, operating and energy costs that can be attributed to the carbon pricing policy relative to a world without a policy implemented.[18] We also refer to metrics such as gross domestic product (GDP) or welfare, particularly in the context of the assessment of macroeconomic and competitiveness impacts. However, we use the required price of carbon to achieve emission reductions as the primary metric of cost.

This approach means that the success of the carbon pricing policy is verifiable if the targets are attained *and* the simple ratio of total abatement costs divided by total emissions reduced, is minimized. Similarly, the mix of alternative design options that make up the carbon pricing policy are assessed based on the primary cost-effectiveness goal. This principal also implies that the carbon pricing policy that is assembled can be scaled to alternative emission reduction targets. That is, the policy should deliver cost-effective reductions regardless of the target.

3.2 *GOAL TWO*: MINIMIZE ADVERSE IMPACTS ON SEGMENTS OF SOCIETY AND THE ECONOMY

By defining adverse impacts on society and the economy as a separate goal, the achievement of the cost-effective emission reductions is possible. However, given the carbon prices required to achieve the emission targets, impacts on some firms and consumers in Canada will be unavoidable. A challenge of the carbon pricing policy is to then address some of these impacts where they are a legitimate concern and require policy action. Policy design must address adverse impacts of the policy in terms of how the policy performs against the following evaluation criteria:

- **Distributional Impact,** where the preferred policy would equitably distribute the costs and financial benefits among producers, households, other industry and government. The burden of compliance costs can be expected to fall not only on those undertaking abatement effort, but also their suppliers and the consumers of their goods and services. Closely related are disproportionate impacts on trade exposed sectors and households. Ultimately the question is: what are the policy design options that minimize income effects on disproportionately impacted groups? And then if these impacts have been addressed, are there still affordability questions?
- **Political Acceptability**, where the preferred policy should be acceptable to stakeholders. Political acceptability ultimately depends on the concerns of the federal, provincial or territorial governments and the targeted stakeholders. In general these concerns involve short-run income impacts on emitters related to *stranded assets* and increased costs. Thus, competitiveness and affordability impacts feed into this criterion.

18 We recognize that the cost-effectiveness indicator is not relevant for setting emission reduction targets. Instead, the preferred target-setting approach would be to minimize total abatement costs while maximizing cumulative emission reductions between now and 2050.

- **Governance and Implementation,** where the preferred policy can be effectively delivered in a multi-jurisdictional framework and governance structure. The need exists to consider questions of policy duplication and harmonization.

All of these impacts flow from implementing the carbon pricing policy, and where possible should be identified and then addressed through policy design. The next chapter lays out the essential elements of the carbon pricing policy to deliver on the first goal of cost-effective emission reductions consistent with the Government of Canada's targets.

4.0 THE ESSENTIAL ELEMENTS OF DESIGN AND IMPLEMENTATION: BROAD AND UNIFIED PRICING OVER THE LONG-TERM

- **To achieve Canada's emission reduction targets at least cost will require a carbon pricing policy that transmits a uniform price across the economy as broadly as possible and that is robust over the long-term.**

Our *Getting to 2050* report left open the question of the core design features of the preferred carbon pricing policy. This chapter focuses on that question and demonstrates that the critical issue for selecting the preferred policy instrument is not simply about choosing between carbon taxes or cap-and-trade systems, but rather how to design a unified carbon pricing policy to deliver least-cost reductions in the long-term, while meeting the government's emission reduction targets. But the NRTEE's research also concludes that in order to deliver these reductions, addressing uncertainties will be central to the carbon pricing policy. This conclusion indicates the need for equal consideration of the design and implementation of the carbon pricing policy. To achieve the goal of attaining the emission reduction targets at least cost, this section identifies two essential objectives for carbon pricing policy:

1. The carbon pricing policy must be designed to apply a uniform carbon price across all emissions and jurisdictions; and,

2. A robust policy must be implemented to send a long-term price signal while being responsive and adaptive to changing circumstances through time.

Finally, this chapter provides an overview of the broad structure of a carbon pricing policy that best meets these objectives and delivers cost-effective reductions. The carbon pricing policy consists of three distinct policy elements and also an implementation strategy for institutions and processes to manage the policy over time and adapt it as required. The rest of the report then addresses how the details of the design of this carbon pricing policy can meet the complementary goal of minimizing adverse impacts through policy design.

4.1 THE NEED FOR A UNIFIED CARBON PRICING POLICY

An essential objective for carbon pricing policy should be to apply a uniform carbon price with broad coverage over the Canadian economy. Both economic and political dimensions are important for unified pricing policy: the emission price should be unified across emissions and across jurisdictions within Canada.

4.1.1 Unifying the Carbon Price Across Emissions[19]

- Carbon pricing is most efficient when it applies a common price across all emissions. Design must ensure that carbon pricing is economy-wide, capturing as many sources of emissions as possible.

- Although some emissions sources are impractical to include in a carbon pricing policy, such as process, landfill and agricultural emissions, failure to address these emissions raises the costs of a carbon pricing policy. Other mechanisms, such as regulations, are necessary to deal with such emissions.

The extent to which all emissions are included under a unified pricing policy is a critical issue for policy design. This chapter first demonstrates that broader, more uniform coverage generally leads to more cost-effective pricing policy. Yet unified pricing across emissions is a challenge; many current and proposed pricing policies in other jurisdictions do not have uniform coverage. The European Union Emissions Trading Scheme (ETS), the Regional Greenhouse Gas Initiative (RGGI) and other initiatives do not include all sectors of the economy. In this section, it is also showed that part of the reason for less than full coverage is that many emissions are administratively and practically more challenging to include under a carbon pricing policy. Finally, the efficiency gains possible from including these "hard-to-reach" emissions are demonstrated.

Trade-offs between coverage, stringency, and targets

To be effective and efficient, a carbon pricing policy must aim to include as many sources of emissions as possible. Broader coverage results in greater emission reductions at a lower carbon price, since it implies more opportunities for cost-effective reductions. If sectors or regions are exempted from policy, more *stringent* policy (with a higher price of carbon) is required if emission reduction targets are still to be achieved. Additionally, more expensive, emission reductions must then come from sectors included under the policy, raising the costs of the policy.

On the other hand, sector-specific policies are often more politically acceptable to regulated entities. The current tendency in provincial, national, and international climate policy has been to exclude emissions that are perceived to be politically challenging, at least at first. This approach means that large industrial emitters tend to face carbon pricing while transportation, light manufacturing, households and buildings remain somewhat exempt, despite accounting for significant amounts of emissions. Sector-specific pricing policies may raise greater concerns about the potential for rent-seeking by the sector, raise questions about the ability of regulators to maintain objective and independent oversight, and reduce political and public confidence in the system. Sectoral policies also move away from a unified price signal, resulting in economic inefficiencies.

NRTEE modelling analysis supports the idea that broader, more uniform coverage is more efficient. Decreasing coverage of the policy means that the price of carbon and the costs of the policy must increase if targets are to be achieved. If only large industrial emitters are included under pricing policy, the price of carbon must rise 2.25 times higher than if the unified price was applied across all emissions in Canada. Medium-term impacts would be particularly acute, with total capital, operating and maintenance and energy expenditures rising in 2020 to

19 Analysis in this section is based on in-house NRTEE modelling using CIMS, as well as on Bataille et al. (2008).

$26 billion above the unified case. Indeed, if lower prices are imposed on households and transportation sectors, there is a risk that 2020 and 2050 emission reduction targets cannot be achieved. Analysis using the CIMS energy-economy model shows that even a price of $600 / tonne on large industrial emitters alone would likely not result in the targets being reached. Further, reductions appear insensitive to even higher carbon prices, so additional reductions are uncertain.

Further, if certain sectors face a much lower price for emissions than others, an inefficient portion of economic activity – and emissions – will shift into these sectors over time, making it more expensive and difficult to achieve long-term emission reduction goals. For example, the analysis suggests that if large emitters, such as the electricity sector, face a higher relative price signal than households, households will reduce their use of electricity and switch to fossil fuels. These actions can raise household emissions and reduce the effectiveness of emission reductions in the electricity sector.

Failure to broaden the scope of carbon pricing leads to higher costs

The analysis summarized in Table 1 highlights the importance of addressing all greenhouse gas emissions, including emissions from upstream oil & gas, agriculture and landfill waste as part of a carbon pricing policy. The table compares the required emission price to achieve 2020 and 2050 targets if these emissions are not included and if complementary regulations are used to address them. It demonstrates that the carbon price per tonne is cheaper if all sectors are included through complementary regulations. If these sectors are not addressed, other sectors must make up the difference in order to meet Canada's targets. To achieve this outcome, higher carbon prices will be needed in the sectors that are within the pricing policy.

CARBON PRICE ($ / TONNE CO_2e) REQUIRED TO ACHIEVE TARGETS WITH DIFFERENT LEVELS OF REGULATORY COVERAGE

	2011-2015	2016-2020	2021-2025	2026-2050
Required pricing path if only emissions from fuel combustion included	$18	$250	$512	$775
Required pricing path if upstream oil and gas are included	$18	$150	$350	$500
Required pricing path if upstream oil and gas, agricultural and landfill emissions are included	$18	$170	$250	$250

TABLE 1

Note that the high emissions prices under some of these scenarios are unlikely. At emission prices of $500 or $775, the response of the energy system is uncertain; the CIMS model is incapable of representing newly innovated technologies that would likely result at such a strong price signal. Further, such a price would pose a formidable political challenge. As such, the prices in Table 1 should be taken only as a directional indicator of the benefits of broadening the coverage of the carbon pricing policy through complementary regulations.

Challenges of including all emissions under a carbon pricing policy

Complete and direct coverage of all emission sources within a carbon pricing policy is challenging. Sectors of the economy with emissions that are difficult to include under a carbon pricing policy have been identified, but can nevertheless provide cost-effective emission reductions through other means. Complementary regulations (discussed in Section 7.2) or offsets (discussed in Section 5.4) can be used to address these emissions.

- **High upstream oil and gas well venting and flaring (estimated at 65.7 Mt CO_2e in 2005, or approximately 9% of Canada's emissions).** Venting and flaring, to dispose safely of uneconomic quantities of gas, results in the direct release of large amounts of greenhouse gases. These emissions are difficult to quantify, because they come from numerous sources in remote conditions, but all estimates show them to be very large.
- **Pipeline combustion (estimated at 10.1 Mt CO_2e in 2005, or approximately 1% of Canada's emissions).** Transport of oil and natural gas by pipeline, especially natural gas, creates significant combustion and fugitive emissions. Transmission firms may track some of the gas combusted, as this is no longer available for sale, but the amounts used to run gas actuated auxiliaries and fugitive leaks are extremely hard to measure, as they are from many thousands of sources in very remote conditions.
- **Landfill gas (estimated at 28 Mt CO_2e in 2005, or approximately 4% of Canada's emissions).** Landfills release significant amounts of methane from anaerobic decomposition of organic waste by bacteria. Landfill gas can be trapped and combusted as a flare, converting it from methane to carbon dioxide, a weaker greenhouse gas. Because these methane emissions are not from combusted market fuels and are difficult to quantify, a carbon pricing scheme will have no direct effect.
- **Agricultural emissions (estimated at 56.6 Mt CO_2e in 2005, or approximately 8% of Canada's emissions).** A significant portion of Canada's GHG emissions come from enteric fermentation in the stomachs of sheep and cattle (25.0 Mt CO_2e), manure management (8.6 Mt CO_2e), and agricultural soil management (23.0 Mt CO_2e). Agricultural emissions can be reduced through changes in land use and agricultural practices. Because these emissions are not from combusted market fuels and are spread all over Canada from virtually millions of sources, a carbon pricing policy by itself would have no effect on them.

4.1.2 Unifying Carbon Pricing Policy Across Jurisdictions Within Canada[20]

- **Carbon pricing policies are currently being developed and implemented in an uncoordinated approach at the federal, provincial and regional levels, resulting in policy fragmentation across Canada.**
- **A nationally harmonized carbon emissions price is more economically efficient than a patchwork of regional prices set through federal, provincial, territorial or regional policies.**

A key issue for Canadian carbon pricing policies is reconciling federal, provincial and regional carbon pricing policies and approaches. Just as the issue of coverage illustrates the importance of unifying carbon pricing policy across sectors and emitters, the issue of fragmented policies illustrates the importance of unifying carbon pricing policy across jurisdictions. The issue of governance is challenging, as federal and provincial governments share jurisdiction for regulating carbon emissions. At the same time, the federal government has jurisdiction over border adjustments and international trade issues. In addition to the federal *Turning the Corner* plan which proposes an intensity-based emissions trading system, British Columbia and Quebec have implemented forms of carbon taxes, Alberta has developed a provincial emissions trading system, and British Columbia, Manitoba, Ontario, and Quebec plan to participate in the Western Climate Initiative regional cap-and-trade system, along with seven US States.[21]

Economic efficiency of fragmented, regional carbon pricing policy approaches

To provide a sense of the economic trade-offs between fragmented regional and coordinated national approaches, a *fragmented policy* scenario using the CIMS model was explored. Results of this illustrative modelling suggest that a coordinated national approach to carbon pricing, where the carbon price is unified across jurisdictions, tends to be more cost effective than a fragmented regional approach.

Under the fragmented policy scenario, each region represented in the model (BC and the territories, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and the Atlantic region) was modelled separately.[22] For each region, the carbon prices required to meet that region's share of Canada's emission reduction targets for 2020 and 2050 was determined. These carbon prices thus represent the pricing approach each region could take independently to reduce its emissions by 20% in 2020 and 65% by 2050 from its *business as usual* trend. The required price trajectories are shown in Figure 3. These price trajectories were compared to the Canada-wide *fast and deep* price signal. Total emission reductions across Canada are thus the same for both the unified and fragmented scenarios; the distribution of emission reductions, however, is quite different, as regions with lower-cost reductions achieve greater reductions, and regions with higher-cost reductions achieve fewer. For example, Alberta's carbon price would be about $400 / tonne CO_2e in 2020 versus $150 / tonne CO_2e for a unified carbon price.

20 Analysis in this section in based on in-house NRTEE modelling using the CIMS model.

21 Government of British Columbia (2008); Government of Quebec (2008); Government of Alberta (2008); and Western Climate Initiative (2008).

22 In-house modelling using CIMS.

REQUIRED REGIONAL CARBON PRICES UNDER FRAGMENTED POLICY SCENARIO

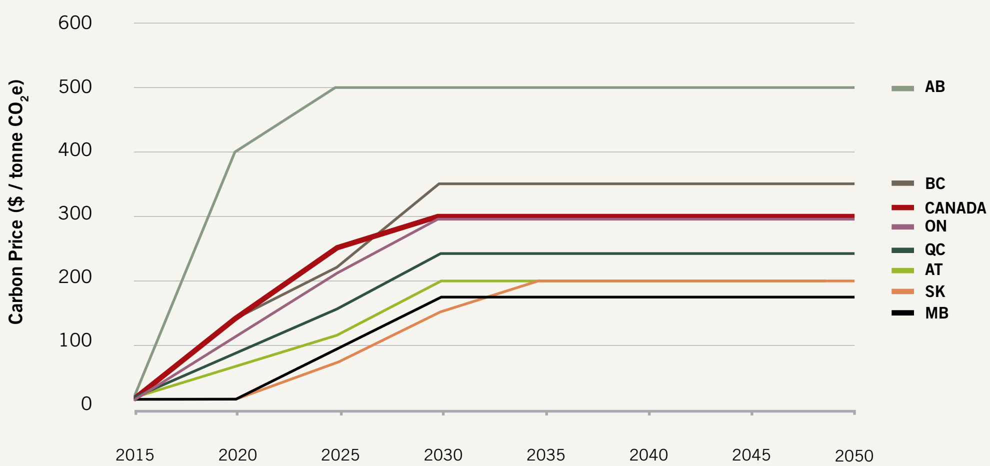

FIGURE 3

Differences between the regions' required emissions prices result from differences between the compositions of their energy systems. The figure does not include the effects of complementary policies or linkage with international markets, both of which would lower the prices shown.

The fragmented policy scenario illustrates the increased economic efficiency of a national approach. Figure 4 compares a weighted average of the varying regional price trajectories to the emission trajectory required for a national program to achieve national emissions reductions of 20% by 2020 and 65% by 2050 relative to 2006 levels. While both approaches result in the same amount of overall emission reductions, the fragmented regional approach requires an emission price almost 25% higher than the national approach. The modelling analysis suggests that achieving reduction targets under the fragmented approach has significantly higher overall costs of abatement than under a unified approach. A nationally unified approach has lower costs for Canada because it allows for the least expensive emission reductions overall to be achieved rather than requiring a specific amount of reductions in each region. These lower costs result in greater economic efficiency for achieving the national target and thus more cost-effective policy.

HIGHER CARBON PRICES WITH FRAGMENTED POLICY ACROSS JURISDICTIONS

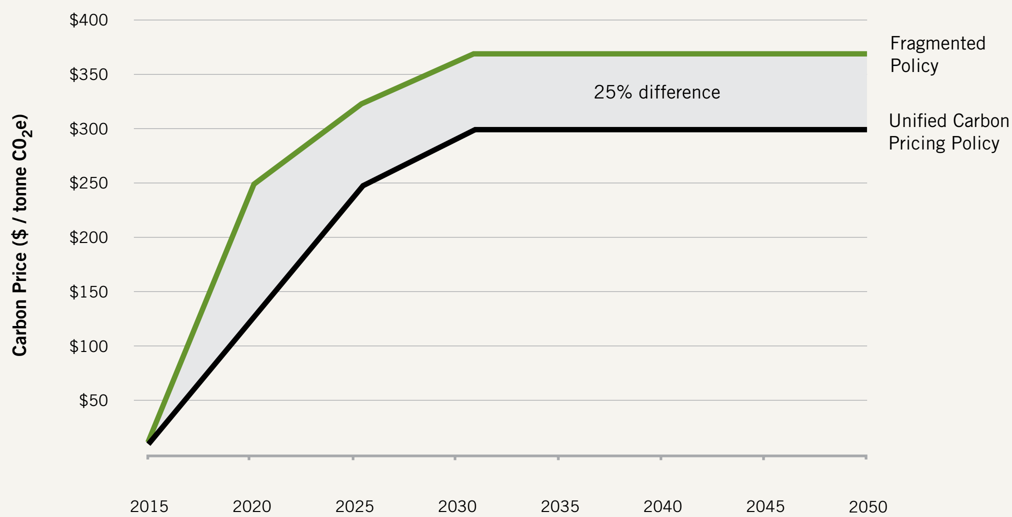

FIGURE 4

Economic costs of the fragmented policy scenario

These results have four important implications for consideration in designing a Canadian carbon pricing policy:

First, the overall cost of carbon pricing policy is reduced where a common carbon price is applied across Canada. A fragmented, province-by-province approach will increase the overall costs to Canadians of reaching Canada's emissions targets (modelling suggests an increase in costs of $40 billion). In terms of economic impacts, the GDP costs of this fragmentation relative to an efficient unified policy are 7% greater than the unified approach in 2020, 20% in 2035, and 7% in 2050. While provinces can have a strong role in implementing carbon pricing policy, a unified carbon price improves economic efficiency, and reduction targets are achieved at lower cost.

Second, some provinces (such as British Columbia and Alberta) would face significantly higher costs of achieving their share of Canadian emission reduction targets if they were to act independently.

Indeed, if it acts independently, Alberta will have difficulty achieving 20% reductions by 2020, even at prices of $400 per tonne. Similarly, achieving 65% emission reductions in Alberta alone by 2050 will require very high emission prices in that province.

Third, while a national approach is more cost-effective overall, it has implications for distributional effects. Effectively, the economic efficiency gains that would be achieved through a coordinated approach result from less expensive reductions from one region replacing more expensive reductions in another. Regions like Manitoba and Quebec would abate more emissions, and regions like Alberta and BC would abate fewer. On the level of firms, some emitters will thus be relatively better off under a national policy, while some will be relatively worse off, compared to a fragmented policy.

Fourth, without a national system, provinces have less incentive to implement stringent provincial policy. They can benefit from emission reductions in other jurisdictions without imposing costs on local industry and households (i.e. there is an incentive to "free-ride"). National policy is therefore more likely to achieve the medium and long-term targets for the country as a whole, in the most cost-effective way.

Administrative complications of regional policy variation

The fragmented policy approach will also result in additional, harder-to-quantify costs as compared to a coordinated national approach. Policy variation among regions, not only in terms of the price of emissions, but also with respect to the rules for compliance, will complicate business planning for firms with inter-provincial operations. Firms will face higher transaction costs from compliance with multiple regional policy regimes. Variation in carbon pricing policies among regions could increase uncertainty as to the long-term durability of these policies. A coordinated carbon pricing policy regime would be more credible over the long-term, and thus provide clear incentives for firms to invest in low-carbon technologies with longer life-cycles.

Inter-provincial leakage could also be an issue. Large discrepancies between the stringency of policy in different regions could result in industry relocating from regions with higher carbon prices to those with lower prices.

Finally, some smaller provinces may have insufficient administrative capacity to develop and implement effective provincial carbon pricing policy. A national approach would ease the administrative burden and could help share costs.

4.2
THE NEED FOR ROBUST, LONG-TERM CARBON PRICING[23]

- **Given the long time periods required for the decarbonization of the Canadian economy, carbon pricing policy implementation must pay particular attention to issues of uncertainty. It must balance ensuring policy adaptability with providing a durable, long-term price signal.**

A second essential element of carbon pricing policy is that it must send a price signal to the economy that is durable and credible over the long term. The NRTEE's research suggests that two elements are essential to create such a policy. First, the carbon pricing policy must provide investors with policy certainty, making clear the "rules of the game." Second, policy must be adaptable through time in order to manage uncertainty and respond to changing circumstances. While policy adaptability and policy certainty are essential elements for any carbon pricing policy, there are trade-offs between the two criteria. If a policy has clearly been designed to be flexible or changeable at some future time, uncertainty as to the future nature of the policy follows. On the other hand, an attempt to fix policy in advance would imply a failure to adapt to new information, such as evolving climate science or the policies of Canada's trading partners. Effective carbon pricing policy needs to find a balance between adaptability and certainty – it should be adaptable to changing and unknown future circumstances, but certain enough to transmit a durable, long-term carbon price signal to the economy upon commencement.

4.2.1 Policy Certainty to Influence Long-term Investment Decisions

Firms and households routinely manage risk and uncertainty when making investment decisions. Yet uncertain climate policy raises additional risks. It raises the cost of capital and alters investment decisions. Policy uncertainty increases incentives to delay investments in carbon-reducing technologies in order to wait for additional information or clearer policy commitment from governments. Firms and households also tend to avoid making investments that could disadvantage them as an early mover, especially if they believe they might be forced to further reduce emissions under a policy, or that policy could change to a less stringent one in the future.

The NRTEE's research suggests that a clear communication of a government's long-term commitment to a pricing policy is critical to achieving low cost reductions aligned with the GHG targets. If consumers believe government might backslide, or soften pricing policy as a result of political pressure, the policy's effectiveness is reduced. In Figure 5, two scenarios are presented, one where investments are made with complete confidence in the carbon pricing policy and one where there is no confidence. With a lack of confidence, there is a lower level of overall investment resulting in much lower emission reductions. This conclusion is supported by studies that have shown that under uncertainty, a higher price on carbon is required to trigger investment in low-carbon emission technologies and that adoption of different electricity generation technologies can vary substantially depending on investors' perceptions of

23 This section is informed by in-house NRTEE research on policy certainty and adaptability.

carbon price uncertainty.[24] With confidence in the carbon pricing policy, investments are made that reflect the future value of carbon and so better long-term technology choices prevail.

IMPACT OF POLICY CERTAINTY ON EMISSION REDUCTIONS

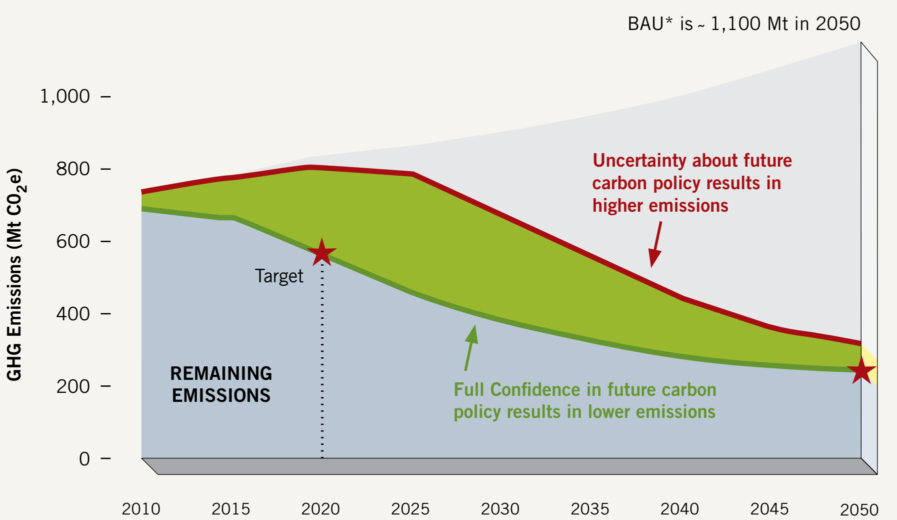

FIGURE 5

* Business as usual ★ Government of Canada Emission Reduction Targets in 2020 and 2050

Expected future prices of carbon emissions influence investment decisions in the present. As a result, effective policy must be implemented to clearly and consistently communicate the nature of a carbon pricing policy. Policy certainty therefore suggests that the carbon pricing policy will be maintained and is defined through time. Essentially, policy certainty ensures the carbon price signal is not diluted by uncertainty about the permanence or longevity of carbon pricing policy.[25]

4.2.2 Policy Adaptability, Given the Multiple Sources of Uncertainty

While the issue of policy certainty illustrates the importance of addressing uncertainty from the perspective of firms and households, the issue of policy adaptability highlights the significance of uncertainty from the perspective of

24 For detail on how policy uncertainty affects and delays investment in low-carbon technologies, see Blyth et al. (2007); and Reedman et al. (2006).

25 Bataille et al. (2007).

policy-makers. Substantial sources of uncertainty complicate the design of a carbon pricing policy. Key sources of uncertainty include:

- The stringency and timing of climate policy to be implemented by Canada's major trading partners;
- The urgency of emission reductions, as dictated by evolving climate science;
- The effectiveness of policies;
- The costs of policies;
- Economic activity; and
- The impacts on stakeholders.

Because of these sources of uncertainty, governments face risks in implementing domestic carbon pricing policy, and must therefore take these issues into account. If, for example, Canada was to implement policy independent from its trading partners, it could subject Canadian industry to heightened competitiveness concerns. If policy was set too stringently, and emission mitigation costs were unexpectedly high, the Canadian economy could suffer disruption.[26] Similarly, if short-term Canadian emission reductions were too shallow, Canada might be forced to move toward more aggressive reductions in the future that may cost the economy more than if the emission reduction targets had been set higher in the present. These risks can be reduced if the policy is designed to be adaptable and flexible. Policy adaptability would therefore allow a policy to respond to new information in the future and help ensure it remains effective and economically efficient.

Principles of adaptive management can be applied to climate change policy. Such principles revolve around the notion that policies should respond to changes over time and make explicit provision for learning.[27] Basically, they seek to accommodate uncertainty within the policy framework. An adaptive management framework relies on monitoring results of policy experiments to test the impacts of different policy and management approaches on complex systems. This approach can be useful given the complexity of the energy system and the uncertainties described above. Explicitly incorporating such adaptive mechanisms as automatic policy reviews and adjustments, regular and transparent reporting requirements, clear evaluation and revisions, into policy design can enable learning.[28]

26 See Hall and Fischer (2008) for a more detailed discussion on the use of adaptive approaches and hybrid policies to manage trade-offs between price and quantity certainty. See Kopp et al. (1997) for an example of such an approach.

27 See also the forthcoming publication from IISD and TERI, which further considers adaptive policy making; Swanson and Bhadwal (2008).

28 For relevant research on adaptive management and adaptable climate policy see Arvai et al. (2006); See also Bennet and Howlett (1992).

4.2.3 Balancing Policy Certainty and Adaptability

While policy adaptability and policy certainty are important objectives for a carbon pricing policy, there are trade-offs between the two goals. If a policy has clearly been designed to be flexible or changeable at some future time, uncertainty cannot be avoided. On the other hand, fixing policy for the long-term implies that it cannot adjust to new information. The NRTEE's research suggests that a carbon pricing policy should instead strive toward balancing adaptability and certainty; it should be adaptable in future time periods, but transmit a robust price signal to the economy. Achieving this balance is really about governance: the design of institutions and processes associated with implementing and managing a carbon pricing policy over time. Uncertainties from the policy makers' perspective can be managed through this adaptive approach.[29]

4.3 A CARBON PRICING POLICY FOR CANADA[30]

The essential objectives for cost-effective carbon pricing policy have been identified above. To meet these objectives, a policy that includes three design elements as well as an implementation strategy to ensure the carbon pricing policy can be managed over the long term, is required. An overview of this carbon pricing policy, which is the focus of the separate *Advisory Note*, is set out below. Design options for these elements are explored in detail in subsequent sections of this report.

4.3.1 Design of Three Policy Elements

The NRTEE *Advisory Note* recommends a carbon pricing policy based on three main elements to meet the high-level, essential design objectives set out above. The carbon pricing policy includes:

1. **A unified carbon price across all emissions through a single national cap-and trade system.** Detailed design options are explored in Section 5.0. This unified pricing instrument would include:

    - *A cap for large emitters.*[31] This covers approximately 51% of emissions. By setting a maximum carbon price, desirable elements of carbon taxes can be included to enhance price certainty and contain costs while ensuring the cap on emissions works efficiently; and

29 Note that an alternative approach could be to focus exclusively on policy adaptability and increase the stringency of the policy (the price on emissions) to such a level that firms and households would adopt low-emission technologies despite the presence of policy uncertainty. However, given that this approach would increase the cost of policy and would be even more politically challenging to implement, it is not considered as being particularly practical or useful.

30 See NRTEE *Achieving 2050: A Carbon Pricing Policy for Canada (Advisory Note)* for details

31 *Large emitters* are companies that produce goods in emissions-intensive sectors, including primary energy production, electricity production and selected areas of mining and manufacturing production.

- *A cap for the rest of the economy*. This covers approximately 36% of remaining emissions in buildings, transportation and light manufacturing. A cap would be applied at a point in the fuel distribution chain to those that distribute or import fuel, thereby limiting the number of trading entities while broadening coverage throughout the economy.

2. **Complementary regulations and technology policies.** Complementary regulations can further improve the cost-effectiveness of the carbon pricing policy by ensuring all low-cost emission reduction opportunities are achieved. Emissions from agriculture, waste, and upstream oil and gas can be difficult to include under a cap-and-trade system directly. Other complementary regulations are necessary to ensure the carbon price reaches these sectors of the economy, supplemented by targeted technology policy to address market barrier issues. This approach would include regulations for some of the remaining hard to reach emissions. Detailed design options for these complementary policies are explored in Chapter 7.0.

3. **International carbon abatement opportunities.** As carbon prices rise, there will need to be more awareness of how the domestic carbon costs align with that of major trading partners. Also, as carbon costs rise and additional units of reductions become more expensive, a disproportionately high amount may be spent on relatively few additional reductions. For these reasons, access to reductions outside of Canada are included in the carbon pricing policy, again to ensure Canada's emission reduction targets can be achieved at least cost. Further discussion of international purchase opportunities is found in Chapter 6.0.

4.3.2 Governance and Implementation of an Adaptive Carbon Pricing Policy

Implementation is at least as important as policy design. Institutions and processes to manage the policy over time are essential to implementing a durable, long term carbon pricing policy. Higher level recommendations for the design of these institutions and processes are also developed as part of an implementation strategy for the carbon pricing policy. Detailed implementation options are explored in Chapter 9.0.

5.0 THE DESIGN OF CARBON PRICING INSTRUMENTS

- **Policy design decisions have trade-offs and implications for how well the policy 1) provides broad, uniform coverage and 2) addresses the risks of adverse outcomes.**

An instrument to implement a price on carbon emissions is the central element of a carbon pricing policy to achieve Canada's emission reduction targets at least cost. Design of a pricing instrument, however, is complex. There are multiple dimensions to carbon pricing policy design, and policy makers must make design choices in several key areas. This includes choosing to balance emission price or reduction quantity, determining how revenue from the policy will be used or permits allocated, or including or excluding mechanisms such as border adjustments.

To achieve cost-effective reductions, a carbon pricing instrument must implement a unified price signal as broadly as possible. Detailed design choices for the pricing instrument can affect how well this unified price signal is applied. Yet the design must also address risks of adverse competitiveness and distributional effects (these possible impacts are discussed in Chapter 8.0). The design problem is challenging, however, because design choices involve trade-offs for how well the policy addresses these different and competing issues.

This chapter assesses how various design decisions affect how carbon pricing policy can 1) provide broad, uniform coverage, and 2) address adverse competitiveness and distributional impacts. To evaluate trade-offs between alternative design choices, five evaluation criteria set out in Section 2.2.1 are used. Not every design choice has implications for every evaluation criteria, so only relevant trade-offs for each section are described.

POLICY EVALUATION CRITERIA

- *Environmental Effectiveness* is a measure of how a design choice affects whether a carbon pricing policy will achieve the emission reduction targets.
- *Economic Efficiency* is a measure of how a choice affects the cost-effectiveness of a carbon pricing policy; efficiency means meeting emission reductions at least cost.
- *Distributional Effects* is a measure of impact on equity and the extent to which some stakeholders are affected more adversely than others.
- *Political Acceptability* is a measure of likely support politicians would find to implement a policy option.
- *Administrative Feasibility* is a measure of the burden of implementing and reporting, monitoring, and enforcing a policy over time.

Key design decisions and trade-offs between sets of policy options for each of these decisions are described and evaluated in this chapter, as follows:

- The section on **balancing price and quantity certainty** explores how design elements such as price ceilings, intensity caps and adjusting taxes ensure emission reduction targets are achieved, but costs are contained and adverse impacts are mitigated.
- The section on **point of regulation** explores options for where in the fuel supply chain a carbon pricing policy is applied. This design decision has implications for how broadly the price signal is applied.
- The section on **revenue recycling** explores options for distributing the value of emissions, in terms of allocating either emission permits or revenue collected. Revenue recycling decisions have complex trade-offs between the cost-effectiveness of the policy and how adverse impacts can be addressed.
- The section on **offsets** explores options for broadening coverage to improve cost-effectiveness.
- The section on **border adjustments** explores options for trade policy mechanisms to address adverse competitiveness impacts.

5.1 APPROACHES TO BALANCE PRICE AND QUANTITY CERTAINTY[32]

- **A spectrum of carbon pricing policy approaches exists to balance trade-offs between price certainty and quantity certainty.**
- **Differences between cap-and-trade and carbon tax systems can be blurred through policy design.**
- **Priorities should shift from cost containment in the short term to certain emission reductions in the longer term.**

The central design decision for carbon pricing policy is the choice of policy instrument. This chapter develops a framework for instrument choice, suggesting that instrument choice is more nuanced than simply a choice between cap-and-trade systems and carbon taxes; a spectrum of options is available. It identifies the mechanisms through which elements of carbon taxes and cap-and-trade systems can be blended to best achieve objectives and discusses the trade-offs among options.

32 Analysis in this section is drawn from reports commissioned by the NRTEE, and from stakeholder research: Hall and Fischer (2008); The Delphi Group (2008).

5.1.1 A Reframing of the Policy Discussion

Carbon taxes and cap-and-trade are both market-based approaches to reducing greenhouse gas emissions. Both work by placing a price on greenhouse gas emissions, creating an incentive to reduce emissions. In economic terms, both are efficient regulatory tools because they equalize the marginal cost of abatement across all emissions sources. This approach allows those sources that can reduce emissions most cheaply to engage in relatively more abatement, lowering net societal costs. In this sense, they are fundamentally similar.

The two general approaches also have differences. In their "pure" forms, carbon taxes provide certainty about marginal abatement costs but leave levels of emission reductions uncertain, while cap-and-trade programs provide certainty about the ultimate level of emissions but allow uncertainty over the price of emission permits. In this sense a carbon tax could be called a "price-setting" policy while cap-and-trade could be referred to as a "quantity-setting" policy. Neither instrument can guarantee both certainty about the quantity of emissions reduced and certainty about the price of carbon.

BASICS OF CARBON TAXES AND CAP-AND-TRADE SYSTEMS

A **carbon tax** sets a per-unit charge on emissions. Typically the system involves a tax on fuels that emit carbon dioxide when burned and on other greenhouse gas emissions. The tax thus provides price certainty, but leaves the annual level of emission reductions uncertain (depending on how the market responds to the price).

A **cap-and-trade system** involves setting the allowable level of emissions by issuing emission permits (sometimes called 'allowances'). If individual emitters produce more emissions than they have permits, they can purchase additional permits from firms that have more permits than they need to cover their emissions. In theory, government can ensure that reduction targets will be met by choosing the number of permits to issue, but the price of permits will be set by the market and is thus uncertain.

In *Getting to 2050*, the NRTEE recommended a carbon pricing policy in the form of a carbon tax, a cap-and-trade system, or hybrid of the two. Subsequent dialogue in the media, the economics literature, and in Canadian politics has focused on the differences between cap-and-trade systems and carbon taxes. In reality, however, price-setting approaches (e.g. tax) can be blended or merged with emissions-setting approaches (e.g. cap-and-trade) in various ways. The two mechanisms thus form opposite ends of a spectrum of possible policy approaches. Most real-world pricing policies are actually a blend and can be notionally mapped onto this spectrum, as illustrated in Figure 6.

The trade-off between price and quantity certainty is a central issue for carbon pricing policy. Policy must find a balance between providing sufficient emissions quantity certainty to ensure environmental targets are achieved, and providing sufficient price certainty to ensure predictability in abatement costs for emitters. This framing of the issue as a balance of price and quantity, rather than a choice of tax or trade, is useful because it creates more options for designing optimal policy to most cost-effectively achieve deep emission reductions.

SPECTRUM OF CARBON PRICING POLICIES: PRICE CERTAINTY VS. REDUCTION CERTAINTY

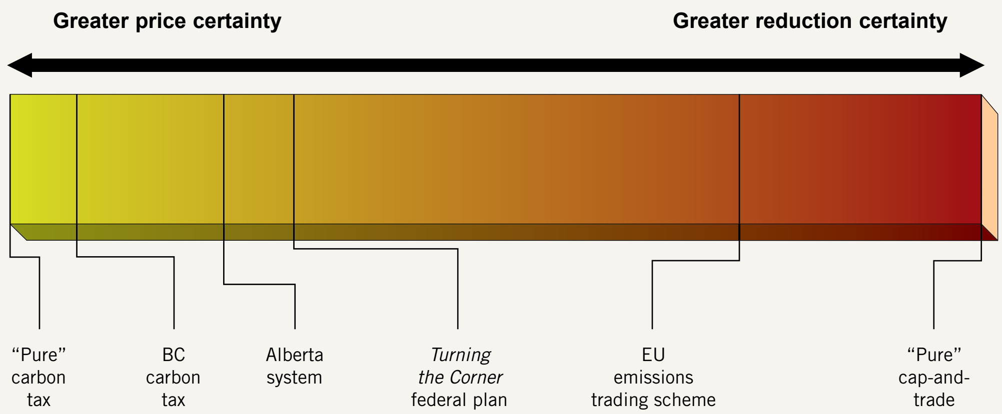

FIGURE 6
While the positions of these pricing policies on the spectrum are notional, they are based on how each policy is designed to bring greater price certainty to a cap-and-trade system or greater quantity certainty to a carbon tax system. For example, the BC carbon tax is close to a pure carbon tax, but will be adjusted through time. The federal Turning the Corner plan initially includes a maximum price through the Technology Fund. The EU trading system allows permit banking and some offsets.

5.1.2 Trade-offs between Price and Quantity Certainty

The spectrum of policy options between taxes and cap-and-trade systems can be illustrated with Figure 7. At one end of the spectrum, a pure carbon tax ensures price certainty in which the costs of emission reductions are known but the quantity of reductions is uncertain. At the other extreme, a pure cap-and-trade system provides greater certainty as to the emissions to be reduced, but the price of emission reductions is set by the market.

As the spectrum implies, a central question for carbon pricing policy is whether an emphasis on quantity or price is most appropriate. Economics literature has generally viewed price-setting approaches to be more cost-effective. Price-setting approaches provide maximum flexibility about where and when emissions occur, as appropriate for a global stock pollutant like carbon dioxide (and other GHGs). Quantity-setting approaches, meanwhile, are viewed as being more focused on the environmental outcome (achieving specific reductions) and so would rank higher in terms of policy effectiveness. Policies that lean towards greater price certainty will tend to be more economically efficient, while policies that focus on quantity certainty provide greater confidence about environmental effectiveness.

The weight given to price certainty or quantity certainty has implications for investment. Achieving significant cuts in emissions will require large capital investments in long-lived infrastructure, particularly in the energy sector. Taxes

SPECTRUM OF CARBON PRICING POLICIES: POLICY DESIGN OPTIONS

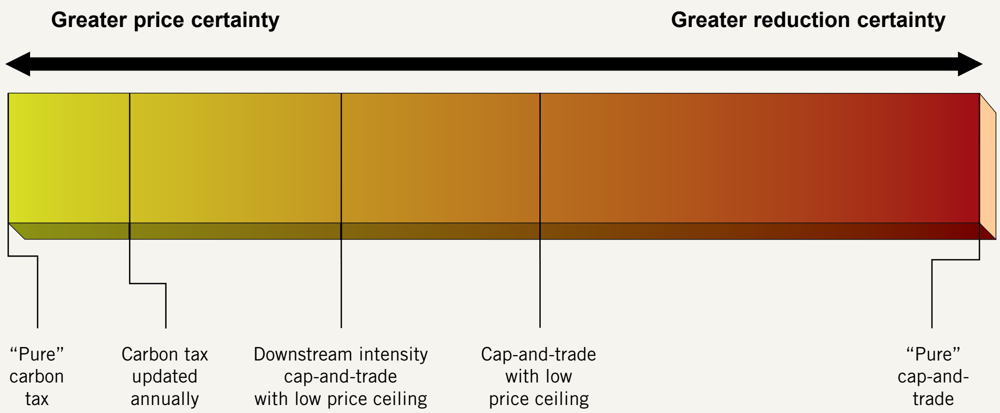

FIGURE 7

provide greater certainty about future prices, and hence the value of emission-reducing investments, while future prices are uncertain in cap-and-trade systems. This price uncertainty can cause firms in a cap-and-trade system to delay investment decisions, as there is an option value in delaying investment in order to get more information in the future about the likely range of prices.[33]

While price certainty approaches have economic appeal, other considerations are also important. Taxes could be more difficult to link to international emissions trading markets, potentially increasing the overall costs of meeting the Government of Canada's reduction targets. The political difficulty of increasing tax rates to achieve emission reduction targets may also reduce the case for taxes as the policy of choice.[34] In the near term, carbon tax instruments seem to be politically more challenging to implement than cap-and-trade instruments. While British Columbia has implemented a carbon tax, it has generated substantial opposition in that province. At the federal level, the Liberal Party proposed a similar carbon tax but was defeated in the 2008 federal election. Greater current political momentum exists for cap-and-trade approaches: Ontario is moving forward with plans to introduce a provincial emissions trading scheme; several provinces are observers or participants in RGGI or WCI; and the current federal government has proposed using a cap-and-trade approach in its climate policy.

33 Abel, et al. (1996).
34 Parry and Pizer (2007a).

The choice of pricing instrument does not significantly alter the distributional impacts of carbon pricing policy. Carbon pricing has a greater effect on some sectors, households and regions than others, and this is true regardless of the pricing instrument. The extent of distributional impact depends much more on other policy design elements, such as how revenue is used to mitigate adverse distributional impacts.

Carbon taxes have advantages with respect to their ease of implementation by government. First, as British Columbia has demonstrated, carbon taxes can be set up and started relatively quickly. Experience in Europe with the Emissions Trading Scheme suggests cap-and-trade systems take more time to set up and can experience some early problems.[35] Cap-and-trade systems require the establishment of new institutions to allocate permits and facilitate trading. In contrast, the administrative and institutional systems for collecting taxes are already in place. In the medium and long term there are few differences between carbon taxes and cap-and-trade with respect to governance and administration. Both approaches must monitor and verify emissions, assess tax or permit liabilities, distribute revenues (or permits), and enforce compliance.

Both carbon taxes and cap-and-trade systems can be adjusted in response to new information over the relevant time-scales (years or decades). Two further differences between taxes and cap-and-trade confer slight advantages to one over the other. First, taxes may be less vulnerable to rent-seeking than cap-and-trade, particularly through the allocation of permits.[36] Second, cap-and-trade systems can adjust almost instantaneously to new information, with anticipated changes in supply or demand for permits reflected in the market price.

Table 2 summarizes the essential trade-offs between price setting and quantity setting policy instruments.

SUMMARY OF TRADE-OFFS BETWEEN PRICE SETTING AND QUANTITY SETTING INSTRUMENTS

	"Pure" Carbon Taxes	"Pure" Cap and Trade
Strengths	• Easier to establish quickly • Less vulnerable to political rent-seeking • May be more economically efficient	• Easier to align with trading partners, through linkages • Can respond more quickly to new information • Greater guarantee that emission targets will be met
Weaknesses	• Less guarantee that emission targets will be reached • More difficult to link with international trading systems • Politically challenging to implement	• Price uncertainty may lead to delayed investments • Less transparent; may create opportunities for political rent-seeking • Slower to set up • More administrative oversight and management required

TABLE 2

35 Ellerman and Buchner (2007).

36 On the other hand, Parry and Pizer (2007b) note that if under a carbon tax the government excludes some firms or sectors in response to rent-seeking, the outcome will likely be less efficient than a cap-and-trade system with free permits. Excluding some firms or sectors – thus shielding them from the carbon price – will produce economic distortions that will lower the efficiency of a program.

5.1.3 Mechanisms for Blending Carbon Taxes and Cap-and-Trade Systems

This section introduces the policy design mechanisms that can enable policy makers to balance price and quantity certainty, by blending the desirable attributes of both carbon taxes and cap-and-trade systems.

Combining Taxes and Cap-and-Trade

Carbon taxes and cap-and-trade can be adopted in tandem. For example, a downstream cap-and-trade system for major energy intensive producers and process emissions could be combined with a tax to capture other fossil fuel use in the economy to ensure broad coverage.[37] In the UK, industrial emitters are regulated under the EU Emissions Trading Scheme, a cap-and-trade system. At the same time, all businesses pay a 'Climate Change Levy' on energy bills, similar to a carbon tax.

Banking and Borrowing of Permits

Banking permits means that firms can store up permits in the short term, and use them to cover shortfalls in the future. *Borrowing* means that firms that have a shortfall in the present can *borrow* permits from the future, in effect promising that they will reduce emissions in the future rather than now. Figure 8 and Figure 9 graphically illustrates the principles of banking and borrowing respectively.

Allowing firms to bank and borrow permits across compliance periods prevents excessive market volatility. Firms can balance their costs from year to year, and as a result they can manage the costs more efficiently. Banking also enables a cap-and-trade system to respond to new information, which helps to create an adaptive policy framework. For example, if firms expect caps to be tightened in the near future – perhaps because of new scientific information – they will begin banking permits now in anticipation of tighter future caps, thus raising permit prices and increasing abatement in the present.[38] Banking of permits is generally uncontroversial, as it encourages early reductions to save permits for future times when the cap is more stringent. Banking thus should not affect the quantity of emissions reduced overall. Banking of credits is included within the Government of Canada's *Turning the Corner* plan.

Borrowing could be more problematic, since it implies postponing reductions. Firms could conceivably borrow large volumes in the near-term and then prove unable to make reductions in the future – essentially defaulting on their emission debt. In addition, a large borrowing deficit among many firms could increase political pressure to revise caps downward. The rationale for borrowing is the expectation that technological progress will drive down future abatement costs, making it sensible to shift some abatement from today to that future time. In practice, the process of setting emission caps and targets plays a strong role in the need for time flexibility mechanisms: rather than allowing unlimited borrowing, policymakers can set targets that begin modestly and become more stringent over time – and more quickly than abatement costs are expected to fall – leaving banking the more relevant mechanism to smooth prices over time.

37 Note that if the tax overlaps with the trading system (i.e. if capped industries are not exempt from the tax), then the tax functions like a price floor for permits. It also provides government with revenue, which is not the case if permits are freely allocated within the trading system. See Fischer et al. (2008).

38 This indeed occurred in the U.S. Acid Rain trading program around 2004. The current administration proposed new rules that would have tightened the cap, and permit prices began rising immediately, about two years before the final rules were ultimately promulgated. See: Hall and Fischer (2008).

BANKING OF EMISSION PERMITS

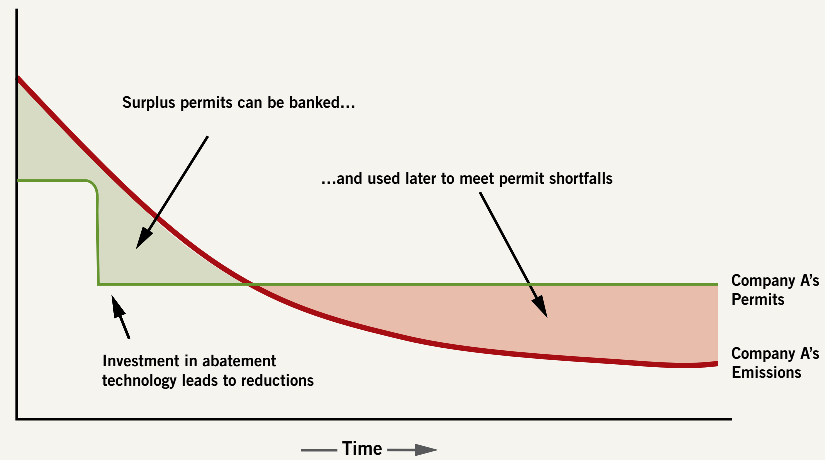

FIGURE 8

BORROWING OF EMISSION PERMITS

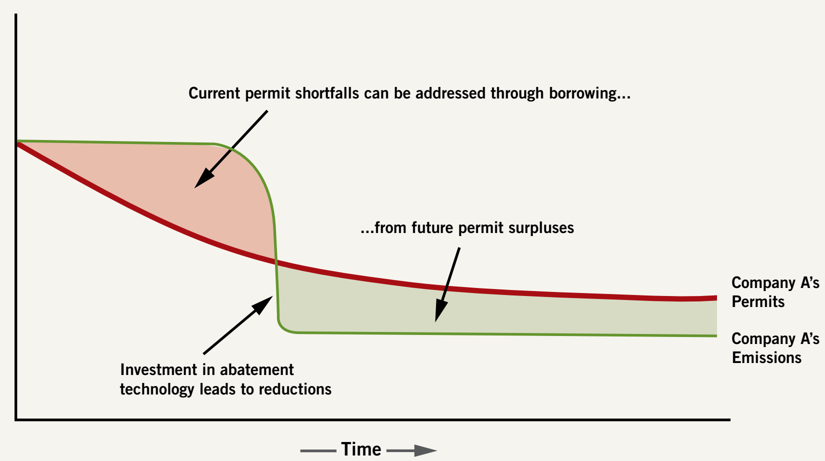

FIGURE 9

Price Ceilings

A price ceiling (or safety valve) sets an upper limit on permit prices.[39] While the price ceiling provides greater certainty of the price of emissions, it does so at the cost of quantity certainty; if government sells permits at the safety valve price, it increases the total emissions allowed under the cap. Figure 10 illustrates the concept of a price ceiling.

One of the key debates with a price ceiling is where it is set: should it be at a price well above expected permit prices, to protect against truly unforeseen costs? Or should it be set at a level where it is triggered frequently, providing greater price certainty and so behaving much more like a tax? A related question is whether emission targets should be more ambitious in the presence of a price ceiling. Given that the price ceiling may allow emissions above the targeted cap in some compliance periods, regulators may want to tighten the overall cap. Price ceilings also have implications for capital investment. A price ceiling eliminates the possibility of very high market prices in the future, thus lowering the expected future price of permits and the incentive to invest.

In the Government of Canada's *Turning the Corner* plan, regulated emitters can meet their compliance obligations by paying into a technology fund, instead of ensuring they have enough emissions permits. This mechanism acts as a price ceiling on emissions permits.[40]

PRICE CEILINGS

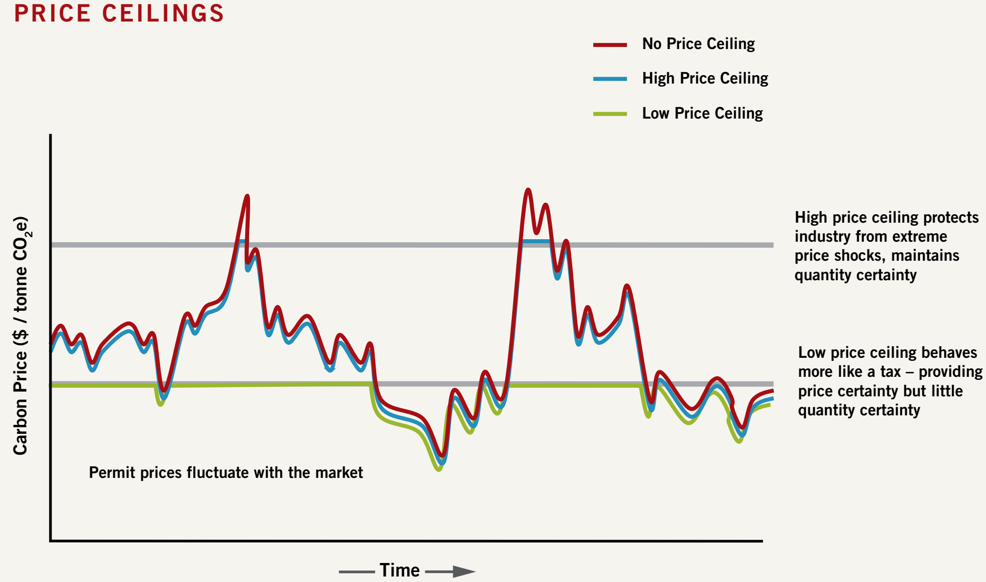

FIGURE 10

39 Although the term "safety valve" is widely used in the climate policy debate, we choose to use the more general term price ceiling, since the term 'safety valve' has acquired different connotations in Europe, where it implies a very high price ceiling, and the US, where it implies a very low price ceiling.

40 Note that it is only a partial price ceiling, as only a portion of compliance obligation can be met through the technology fund. Also note that the permits are within an intensity based system, not a capped system.

Intensity caps

Quantity-setting instruments such as cap-and-trade do not have to set absolute caps. Caps can also be indexed to the level of economic activity (or output) in a regulated sector. These *intensity caps* have features of both price and quantity setting approaches. The federal *Turning the Corner* plan has adopted this approach. Although intensity-based trading has some short-term benefits, in the long-term intensity-based systems do not ensure emission targets are reached. Overall, intensity caps are an inefficient approach to reaching a specific emissions goal such as Canada's 2020 and 2050 targets.[41] Moreover, other international cap-and-trade systems with absolute caps would be less likely to agree to link with an intensity-based system (see Section 6.1), as such a linkage could cause total emissions to rise.[42]

Adjusting taxes

Carbon taxes can also be modified to provide greater certainty about emission reductions, by adjusting tax rates periodically to achieve more (or fewer) emission reductions. Taxes could be modified through periodic review of tax rates by legislators or independent external regulators. A carbon tax could also be designed to be self-adjusting, with the rate of increase (or decrease) linked to changes in emissions over time.

Other approaches to blending price and quantity

Other policy mechanisms were explored and assessed for finding a balance between ensuring reductions and bounding costs of abatement.[43] Other possible mechanisms include: a price floor, in which a minimum cost of permits is set in a cap-and-trade system; triggered mechanisms, in which the cap could be adjusted if pre-set thresholds (such as a given market price) were reached; quantity-limited reserves, which are essentially institutionalized long-term borrowing by the government; and independent oversight institutions which could monitor and adjust a pricing policy as required, moderating between price and quantity certainty goals. The issue of institutions is explored in Chapter 9.0.

5.1.4 Summary and Conclusions for Instrument Choice

Canadian carbon pricing policy should try to strike a balance between price and emissions certainty. Mechanisms for blending price and quantity certainty provide flexibility for balancing how abatement costs are contained while ensuring emission reduction targets are achieved. In the real world it is unlikely that regulators will choose purely price or quantity controls for greenhouse gas emissions. The Government of Canada's *Turning the Corner* plan, for example, would implement a cap-and-trade system, but one with significant flexibility mechanisms: caps in the early years are based on intensity (rather than absolute) targets, and the program includes a payment to a technology fund that functions like a price ceiling for the first several years.[44] As a result, the system shares certain features of a tax.

41 Newell & Pizer (2006) show indexed caps may be preferable to pure quantity-based approaches for many countries, including Canada. However, Fischer (2001) show that intensity approaches are inefficient for achieving a set emission reductions target.

42 See Fischer (2003).

43 Hall and Fischer (2008).

44 Government of Canada (2008).

Blending mechanisms can help to balance price and quantity through time. In the short term, containing costs and providing firms with some assurance that costs of abatement will not become too high may be important to implementing the policy politically. Policy must start with low stringency; to avoid shocking the economy, the price of carbon should increase over time to allow firms and households to make adjustments. Price certainty in the near term can ensure market prices do not become too high too quickly. In the longer term, however, quantity certainty is necessary to ensure Canada does in fact meet its 2020 and 2050 reduction targets. Evolving climate science is also relevant here: if new evidence emerges suggesting sharper emission reductions are necessary, then policies that cap emissions may be preferred to price setting approaches.

A short-term emphasis on price certainty and a long-term emphasis on quantity suggests that policy mechanisms should be transitioned over time. The Government of Canada's *Turning the Corner* proposal for an intensity-based system with a low price ceiling provides greater cost certainty, but implies lower emission reduction certainty because the price ceiling is initially set at a low level. A transition to a system that ensures quantity certainty must occur if Canada is to meet its emission reduction targets.

Good design is more important than instrument choice. Either carbon taxes or cap-and-trade systems could be designed to be cost-effective, depending on the details of the policy design and mechanisms included. The range of mechanisms that blur carbon taxes and cap-and-trade systems emphasize the important idea that *good design* is more important than the choice of instrument. Similarly, instrument choice is only one dimension of policy design. Just as important for ensuring good design are other aspects of carbon pricing policy such as revenue recycling, point of regulation, linkages, and complementary policies.

5.2 POINT OF REGULATION[45]

- **Point of regulation – whether pricing is applied upstream or downstream – must be designed carefully, and will depend on the instrument choice (tax or cap-and-trade).**
- **Point of regulation decisions can effect how broad the emissions coverage will be for the carbon pricing policy.**
- **There may be a case for a mix of instruments, because the most appropriate point of regulation may differ between industrial, transportation and household emissions.**

45 This section is informed primarily by Hall and Fischer (2008).

Carbon fuels change hands along a supply chain from producers, to refiners and processors, to distributors and ultimately to final consumers. Carbon pricing can be applied at various points throughout the fossil fuel supply chain. For example, a carbon tax could be levied on consumers at gas pumps, or it could be levied on producers and importers of carbon-based fuels like oil and gas. The point at which carbon pricing is applied is known as the point of regulation.

As illustrated in Figure 11, *downstream* refers to the point at which emissions are finally released, typically where fuels are combusted. *Upstream* refers to the point at which carbon fuels enter the economy, such as oil wells and import terminals. Economic theory suggests that the point of regulation does not affect the economic efficiency or environmental effectiveness of carbon pricing policy – the price signal will be the same regardless of where it is applied in the fuel chain, because price increases are passed on to final emitters further downstream. However, other factors make this design choice important.

Carbon taxes can be applied with relative ease upstream or downstream. In upstream systems, a carbon tax is levied on importers and producers of fossil fuels, based on the carbon content of the fuels. The BC carbon tax is applied upstream. In downstream systems, the tax is levied on consumers at the gas pump and on fuel bills.

SCHEMATIC OF ENERGY SUPPLY WITH UPSTREAM AND DOWNSTREAM ELEMENTS

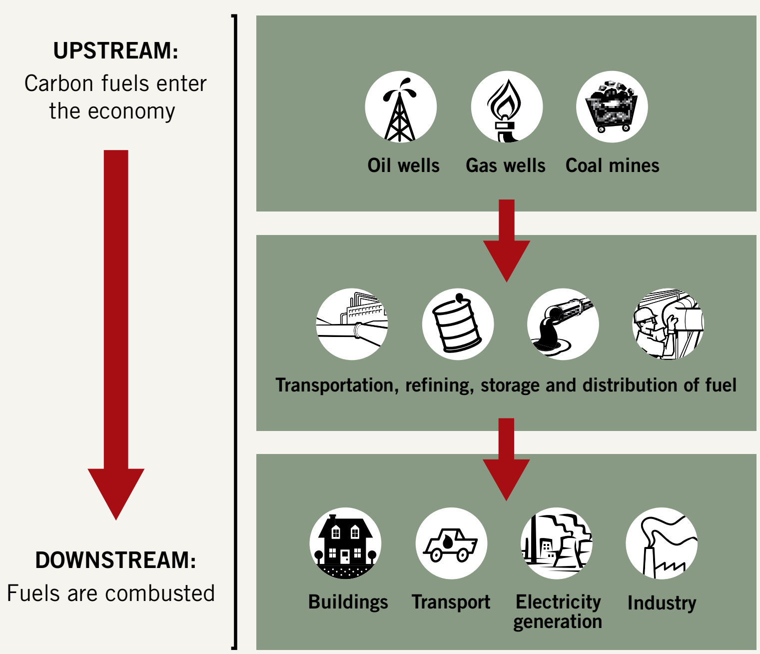

FIGURE 11

The choice of point of regulation for cap-and-trade systems is more complex than for carbon taxes. This is because the effective functioning of an emissions trading system is influenced by the number of participants. A trading system with many participants trading small amounts is administratively complicated; a system with too few participants can result in insufficient market liquidity and creates the potential for market manipulation. Several options are possible, each with strengths and weaknesses.

Downstream cap-and-trade among large emitters. In most existing and proposed cap-and-trade systems, only large emitters are included, typically electricity generators and industrial plants. Examples include the EU Emissions Trading Scheme and the Regional Greenhouse Gas Initiative (RGGI) in the US. The administrative burdens of a large final emitter trading system can be kept low, because of the relatively small number of regulated entities[46], and such systems generally function well. However, such systems do not achieve broad coverage of all emissions in the economy, a central goal of efficient carbon pricing. This is because emissions from buildings and transportation are not affected by large emitter cap-and-trade systems. A large emitter trading system alone will not be sufficient to meet the Government of Canada's targets at least cost.

Downstream cap-and-trade among small emitters. Buildings and transportation emissions could be included in a cap-and-trade system by capping the emissions of individuals and/or businesses. The UK is establishing a cap-and-trade system in its commercial and institutional sector, and has explored the feasibility of personal carbon trading.[47,48] However, the administrative challenges involved in establishing cap-and-trade systems involving many thousands or even millions of participants are formidable. Personal carbon trading, in particular, is seen as prohibitively complex.

Upstream cap-and-trade systems. In an upstream system, the amount of fossil fuels entering the economy would be limited, with caps placed on importers and producers. Such a system has the advantage of achieving broad, economy-wide coverage of emissions, a central goal of efficient carbon pricing policy. In addition, an upstream system involves few regulated entities, and as a result is administratively more straightforward. However, a fully upstream cap-and-trade system has two principal disadvantages. First upstream carbon prices provide no incentive for carbon capture and storage, thought to be an essential technology to reduce emissions, or for process and fugitive emissions, which are important sources of GHGs. While additional rules could be developed to address these issues, they would add complexity to the upstream system. Second, the small number of regulated entities may enable market manipulation, since the actions of individual regulated firms could have a significant impact on permit prices.

Mixed cap approaches. The broad coverage benefits of upstream cap-and-trade can be combined with the administrative attractiveness of large emitter trading systems. For example, a national cap on emissions could be apportioned between large emitters and the suppliers of fuel for the rest of the economy (in particular heating

46 In 2007, there were 307 facilities in Canada emitting more than 100,000 tonne CO_2e, the threshold for mandatory reporting under the Facility Greenhouse Gas Reporting Program. Environment Canada (2008).

47 Defra (2009).

48 Prescott (2008) and Defra (2008a).

and transportation fuels).[49] This approach applies the most appropriate point of regulation to different areas of the economy. However, if a mixed cap is used, it will be important to ensure that prices are harmonized across the economy to the greatest degree possible, for the reasons laid out in Chapter 4.0.

Figure 12 illustrates one possible way in which a mixed cap system might ensure full coverage of the economy.[50]

CAPPING EMISSIONS IN THE FOSSIL FUEL SUPPLY CHAIN

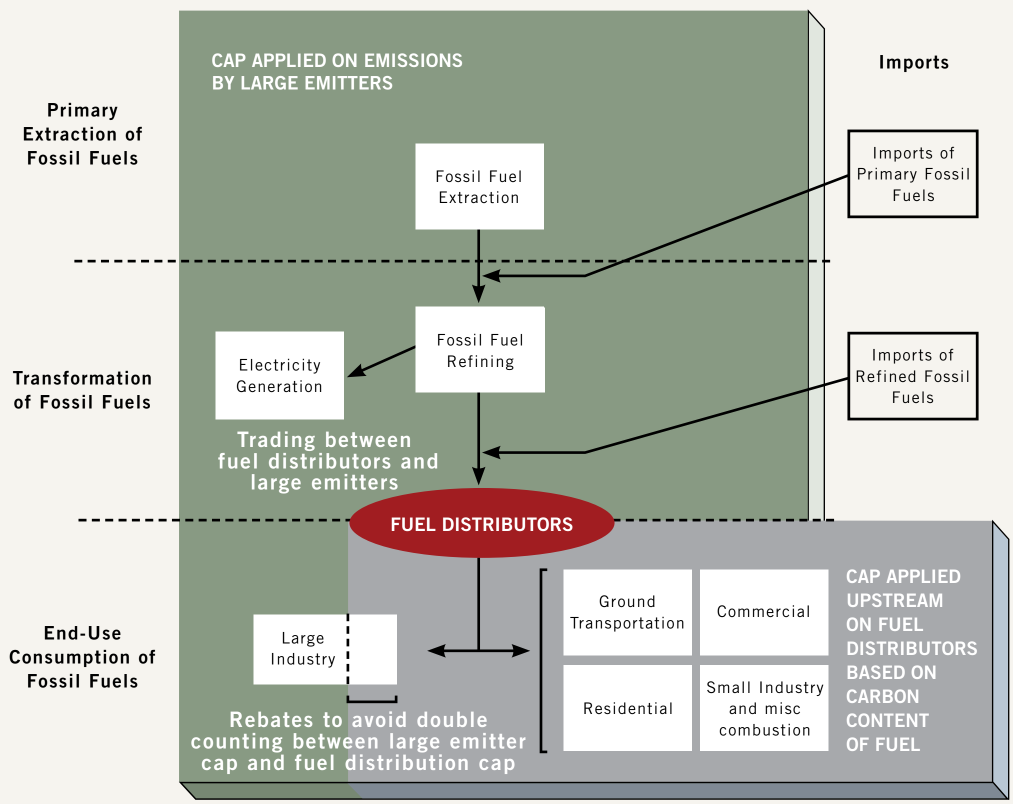

FIGURE 12

A single national cap on emissions could be regulated separately for large final emitters and for fuel distributors. A portion of the cap could be imposed on carbon emissions of large emitters, including the upstream oil and gas, fuel refining, and electricity generation sectors as well other large industrial emission sources. The remainder of the cap would be applied upstream to fuel distributors based on the carbon content of the fuels distributed. Distributors would pass the added costs of achieving the upstream portion of the cap down to fuel consumers through an increase in the price of fuel, ensuring that residential, commercial, transportation, and small industry would also see a price on burning fuel and generating carbon emissions. Allowing trading between large emitters and the fuel distributors would ensure a uniform price signal across the economy, though large industrial emitters would need to be rebated to ensure they would not pay the carbon price under both points of regulation.

49 Similarly, as noted in *Getting to 2050*, a cap-and-trade system for large emitters could be complemented by a carbon tax for the building and transportation sectors, ensuring broad emissions coverage.

50 The NRTEE recommends this approach in the Advisory Note.

Point of regulation is central to policy design. The administrative, political and institutional contexts of industrial emissions and household emissions are very different. As a result, there may be a case for regulating these emissions sources at different points in the fuel chain, or with different instruments. However, if different instruments are used, mechanisms to harmonize emissions prices between instruments will be necessary.

5.3 REVENUE USE AND PERMIT ALLOCATION[51]

- **Allocating permits in a cap-and-trade system and recycling revenue from a carbon tax or permit auctions are questions of value distribution.**
- **Permits in a cap-and-trade system should be auctioned where possible, to avoid political rent-seeking; to reduce administrative complexity; to generate government revenues; and to foster transparency.**
- **Some allocations could be provided free to a targeted group of cost and carbon exposed industries to address competitiveness issues and emissions leakage.**
- **Revenue use must address a trade-off between economic efficiency and equity. The most equitable revenue-use options (rebates to households) are economically inefficient; the most economically efficient (corporate tax cuts and/or output-related rebates) exacerbate the regressive impacts of carbon pricing.**
- **Some revenue-use options can improve the environmental effectiveness of carbon pricing. Revenues can be spent on R&D, or to fund complementary policies and technology deployment. Some of these options can be targeted at low income households or at-risk industries. However, free-ridership becomes a concern, diminishing the effectiveness of such subsidies.**
- **Jurisdictional authority must be taken into account for revenue-recycling decisions.**

Carbon pricing policies generate value, and that value must be allocated. In cap-and-trade systems, governments must decide whether to give that value to regulated industries, through free allocation of permits, or whether to auction permits. If permits are auctioned, or if a carbon charge is imposed, revenues are significant. Various revenue recycling options are available and could be used to help address key issues for policy design including competitiveness and leakage issues, adverse distributional impacts, and barriers to technology.

51 Analysis in this section is informed by: Rivers (2008); The Delphi Group (2008); and Hall and Fischer (2008).

5.3.1 Objectives of Revenue Recycling and Permit Allocation

The questions of allocating permits and how to use revenues are closely linked. Modelling by the NRTEE and others suggests that allocation and revenue recycling decisions can contribute to successful carbon pricing policy in four ways:

1. **Minimize the economic costs of carbon pricing.** Allocation and revenue recycling approaches differ in their efficiency, resulting in different overall costs to carbon pricing policy. Allocation and revenue recycling can also be used to minimise negative impacts on the competitiveness of affected industries. These policies can improve the economic efficiency of carbon pricing policy, as the revenues they raise can be used to offset other distortionary taxes in the economy.

2. **Ensure fairness.** Carbon pricing policy can have a disproportionate impact on low income households, and on some regions. Allocation and revenue recycling can be used to minimise regressive impacts on households, consumers and regions.

3. **Further the abatement objectives.** Revenue-use has relatively smaller implications for environmental outcomes than for efficiency and fairness, but revenues can still be used to enhance policy effectiveness. For example, investment in research and development can lower long-run marginal abatement costs and thus lead to greater emission reductions at a given tax rate.

4. **Address competitiveness and leakage risks.** The inclusion of trade-exposed, emissions-intensive industries within a carbon pricing policy may create competitiveness and leakage risks, with implications for political acceptability and environmental effectiveness. Revenue and allocation decisions can reduce leakage and related competitiveness concerns while maintaining the incentive for firms to reduce emissions.

Trade-offs exist in meeting any and all of these objectives, in particular between cost-effectiveness and equity. Allocation and revenue-use also pose questions of political acceptability: given that some regions are more emissions-intensive than others, fiscal-federalism issues of perceived wealth transfers between regions could be controversial. Free allocation reduces the burden on regulated entities and so may reduce political resistance to regulation among emitters; on the other hand consumer and stakeholder groups will likely favour policies that reduce their costs through income tax reductions and/or rebates for energy purchases. These decisions can affect not just the acceptability of legislation as it is passed, but also the continuing support for carbon pricing policy over the long term.

5.3.2 Permit Allocation in a Cap-and-Trade System

In a cap-and-trade system, emissions permits can be allocated for free, or sold through an auction. Even if they have been allocated for free, the permits still have a value, since they *could* be sold. Free allocation leaves the value of emissions permits with the emitting entities, while auctioning appropriates the value as government revenue.

The process of allocating permits is closely linked to that of setting the cap. Clearly, if the Government of Canada's targets are to be met, the cap must be consistent with these targets, and must be reduced in each compliance period. Allocation is then the question of how that cap is apportioned between industries and firms.

Free allocation of permits

Emissions permits can be allocated to regulated entities for free. Free allocation does not change the incentive to reduce emissions, because the marginal cost of additional permits will be set by the permit trading market.

To be successful, free allocation requires good historical emissions and output data, and ongoing collection of data. Without good data, the process of apportioning emissions permits in a transparent, accountable and fair manner is difficult. Given the enormous financial value at stake, lobbying for larger allocations of free permits can be expected. A process based on poor data will effectively lead to a loosening of the cap, as it will be impossible to objectively evaluate the claims of firms or industries to a particular entitlement of emissions permits. This approach would undermine both the environmental effectiveness of the system and long-term confidence in its operation.

There are two main ways to determine how to distribute free permits;[52]

- On the basis of historical emissions.
- On the basis of historical output.

Allocating on the basis of historical emissions is more administratively straightforward than output-based allocation, assuming good historical emissions data exists for all participants in the emissions trading system. However, it is not an appropriate long-term approach, because it effectively subsidizes high-emitting activity since higher emitting industries and firms receive more permits, which have monetary value.

Output-related free allocation can be based on a number of different metrics, such as historical value-added. Output-related free allocation can improve the economic efficiency of carbon pricing policy, because it provides an incentive to increase production where this can be achieved without raising emissions.[53] Such a system could be used to reduce competitiveness concerns in trade-exposed industries.

As noted above, emissions permits have a value and could be sold. The opportunity cost of not selling the permits is typically passed on to consumers.[54] As a result, free allocation can exacerbate the regressive impacts of carbon pricing policy, since the costs are disproportionately borne by the poor as a fraction of income, while the revenues are returned to shareholders, who are generally higher-income households.[55] Free allocations have the additional

52 Other approaches are also possible, and permits can be allocated on the basis of a wide range of criteria to meet policy goals. However, emissions-based and output-based approaches have been the most common in other systems.

53 Rivers and Sawyer (2008).

54 Note that in some sectors, particularly in electricity, regulation may prevent costs from being passed-through to consumers. In such cases, free allocation can avoid economic hardship for regulated electric utilities.

55 Burtraw et al. (2008).

disadvantage of not generating revenue that could be used to reduce tax distortions elsewhere in the economy to improve the economic efficiency of a policy, address regressive distributional effects, or improve the effectiveness of the policy by supporting low-carbon technology. In Europe, the free allocation procedures led to some large windfall profits in the electricity sector, and resulted in low permit prices in the first, trial period of the ETS.[56] Finally, decisions about how free permits should be allocated are subject to intense lobbying, and the resulting politicization of the carbon market can undermine confidence in its effective operation.

Despite these disadvantages, free allocations have been used in the initial periods of both the EU ETS and RGGI, for two reasons. First, free allocations limit the cost impacts of carbon pricing as the system is established. Second, free allocations can mitigate impacts on trade-exposed sectors, whose competitiveness might otherwise suffer from the costs of purchasing permits. Both the EU ETS and RGGI are moving towards increased use of auctions, discussed below, but these examples demonstrate a potential role for free allocations as a transitional strategy in the early phases of a carbon trading system, where cost containment is a concern.

Auctioning permits

Rather than giving regulated entities emission permits for free, the permits can be sold at auction. In such a system, regulated entities bid to purchase permits to meet their own compliance obligation, or to sell to others should prices rise. The auction is designed and run by the government agency administering the trading system.

Auctioning permits raises significant revenues for the government. A major advantage of auctioning permits is that it minimizes the opportunities for political rent-seeking that arise with administratively allocated free permits. Auctioning permits will also likely be administratively simpler than issuing free permits. Although auctions do require the establishment of an institution and format to conduct auctions, free allocation requires the measurement, reporting, and verification of whichever metrics are ultimately used as the standard for distributing permits. Auctions eliminate this need for detailed information about who “deserves” permits.

As a result of these benefits, most existing and proposed cap-and-trade systems auction at least some permits. This includes the EU ETS, RGGI, the Western Climate Initiative, and Australia’s proposed Carbon Pollution Reduction Scheme, all of which require a minimum percentage of permits be auctioned.

5.3.3 Revenue Use

Revenues from carbon pricing are likely to be significant. A $100 / tonne CO_2e price in 2020 levied on 570 Mt of emissions would raise $18 billion annually.[57] As noted above, revenue can be used to improve carbon pricing policy in four ways: by minimizing the economic impacts of carbon pricing; by ensuring fairness, by furthering abatement objectives, and by minimizing competitiveness and leakage concerns.[58] To meet these objectives, there are four major ways in which revenue can be used. Revenues can be used to:

56 Ellerman and Buchner (2007).

57 Discounted to $2006 using a discount rate of 8%. This rate reflects Government of Canada standard practice on discounting, with observed discount rates published in the *Canada Gazette* ranging from 6% to 10%.

58 Note that carbon pricing will increase the costs of delivering public services at the federal, provincial and local levels, because it will increase costs of energy and transport. A portion of the revenues will likely be needed to cover these increases in government costs.

1. Cut personal income, corporate or sales taxes;
2. Provide rebates to households;
3. Provide rebates to sectors whose trade competitiveness will be affected by carbon pricing; and,
4. Fund complementary policies, including technology research, development and deployment.

The choice of revenue-use approach will depend on the policy objective being sought, as illustrated below in Table 3.

REVENUE-USE OPTIONS AND OBJECTIVES

Revenue-Use Options	Purpose	Objectives and Evaluation Criteria
Cut personal income, corporate or sales taxes	Economic efficiency	Mitigates the macroeconomic impacts of carbon pricing policy, and so improves the overall economic efficiency of the policy and promotes general economic fairness.
Provide rebates to households & consumers	Social equity	Limits the regressive impacts of carbon pricing policy on lower-income households and consumers; minimizes inequitable distributional effects of carbon pricing; improves general social fairness.
Provide free permit allocations and/or rebates to sectors whose competitiveness will be affected by carbon pricing	International competitiveness	Reduces the impacts of carbon pricing policy on the competitiveness of trade-exposed industries and firms; reduces emissions leakage, resulting in improved environmental effectiveness.
Fund technology, innovation, and R&D initiatives	Technology deployment	Lowers the long-term costs of carbon pricing policy by facilitating the development and deployment of low-carbon technologies; improves the environmental effectiveness of carbon pricing policy.

TABLE 3

Revenues can be used to cut taxes

The use of carbon pricing policy revenue to reduce taxes can reduce the overall costs of the carbon pricing policy by reducing the distorting effects of existing labour or corporate taxes. General equilibrium modelling carried out for the NRTEE was used to explore the extent to which recycling revenue as tax cuts can reduce the economic costs of carbon pricing policy. As illustrated in Figure 13, NRTEE modelling assessed three different tax cutting options, and suggests that:

- **Cuts in corporate taxes** stimulate growth more than other tax cuts.
- **Cuts in labour and payroll taxes** do not stimulate as much growth as cuts in corporate taxes, but they perform better than sales taxes.
- **Cuts in sales taxes** are not preferred. They reduce the economic efficiency of carbon pricing policy, as they depress long-term economic growth.

IMPACTS OF ALTERNATIVE REVENUE RECYCLING APPROACHES ON GDP
COMPARISON WITH BUSINESS AS USUAL SCENARIO

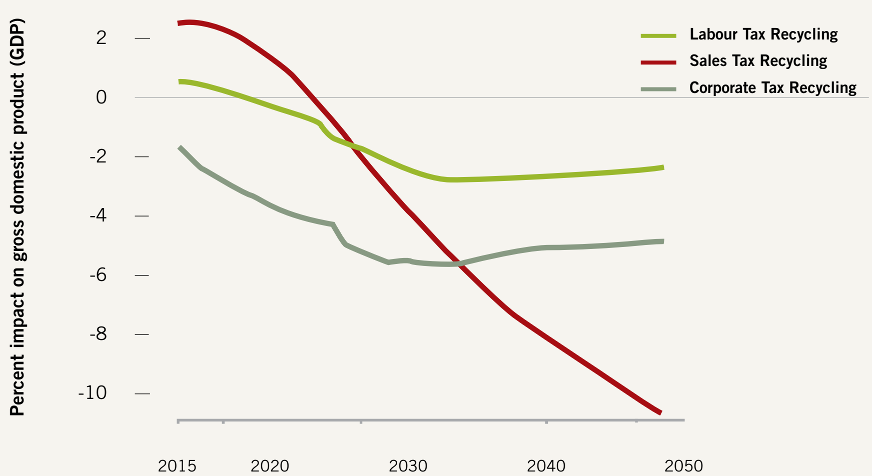

FIGURE 13

The detailed outputs from general equilibrium modelling (shown in Table 4) allow comparisons of tax-recycling strategies across a range of macroeconomic indicators. These re-affirm the patterns seen in Figure 13, corporate tax cuts limit the costs of carbon pricing policy the most, while sales tax recycling performs worst over the long term.

MACROECONOMIC IMPACTS OF DIFFERENT REVENUE RECYCLING SCENARIOS

	Reduce Corporate Tax		Reduce Sales Tax		Reduce Income Tax	
	2020	2050	2020	2050	2020	2050
GDP (%)	0.0%	-2.4%	1.9%	-10.5%	-3.3%	-4.8%
Gross output (%)	-0.3%	-3.5%	5.0%	-13.7%	-3.7%	-6.0%
Consumer welfare (%)	-0.8%	-2.0%	0.9%	-4.4%	0.2%	-3.2%
Price of foreign exchange (%)	-0.4%	-1.4%	6.0%	-4.5%	0.1%	-0.6%
Net wage rate (%)	-1.3%	-5.7%	3.3%	-14.1%	-5.0%	5.6%
Labour force size (%)	0.0%	-0.6%	0.4%	-2.0%	-1.3%	2.5%

TABLE 4

These conclusions from macroeconomic modelling suggest that corporate tax cuts are the most effective of the tax cutting options from an economic perspective.

Revenues can be used to provide relief to low-income households

Revenues can be returned as lump-sum payments to households. This approach can reverse regressive impacts of the policy and may therefore be the most equitable option.[59] However, lump-sum payments reduce the economic efficiency of the policy, as they lower long-term economic growth more than the other revenue recycling mechanisms discussed.[60] However, an alternative could be to provide only low-income households with rebates. This approach would help to reduce regressive impacts of carbon pricing, while allowing some revenue to be used for other purposes. This strategy is currently employed in BC, which has established a Low Income Climate Action Tax Credit to return revenues from the provincial carbon tax to low income households, ensuring the tax is not regressive.[61]

Revenues can be used to address competitiveness issues and leakage

Revenues can be used to provide rebates to industries and sectors whose trade competitiveness may suffer as a result of carbon pricing policy. This approach has the same effect as providing free allocations to these firms, as discussed above. Providing rebates to trade-exposed, emissions-intensive firms could increase the effectiveness of carbon

59 Burtraw et al. (2008).

60 Rivers, and Sawyer (2008).

61 For more on the distributional impacts of the BC carbon tax, see Lee and Sanger (2008).

pricing policy by reducing the leakage of emissions that occurs when industry relocates outside Canada. Addressing competitiveness impacts could also help to mitigate adverse effects of the pricing policy on the economy, which in turn would improve the overall acceptability of a policy. Determining rules for rebates however, can be both administratively complex and politically charged.

Revenues can be used to fund technology development and deployment

Using revenues to fund research and development can reduce the long-term costs of emission reductions and improve the cost-effectiveness of carbon pricing policy. Research and development spending could also support Canada's ability to compete in emerging markets for low-carbon technologies.

Revenue can also be used to fund the deployment of low carbon technologies, such as energy efficiency, renewable energy and carbon capture and storage technologies. Using revenue for such programs can increase the environmental effectiveness of a carbon price by 3-4%.[62] In terms of economic efficiency, these technology programs can perform better than lump sum payments, similarly to income tax reductions, but not as well as corporate tax reductions.[63] However, there are concerns that subsidy programs of this type often pay for technologies that would have been installed even without the subsidy. This is known as *free-ridership*, and it reduces the cost-effectiveness of such approaches.

Where technology funding is targeted at households, for example through home energy efficiency programs, it can reduce the regressive effects of carbon pricing policy. Alternatively, energy and technology programs can be used to help industries most affected by carbon pricing policy, particularly those whose trade competitiveness is eroded by carbon pricing.

Table 5 summarizes the trade-offs between various revenue recycling options based on the five main evaluation criteria.

62 Rivers, and Sawyer (2008).

63 Ibid.

TABLE 5: SUMMARY OF TRADE-OFFS FOR MAIN REVENUE RECYCLING OPTIONS

	Revenue/ allocation approach	Environmental effectiveness	Economic efficiency	Distributional impacts	Administrative feasibility	Political acceptability
Free allocation in a cap-and-trade system	Free allocation of permits on historical output	Targeted free allocations can reduce leakage	Can stimulate growth by incenting production	Value is allocated to industry and not to households	Complex; requires allocation system; high data demands; vulnerable to political rent-seeking	Acceptable with emitters; unpopular with public and consumers
	Free allocation of permits on historical emissions	Limits long-term effectiveness, as it rewards high-emitting activities	Does not stimulate growth	Has little impact on the regressive impacts; may benefit higher-emitting regions	Complex; requires allocation system; high data demands; vulnerable to political rent-seeking	Likely controversial if used long-term
Recycling of tax or auction revenues	Output-based rebates to emitters	Acts as production incentive, can limit environmental effectiveness	Performs well, as it stimulates growth	Value is allocated to industry and not to households	Complex; requires data for historical emissions for emitters	Acceptable with emitters
	Tax cuts	Tax cuts have little impact on environmental effectiveness	Corporate and labour tax cuts provide economic stimulus; sales tax cuts do not	Corporate tax cuts exacerbate the regressive impacts of carbon pricing; labour tax cuts targeted at low-income groups can reduce regressive impacts	Straightforward; requires adjustment to existing tax rates	Likely to be acceptable to pub-lic and industry; may depend on design and mes-saging
	Lump sum payments to households	Likely to have little impact on effectiveness	Reduces economic efficiency	Reduces or reverses the regressive impacts of carbon pricing	Straightforward; similar to GST rebate	Enhances public acceptability of carbon pricing
	Investments in R&D	Likely to enable deeper long-term reductions	Can lower long-term costs; efficient where it tackles market failures	Has little impact on the regressive impacts of carbon pricing	Moderately straight-forward; can use existing R&D funding systems; priority setting can be seen as picking winners	Likely to be acceptable
	Investments in energy efficiency and renewables	Likely to improve environmental effectiveness where free-ridership not a concern	Performs better than lump sum payments, not as well as corporate tax cuts or output-related rebates	Can reduce regressive impacts if targeted to low-income households	Can be complex; requires administrative structure to identify cost-effective, additional investments	Likely to be acceptable; some subsidies may be controversial

5.4 DOMESTIC OFFSETS[64]

- **Offsets have the potential to improve the cost-effectiveness of pricing policy by broadening coverage.**
- **Issues of additionality and free-ridership limit the usefulness of offsets; they should not be an integral part of a carbon pricing policy over the long-term.**

Offsetting provides participants in a cap-and-trade system, or payers of a carbon tax, with an alternative way of complying with the carbon pricing policy. Instead of buying emission permits or paying the tax, regulated firms can fund projects that reduce emissions outside the scope of the carbon pricing policy.[65]

For example, consider a company regulated under a cap-and-trade system. It must hold enough permits to cover its annual emissions, and the price of permits is determined by the emissions trading market. If market prices are high, the company could buy offsets to cover its remaining emissions, rather than buying regulated permits. Offsets might come from a farmer who has adopted new manure management approaches that reduce methane production, for example, or from any other project that reduces emissions from sources that are not covered by the carbon pricing policy.

In theory, offsets can enhance the effectiveness and efficiency of carbon pricing policy, by extending coverage to those sectors that are difficult to include within a broad policy. Examples of such sectors and emissions sources include high upstream oil and gas, agriculture and landfills. By providing an incentive for reductions from sources that would otherwise fall outside the reach of carbon pricing policy, offset programs can extend opportunities for more and/or lower-cost emission reductions.

In practice, the case for offsets may be overturned by uncertainties about the quality of offset programs.[66] For offsets to provide true low-cost emission reductions, they must meet several criteria:

- *Additionality*. The emission reductions in an offset project would not have happened in the absence of offset payments. Additionality can be difficult to show, and it is likely that some projects that would have happened in the absence of the offset program still receive payments. This is known as 'free-ridership', and it undermines the environmental effectiveness of carbon pricing policy.
- *Clear ownership*. Offsets must have a clear owner. If the reductions represented by offset credits are attributed to more than one owner, overall emissions will rise. Effective offset programs require a clear and regulated registry system to track ownership.

64 This section is informed primarily by Hall and Fischer (2008).

65 Offsets are typically used in conjunction with cap-and-trade systems, rather than carbon taxes. However, they could also be used for compliance with a carbon tax, with regulated entities buying offsets to cover their emissions rather than paying the charge.

66 Wara and Victor (2008).

- *Permanence*. Offsets arising from projects that involve the biological sequestration of carbon through afforestation or ecosystem restoration are not necessarily permanent, unlike offsets that arise from projects that prevent emissions. Biological sequestration projects are vulnerable to risks such as fire and storm damage that will result in the release of sequestered carbon back into the atmosphere. Mechanisms must be established to deal with these risks, and to ensure permanence in emission reductions.

Where these criteria are not met, the use of offsets will reduce the economic efficiency and environmental effectiveness of the carbon pricing policy. The difficulties of establishing additionality are significant. Ensuring the quality of offsets creates a burden on government agencies to establish and enforce offset rules. In the near-term regulators cannot escape the fact that offsets carry a trade-off between low-cost reductions and policy certainty. At their worst, poorly-functioning offset systems can create "hot air" credits that do not represent real and additional reductions. The presence of such offsets would reduce the effectiveness of a carbon trading policy by reducing the market price of emissions permits, and thus the market signal to cut emissions.

In terms of political acceptability, offsets can be a politically attractive way of keeping costs down in a cap-and-trade system with uncertain prices. On the other hand, they may be seen as a weakening of carbon pricing policy, especially in the long term, and as an inexpensive loophole in regulation for carbon-emitting industries.

5.4.1 Offset Policy Options

If offsets are included in carbon pricing policy, their use will be constrained, either implicitly through the quality-assurance process, or by explicit rules that limit the use of offsets to meet compliance targets. A variety of policy mechanisms can be used to control the number or type of offset projects allowed into a pricing program, including quantitative limits, set asides, trading ratios, and rental credits.[67]

A range of options is available for the design of an offset program, which balance the potential benefits of increased opportunities for the market to find least-cost reductions with the dangers of diminished environmental integrity and cumbersome administrative burden:

- ***Offsets not allowed.*** Policy-makers may determine that the difficulties of ensuring quality offsets are too great, and that offsets should not be allowed as a compliance mechanism. Where this is the case, other forms of regulation and policy should be used to deal with emissions sources outside the regulated scope, such as landfills and agriculture.

- ***Only certain types of offset allowed.*** By establishing a list of eligible offset project types, in which procedures for determining additionality are well developed, policy-makers can get some of the benefits of offsets while limiting the risks of low-quality offsets. The RGGI program has established a list of eligible project types.

67 Hall (2007).

- ***Offsets allowed, but their use limited.*** The EU ETS allows offsets but limits their use, allowing firms to meet only a portion of their compliance obligations through the use of offsets. This restriction ensures that at least a portion of emission reductions occur within the regulated sectors.

- ***Offsets allowed in the short term, phased out over time.*** Offsets can help contain costs during the initial stages of carbon pricing. As a result, they may be attractive in the short term, even if their long-term use makes it difficult to guarantee that targets will be met.

- ***All offset types allowed, rigorous process to ensure quality.*** Policy-makers can allow offsets from any project type, and establish a rigorous procedure for offset validation, verification and monitoring, to ensure that the offset program does not undermine environmental effectiveness. The Clean Development Mechanism of the Kyoto Protocol, an international offset mechanism, uses this approach, as does the *Turning the Corner* plan of the Government of Canada[68].

A final choice in establishing an offset program involves the location of offset projects: domestic or international? Domestic offsets may be easier to monitor, and may provide higher confidence in environmental integrity. They also ensure that carbon pricing revenues stay within Canada. International offsets are likely to be cheaper, since lower-cost emission reductions are available outside Canada. The Clean Development Mechanism of the Kyoto Protocol is an example of an international offset mechanism for which the administrative architecture of validation, verification and monitoring of offset projects has already been established. The disadvantage of such a system is that large capital flows out of Canada may not be politically acceptable. This issue is further discussed in the broader context of international abatement opportunities.

5.4.2 Summary and Conclusions for Offsets

High-quality offsets can enhance the economic efficiency of carbon pricing policy by extending the reach of pricing beyond regulated sectors. However, achieving high-quality offsets is difficult, and policy-makers must weigh the risks of low-quality offsets in considering whether to allow their use, and how to design an offset program. In particular:

- Offset programs tend to diminish environmental effectiveness, because of free-ridership and the difficulties of ensuring additionality; and

- If they are to maintain environmental effectiveness, offset programs become cumbersome and administratively complex;

Given the existence of an offset market already in Canada, there may be a case for limited use of offsets in the short term. However, complementary regulations in many cases are a better approach than offsets to dealing with domestic emissions outside the scope of carbon pricing policies. International offsets may represent cost-effective emission reductions; however, the problems of additionality and free-ridership mean that their use should be limited.

68 Although note that the *Turning the Corner* plan excludes the use of offsets arising from forest sink projects.

5.5 BORDER ADJUSTMENTS[69]

- **Border adjustments, such as import tariffs or export subsidies, could help address competitiveness issues for some sectors and reduce leakage; however, this comes at a significant cost to the Canadian economy, and other mechanisms are better suited to addressing competitiveness and leakage concerns**
- **Border adjustments become less important as more of Canada's trading partners implement comparable carbon pricing policies.**
- **Border adjustments may conflict with WTO or NAFTA obligations, requiring caution about their establishment.**

Border adjustments are a mechanism to correct for trade distortions that may occur as a result of carbon pricing policy. For example, if Canada imposed a significant carbon price on domestic producers, imports could be expected to rise, as foreign producers who are not subject to a Canadian carbon price gain a competitive advantage. These trade effects weaken the policy, by potentially leading to greater production from high-emitting industries outside Canada (known as *leakage*), and by imposing costs on Canada's economy. These potential competitiveness issues arise if Canada's trading partners adopt carbon pricing policies of lower stringency, as discussed in more detail in Section 8.3. These issues can also be dealt with through other mechanisms, such as output-related rebates or allocations for all emitters, but border adjustments deserve special attention given their prominence in public debate about carbon pricing policy.

There are two basic approaches to border adjustments:

1. Import adjustments require imported goods to pay for their unpriced emissions costs. This might mean paying a carbon tax in the form of an import carbon tariff, or if a cap-and-trade system is in place, a border adjustment could require importers to purchase emissions permits.

2. Export adjustments relieve exports of their expected emissions costs by providing export rebates.

While import adjustments level the playing field between domestic production and imports, export rebates level the playing field between Canadian exports and production abroad.

69 Analysis in this section is informed by: Hall and Fischer (2008); Rivers (2008); and The Delphi Group (2008).

5.5.1 Evaluation of Border Adjustments

The potential economic and environmental benefits of border adjustment mechanisms, both import tariffs and export rebates, were evaluated using the dynamic computable general equilibrium D-GEEM model. Table 6 shows the forecasted effects of border adjustments relative to the business as usual reference case. For all scenarios, a representative price of $100/tonne CO_2e is applied to GHG emissions, with revenue from the policy allocated to reducing income taxes. In the “Import Tariff” scenario the size of the tariff in the model is automatically adjusted at a commodity level so that imports are prevented from increasing in volume by more than 10 percent as a result of carbon pricing. In the “Export Rebate” scenario, a subsidy is applied in the model, with the size of the subsidy adjusted at a commodity level so that exports are prevented from declining in volume by more than 10 percent as a result of carbon pricing.

ECONOMIC IMPLICATIONS OF BORDER ADJUSTMENT MECHANISMS RELATIVE TO BUSINESS AS USUAL (ASSUMES $100 / TONNE CO_2e CARBON PRICE)

	Year	No Border Adjustments	Import Tariff	Export Rebate
Consumer welfare	2020	-0.96%	-0.89%	-0.59%
	2050	-0.86%	0.83%	-0.47%
Gross Domestic Product	2020	-1.75%	-1.83%	-0.62%
	2050	-1.23%	-5.44%	-0.40%
Gross Output	2020	-2.03%	-2.05%	-1.80%
	2050	-1.74%	-6.36%	-1.63%
Net wage rate	2020	7.89%	8.66%	5.80%
	2050	8.58%	-6.36%	6.26%
Return on new capital investments	2020	-1.18%	-1.17%	-1.21%
	2050	-1.34%	-1.34%	-1.33%
Labour force size	2020	2.13%	2.27%	1.55%
	2050	2.24%	-1.96%	1.61%
Total trade	2020	-0.69%	-0.97%	-0.63%
	2050	-0.64%	-6.61%	-0.66%
Price of foreign exchange	2020	0.21%	0.16%	-0.51%
	2050	-0.07%	-0.07%	-0.64%
Greenhouse gas emissions	2020	-33.24%	-33.11%	-29.09%
	2050	-38.32%	-40.33%	-33.73%

TABLE 6

NRTEE modelling supports the idea that import tariffs are thought to be effective at preventing leakage, and therefore maintain the environmental effectiveness of carbon pricing policy. Analysis using the D-GEEM model, as shown in Table 6, shows that emission reductions in 2050 are forecast to be greater under the import tariff scenario than if no border adjustments are made. However, the modelling results suggest that import tariffs strongly reduce the cost-effectiveness of carbon pricing policy, by worsening the negative effects of climate policy on GDP and Gross Output. The forecast makes intuitive sense: for a trade-centric economy like Canada's, barriers to trade are likely to reduce economic output.

Export rebates perform better than import tariffs in terms of reducing the negative economic impacts of carbon pricing in the model forecast. Table 6 shows slight improvements in economic performance of carbon pricing policy with export rebates, for several metrics of economic performance.[70] However, export rebates are less environmentally effective than import tariffs, because they do not protect the domestic market from imports that have not been exposed to carbon pricing, and therefore leakage is still a risk.

In addition to their economic effects, these policies amount to trade tariffs and subsidies and may be constrained by WTO and NAFTA obligations. Legal scholars have differing opinions over whether border adjustments would be accepted in a legal dispute, and trade disputes are possible. Furthermore, both types of border adjustment are likely to be administratively complex.[71] Calculating the emissions embodied in imports is difficult, from defining the product category and gathering emissions data to accounting for trade in intermediate goods and component parts. Determining appropriate rebates for exports is also challenging. Significant caution should be taken in designing these measures if Canada decides to implement them.

5.5.2 Summary and Conclusions on Border Adjustments

The evidence and analysis indicates that, while border adjustments could reduce impacts of climate policy on leakage and on threats to specific industries, their broader macroeconomic effects could be adverse, particularly in the case of import tariffs. Export rebates may result in smaller declines in economic growth, though they may be less effective in preventing leakage. Other approaches to preventing leakage and avoiding threats to the competitiveness of specific sectors should be considered, including linkage with other cap-and-trade systems and free allocations.

70 This finding is consistent with other recent research on the effect of border adjustments on the Canadian economy: Fischer and Fox (2008).

71 Pauwelyn (2007).

6.0
INTERNATIONAL ABATEMENT OPPORTUNITIES

- **International abatement opportunities can reduce the costs of achieving Canada's emission reduction targets. They may also help align carbon prices in Canada with carbon prices internationally, partially mitigating competitiveness issues.**

Climate change is a global issue, and the geographic location of emission reductions is irrelevant. Therefore, a strategy that complements domestic action with real and verifiable reductions from international sources with relatively lower marginal abatement costs will help meet the long-term targets more cost-effectively.

The NRTEE's research indicates that delivering on the cost-effectiveness goal will require balancing the cost of domestic action with low-cost carbon abatement opportunities available internationally. Figure 14 illustrates domestic marginal abatement costs for emission reductions corresponding to the target levels contemplated by the federal government. At reductions beyond 45% below 2006 levels, the cost of reductions rises at greater rate than the quantity of emissions reduced, and each tonne reduced becomes more expensive.

An important additional design issue is the interaction between a Canadian pricing system and other systems internationally. Three main options could play a role in a Canadian carbon pricing policy: first, linkages with other systems could enable Canadian emitters to purchase credits from other international permit trading systems; second, policy could allow firms to purchase international offsets; and third, the Canadian government could itself purchase emission reduction credits to ensure targets are achieved. Purchasing emission reductions credits on the international market can significantly reduce the required emission price in Canada, thus reducing costs to Canadian firms and consumers of achieving targets. International linkages can also align prices in Canada with emissions prices internationally.

THE RAPIDLY RISING DOMESTIC COSTS OF ABATEMENT

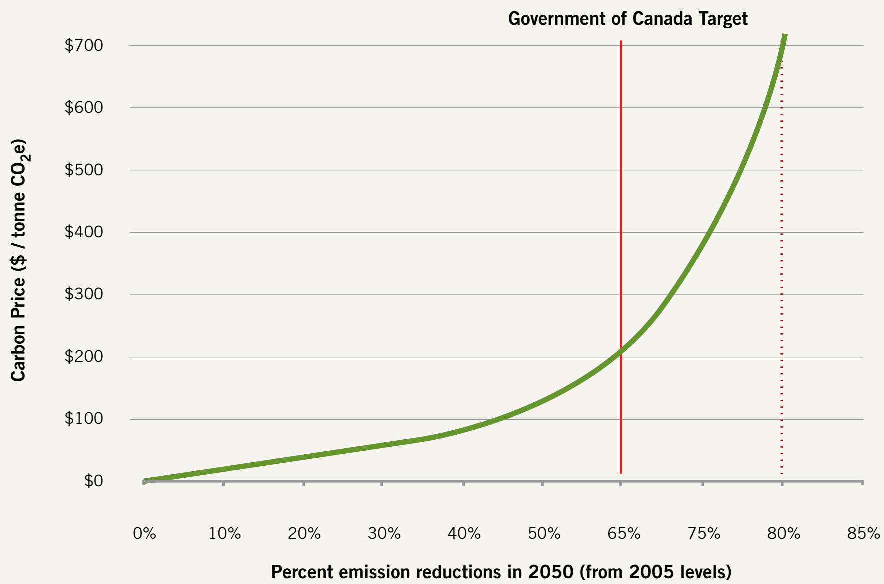

FIGURE 14

6.1 LINKAGES WITH OTHER SYSTEMS[72]

- **Linking can enable international emissions trading, reducing costs and aligning carbon prices internationally. Linkages with trading partners (particularly the United States) could reduce competitiveness risks.**
- **Aligning some design elements facilitates linkages with carbon pricing systems in other jurisdictions; the currently proposed Canadian policy framework complicates linking, though it does encourage international offsets.**
- **Linkages reduce the ability of governments to influence the price of emissions and could make adaptive policy more challenging.**
- **In the short term, an un-linked Canadian system would allow for more flexible policy design and Canada to more easily adapt its approach to carbon pricing over time. In the long term, linkages could help enable a global emission reductions policy framework.**

Defining linkages between jurisdictions is an important design decision for a carbon pricing policy regime. Linkages can connect tradable permit systems at the regional, national, or international levels. The implications for linking are similar no matter the level of trading system to be linked. Linking is sometimes considered as a means to containing costs in a cap-and-trade system; however, linkages only lower the market price of carbon if the linked system has more low-cost emission reduction opportunities. Similarly, linking can provide greater price certainty by improving the liquidity of a tradable permits market. A market increased in size through linkages will have smaller fluctuations in the market price of carbon due to short-run shifts in supply and demand. Finally, linking could also be considered an approach to addressing competitiveness issues; since linked systems converge to a common price of carbon, linkages between trading partners eliminates systemic competitive disadvantage.

Linkage with other cap-and-trade systems would enable Canadian firms to purchase or sell permits to, or from, the linked system. In a two-way linkage, permits can flow in either direction between two or more emissions trading systems. If the two-way linkage is unrestricted, it will eventually result in the convergence of market permit prices between the two systems. A two-way linkage could therefore result in either increases or decreases in emission permit prices in Canada.[73]

72 Analysis in this section is drawn from Hall and Fischer (2008) and from Jaffe and Stavins (2008).

73 Note that two systems can become indirectly linked if each is directly linked with a common third system. Through trade with the common third system, supply and demand for allocations in one system can affect prices in the other system, even though they are not directly linked.

Linkages could also be restricted in order to ensure that a substantial number of reductions would occur within Canada; government could limit the quantity of permits from another system. If permits from different systems represented different amounts of emissions, government might also apply an "exchange rate" to permits from other systems. Finally, governments could impose conditions on accepting permits depending on the emission reduction measure.

A carbon tax system could also be linked to a tradable permit system by setting the price of carbon to the market price of tradable permits in the linked system. A linkage could be established between tradable permit systems and a carbon tax system by allowing emission reduction permits from the trading system to offset carbon liabilities within the tax system. That is, the emissions an emitter would pay taxes on would be reduced by the amount of emissions attributed to a purchased permit. This kind of linkage would not change the domestic price of carbon, set by the carbon tax.

6.1.1 Implications of Linkages

Linkages with other carbon pricing regimes have important trade-offs between different policy objectives. Linkages can have different implications for the effectiveness, efficiency, distribution, administrative feasibility, and political acceptability of a carbon pricing policy. Note that while implications of linking depend on the type of link as well as the nature of the carbon pricing systems being linked, two-way linkages between cap-and-trade systems is the primary focus of this discussion.

The implications of two-way linkages for a policy's effectiveness in reducing greenhouse gas emissions depend on the nature of systems being linked. Linkages lead to a *de facto* harmonization of cost containment mechanisms such as banking, borrowing and price ceiling provisions. For example, if a price ceiling exists in one part of a linked system, permits can be purchased at the price ceiling and sold through the linked system. Cost containment mechanisms reduce uncertainty in the costs of achieving emission reductions, but increase uncertainty as to the total amount of emissions to be reduced in Canada. Linkages can also increase uncertainty as to the amount of emissions reduced globally if other systems have weaker standards for ensuring the quality of emission reductions. Thus linkages between a Canadian cap-and-trade system without cost containment mechanisms and a system with these mechanisms would decrease the overall effectiveness of the policy.

On the other hand, in the long run, linkages can help establish a global framework for emission reductions and facilitate a move toward an internationally unified carbon price. International reductions have the same effect on climate as reductions within Canada's borders. Linked emissions trading markets could therefore provide such a policy framework. Further, Canada's participation could improve the liquidity of an international market, increasing international reductions.

In linked systems, abatement effort will be focused in the regions and sectors that offer the lowest cost reductions. The regions and sectors with the lowest cost opportunities may be outside Canada. Where this is the case, prices will fall, and technological deployment in Canada may be delayed, as the incentives for innovation and deployment will be reduced.[74]

Linkages could affect the political acceptability of carbon pricing policy in both positive and negative ways by altering the distributional impacts of the policy. If the prospective linkage partner system had a lower price of carbon, Canadian firms would have access to lower-cost reductions and thus lower costs of abatement. However, as a relatively small economy, Canada would likely be a “price-taker” if linked with larger systems such as the EU ETS or a forthcoming U.S. cap-and-trade system. The linkage could therefore result in either an increase or a decrease in the price of emissions: some buyers might become sellers or vice versa, and distributional impacts could shift. Linkages might reduce political acceptability because they could lead to flows of capital out of Canada. This issue is particularly critical if the linked system has a price ceiling; in that case, Canadian emitters could effectively be purchasing emission permits from a foreign government.

Linkages can complicate the initial administration of a carbon pricing policy. They require cooperation between the linked jurisdictions on some key policy design elements such as cost containment measures. In a multilateral linkage with multiple linked systems, complexity increases with the number of participants. The EU ETS systems is one example of a successful multilateral system. If policy differences do exist, an “exchange rate” may be required to ensure emission permits from one jurisdiction can be traded as equivalents in another. Finally, given the required cooperation between linked jurisdictions, linkages would reduce Canada’s ability to adapt and adjust its own domestic carbon pricing policy over time.

6.1.2 Linkages with the United States

For Canada, linkage with a U.S. system would be more significant than any other international linkage. Given Canada’s close economic ties with the United States, many NRTEE stakeholders suggested that Canada’s climate policy must align and the two systems must be linked. An assessment of the implications of such a linkage can therefore usefully inform design of a Canadian carbon pricing policy in several dimensions.

A linked North American system has several positive implications for Canada. First, it would reduce potential impacts on competitiveness. Given that the United States is Canada’s major trading partner, a harmonized carbon price resulting from the linked system would reduce competitive disadvantages for Canadian firms that could result from variation in the price of carbon across the border. Second, linking U.S. and Canadian systems could also substantially improve the liquidity of a carbon market. Trade of emissions proceeds more smoothly and market prices are more stable if there is a large supply and demand for tradable permits. Given that Canada is a relatively small market, linking with the US would result in greater liquidity.

74 Kruger et al. (2007).

Linking with the United States could have problematic implications as well. The large size of the U.S. market relative to the Canadian implies that the Canadian government and market would have substantially reduced influence over the price of emissions. A two-way linkage results in the convergence of market prices over time. Since the American market is large, substantial low-cost opportunities for emission reductions exist.[75] As a result of price convergence, the American market would experience small changes while the Canadian market would experience more significant ones, relatively speaking. The Canadian market would essentially be a "price-taker." Canadian policy makers would thus be less able to set or influence the price of carbon. While linking would not affect the total quantity of emissions reduced, a significant drop in the price of emissions could decrease investment in new low-carbon technologies inside Canada and may have implications for the cost of future reductions.[76]

6.1.3 Summary and Key Conclusions for International Linkages

Linking with the United States is the linkage that matters most for a Canadian carbon pricing regime, given the extensive trade between the two nations. The issue of a possible North American emissions trading system is thus worth addressing directly, especially given the Canadian government's stated desire to implement such a system. A linkage between Canada and the United States could reduce competitiveness risks and increase the liquidity of a Canadian emissions trading market, smoothing out some market price fluctuations. Given that linkage likely requires some alignment of design instruments, Canada must be cognizant of U.S. pricing policy and seek to influence it favourably.

Following from the points above, Canada could consider two-way linkages with the United States (and with other international systems such as the EU ETS) as an eventual goal. Eventual alignment with international systems could help facilitate a more unified global price, thus enabling more efficient emission reductions globally. As stringency of a carbon pricing policy will likely increase over time, competitiveness issues will also be much more significant in the long term and would be partially mitigated through linkage. On the other hand, an un-linked Canadian system would allow initial flexibility for adopting domestic cost containment mechanisms such as price ceilings or banking, and would allow Canada to more easily adapt its approach to carbon pricing over time. This approach would also allow Canada to implement a carbon pricing policy immediately without having to wait for the United States to finalize its policy design and implementation. A staged approach, in which a unified Canadian system is first developed and then linked internationally, could be a viable option to meet the eventual goal.

75 In economics terms, the American marginal abatement cost curve is flatter than the Canadian curve.
76 Kruger et al. (2007).

6.2 PURCHASING INTERNATIONAL CREDITS

- **Allowing emitters to purchase international offsets or the federal government to purchase international credits could contain costs while ensuring 2020 and 2050 emission reduction targets are achieved.**

- **Issues of additionality and ensuring the quality of international offset credits are important in determining how allowing international credit purchases might impact the environmental effectiveness of the carbon pricing policy.**

Other approaches to international purchases can also lower the overall costs of achieving Canada's emission reduction targets. International offset credits, such as the Clean Development Mechanism (CDM) and Joint Implementation (JI) mechanisms from the Kyoto Protocol, could be available at lower costs than domestic reductions. Including purchases of these credits as part of a carbon pricing policy – whether by allowing firms to purchase credits or through direct purchases by the Government – could reduce the costs of carbon pricing policy.

6.2.1 Purchases of International Offsets

Policy could provide additional cost containment by allowing firms to achieve their emission caps through purchase of international offsets. Allowing these offsets would reduce the market price of emissions within Canada, as long as international offsets remained less expensive. If international prices were higher than the Canadian market price, allowing international credit purchase would have no effect on the price in Canada, as Canadian firms would not purchase higher price permits from elsewhere.

Allowing international credit purchases by firms is very similar to allowing domestic offsets (see Section 5.4), and has similar trade-offs. If the international offset is credible (that is, represents a real reduction that would not have occurred in any case), international offsets can increase economic efficiency without affecting environmental effectiveness. However, international offsets can be politically challenging because they represent investments and flows of wealth out of Canada.

6.2.2 Government Purchases of International Credits

Alternatively, the Government of Canada could directly purchase international emission reduction credits as a way of balancing price and quantity certainty. If cost containment mechanisms such as a price ceiling are triggered, Canada could reduce its costs of abatement, but at the expense of missing its 2020 and 2050 emission reduction targets. The federal government could commit to making up any shortfalls between its targets and its actual emissions reduced. Such a commitment would ensure the environmental goals of the policy were achieved while mitigating cost impacts on firms and households.

6.3 IMPLICATIONS OF LINKAGES AND INTERNATIONAL PURCHASES[77]

- **A scenario allowing access to international purchases could reduce the required carbon price in Canada.**

Purchasing permits internationally, whether by government or by firms, would reduce the amount of abatement required domestically to comply with the government's reduction targets. Purchasing international carbon credits might be appealing especially if abatement costs domestically (to reach a given target) significantly exceed the price of international permits. However, if Canada purchased a significant amount of permits internationally, there could be important repercussions on Canada's terms of trade. For example, purchasing 200 million tonnes of emission permits annually at a cost of $25/tonne CO_2e would cost $5 billion annually. Canada's balance of international trade since 2002 has fluctuated from $48 to $65 billion, so this volume of permit purchases could erode Canada's trade position by as much as 10 percent, with likely impacts on exchange rates and domestic consumption.[78]

Analysis of the impact and implications of allowing international purchases to help satisfy Canadian climate change targets requires assumptions about the future prices of those permits and credits. Such assumptions are highly uncertain. For an analysis of impacts using the D-GEEM model, global cost of mitigation estimates from the Intergovernmental Panel on Climate Change were used, which show carbon prices rising from between 20 and 80 US$/tonne CO_2e by 2030 to between 30 and 155 US$/tonne CO_2e by 2050[79]. To reflect the uncertainty in these projections, three scenarios are conducted in which the international carbon permit price varies from the low end of these forecasts to the high end, assuming a *fast and deep* pricing policy.

The results of the D-GEEM analysis suggest that investing in international emission permits reduces the negative impact on Canada's economic output and consumer welfare than would otherwise be the case through domestic action alone. As shown in Table 7, these values reach over $18 billion annually in some scenarios. Despite the high

77 Analysis in this section is based on Rivers (2008).
78 Statistics Canada (2008).
79 IPCC (2007a).

apparent cost of the permits, modeling results suggest that enabling such purchases allows for Canada's reduction targets to be achieved with a much smaller impact on Canada's economic output and consumer welfare. For example, at the medium international permit price, impacts on consumer welfare are reduced roughly in half from -3.19% to -1.61% in 2050. Similarly, impacts on gross domestic product are reduced from -4.83% to -2.28%. These impacts are mitigated because the international purchases can help to avoid some of the most costly domestic emission abatement opportunities.

FORECASTED ECONOMIC IMPLICATIONS OF INCLUDING INTERNATIONAL EMISSION REDUCTIONS WITH *FAST AND DEEP* PRICING POLICY

	Year	No international credits	Low international price	Medium international price	High international price
Consumer welfare	2020	0.15%	0.14%	-0.35%	-0.40%
	2050	-3.19%	-0.65%	-1.61%	-2.19%
Gross Domestic Product	2020	-3.26%	-0.29%	-1.10%	-1.74%
	2050	-4.83%	-0.85%	-2.28%	-3.68%
Gross Output	2020	-3.71%	-0.31%	-1.19%	-1.92%
	2050	-6.02%	-1.01%	-2.70%	-4.42%
Net wage rate	2020	-4.98%	0.40%	-0.74%	-1.42%
	2050	5.64%	1.26%	1.74%	1.45%
Return on new capital investment	2020	-3.04%	-0.30%	-0.91%	-1.52%
	2050	-3.02%	-0.70%	-1.66%	-2.49%
Labour force size	2020	-1.31%	0.14%	-0.05%	-0.20%
	2050	2.48%	0.54%	1.02%	1.17%
Total trade	2020	-3.25%	-0.12%	-0.79%	-1.38%
	2050	-3.94%	-0.42%	-1.41%	-2.77%
Price of foreign exchange	2020	0.05%-	0.07%	0.13%-	0.14%-
	2050	0.59%	0.02%	0.01%	0.19%
Annual expenditure on permits (billions, $2006)	2020	-	4.60	6.40	5.67
	2050	-	12.81	20.52	18.78

TABLE 7

Economic modelling using CIMS supports this analysis. As shown in Table 8 and Figure 15, the analysis suggests that allowing international permit purchases could substantially reduce the costs of abatement for Canada. A scenario that included international permits as an approach to meeting reduction targets could reduce the required carbon price substantially, by 20% or greater. Such reductions could thus improve economic efficiency of a carbon pricing policy by reducing costs, but could also improve the political acceptability of pricing policy. However, relying on more international emission reductions may reduce the role of low-carbon technological investment within Canada, potentially making additional, future domestic reductions more challenging.

REQUIRED EMISSIONS PRICES FOR ACHIEVING 2020 AND 2050 EMISSION REDUCTION TARGETS – FULLY DOMESTIC VS. INCLUDING INTERNATIONAL PURCHASES

	2011-2015	2016-2020	2021-2025	2026-2050
Fully domestic reductions	$18	$170	$250	$250
Including international purchases	$18	$100	$200	$200
Difference	0	-$70	-$50	-$50

TABLE 8

COST-EFFECTIVENESS COMPARISON BETWEEN DOMESTIC-ALONE VS. INTERNATIONAL TRADING AND PURCHASES

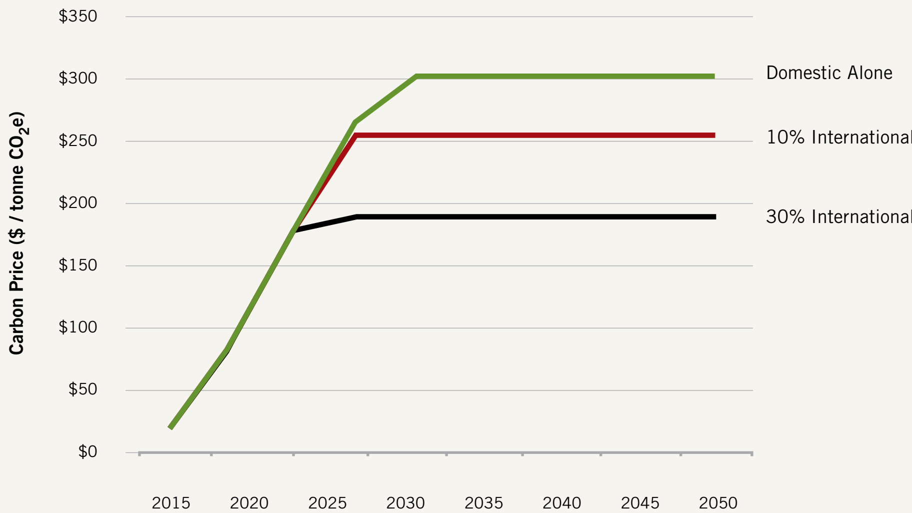

FIGURE 15

Three scenarios explore how overall compliance costs could be contained: a domestic-alone strategy, a strategy allowing 10% of the government's target to be traded internationally, and a strategy allowing 30% of the government's target to be traded internationally. International carbon purchases could likely be obtained at prices lower than Canadian domestic costs. Therefore, compliance costs for the same target and the required domestic carbon price decline the more international trading is allowed.

7.0 COMPLEMENTARY REGULATIONS AND TECHNOLOGY POLICIES

- **Complementary regulations and technology policies are essential to cost-effectively achieving Canada's emission reduction targets by supporting technology development and deployment, by ensuring broad coverage of the carbon pricing policy, and by communicating the importance of the policy to the public.**

Carbon pricing policy is the most effective way to reach the government's emission reduction targets. Ultimately, the biggest driver of technological adoption and change is the carbon price, which determines the demand for clean energy technologies. However, there are barriers to the adoption of new technologies that can reduce the effectiveness of carbon pricing policy, and complementary technology policies may be necessary to ensure cost-effective emission reductions. Research indicates that some sector emissions are also not easily addressed by a carbon price. To fully unify policy across emissions, complementary regulations are required in these sectors, including agriculture, buildings and upstream oil and gas.

Complementary policy measures can serve several purposes. First, addressing key barriers to innovation and deployment of technology can enable the carbon pricing policy to efficiently facilitate the technological transformation of the energy system in Canada. Second, addressing market coverage issues associated with upstream oil and gas, pipeline emissions, landfill gas, and agriculture can broaden coverage of the carbon pricing policy, improving its overall cost-effectiveness and reducing emissions. Third, addressing distortionary subsidies can ensure that the carbon pricing policy actually does impose a unified price signal. Finally, marketing, information, and education policies can communicate the importance of the policy to the public, helping to ensure it is politically acceptable and will be long-lasting.

7.1 COMPLEMENTARY TECHNOLOGY POLICY: ADDRESSING BARRIERS[80]

- **Technology policy is a complement to carbon pricing policy. While carbon pricing is the policy instrument to promote low-carbon technologies, additional steps to address barriers to technology innovation and deployment are required, especially given the importance of technology to achieving emission reduction targets.**
- **Broad, non-prescriptive support to innovation and technology research, development and deployment should complement the economy-wide price signal.**
- **Specific technologies and efforts can be supported in order to address market failure. Policy approaches include standards, information programs, and financing support.**
- **There is also a need to examine the impact of distortionary subsidies and how they affect a carbon price signal on technology development and deployment in the market place.**

The penetration of low-carbon technologies into the Canadian market is essential for Canada to meet its emission reduction targets for 2020 and 2050. To encourage investment in technology and the resulting transformation of the Canadian energy system, policy must transmit the required *fast and deep* price signal to the economy. A carbon pricing policy is the most important single measure to drive the adoption of carbon abatement technology in Canada. However, a carbon price alone is likely insufficient to drive the required technological change.[81] Given the importance of technology and the scope and scale of the required transformation, barriers to the deployment of technology represent an additional issue that should be addressed through the design and implementation of complementary policies.

Addressing market failures can improve both the effectiveness and economic efficiency of the carbon pricing policy by ensuring the price signal has full impact on the technology choices of firms and households. As set out below, however, not all barriers are market failures, and using complementary technology policy to address additional barriers can reduce the cost-effectiveness of a carbon pricing policy. Further, being technology prescriptive, or trying to "choose winners" through policy will likely increase the overall costs of carbon pricing policy. In this section, broad, non-prescriptive approaches are first described, followed by more specific, targeted options.

80 This section is informed by EcoRessources (2008); Fischer (2008); and The Delphi Group (2008).

81 Fischer and Newell (2008); NRTEE (2007).

7.1.1 Broad Policies to Address Barriers to Technological Development and Deployment

Some barriers can be addressed by broad, non-prescriptive, and cost-effective policy.

Supporting research

The social value of research and innovation often surpasses what the innovators themselves can appropriate. These knowledge *spillovers* represent a kind of market failure, since by receiving only a fraction of the benefits, innovators have only a fraction of the incentive to engage in the R&D.[82] Studies of commercial innovations suggest that, on average, less than half of the gains to R&D return to the originator, although appropriation rates vary considerably over different types of innovations. Basic research, in particular, is an excellent candidate for government support, as the commercial applications are often distant and unknown. However, it is important to remember that spillovers are not the exclusive domain of clean energy technologies, and that excessive policy support for clean energy research could risk crowding out useful innovation in other sectors.

Removing distortions from existing regulations and institutions

Inefficient regulations can impede technical progress. Unnecessary legal and regulatory barriers that favour incumbents should be removed to allow for better competition. Licensing, regulations, and interconnection procedures must be clear, not overly burdensome, and coordinated across jurisdictions, while allowing for appropriate oversight to balance potential trade-offs in economic and environmental costs. Often, streamlining regulations need not be technology-specific and can benefit all participants, not just new green entrants.

New technologies may also require explicit new policies to create regulatory certainty. For example, the long-term impacts of large-scale carbon capture and storage (CCS) remain uncertain, and relevant regulations, guidelines, and industry protocols are needed to assign liability and develop good practices.[83]

82 Studies of commercial innovations suggest that, on average, less than half of the gains to R&D return to the originator, although appropriation rates vary considerably over different types of innovations. See, for example, Jones & Williams (1998).

83 For a discussion of these issues in the Canadian context, see Kennedy (2008).

7.1.2 More Specific Policies to Address Barriers to Technological Development and Deployment

Some barriers may require targeted policy measures.

Information

For markets to function, they require not only good property rights and competition, but also information. Some product characteristics are easily observable, but others—like energy consumption rates—are not available or credible without government intervention to make them more visible. Improving the availability and visibility of information, product-specific labels, credible reporting standards, and educational campaigns can allow better consumer and firm decision-making at lower costs.

Standards

Still, perfect information may not be enough. Consumer uncertainty about energy prices and the quality and reliability of the new technologies being offered to them can contribute to seemingly myopic behaviour. Poor choices can also arise when those making decisions about the energy-using appliances and building features are not the same people as those using or paying for the energy, such as in landlord-tenant relationships. Coping with short payback horizons and principal-agent problems can require service-specific policy interventions, such as energy efficiency standards, fuel-economy standards, and building codes. While these standards are generally informed by technological options, they need not be prescriptive of particular ways to meet the standards. Indeed, they should be designed so as to allow cost-effective alternatives and ongoing incentives for improvement.

Financing

Risk and payback horizons also influence investment decisions; if the private perceptions of these factors do not align with the public ones, then policies may be needed to assist financing and manage risks for publicly desirable projects. Technologies for which capital costs are very large are more likely to need preferential financing or guarantees to reduce private investment risks. Ultimately, greater certainty about the carbon pricing policy will also help to reduce risks and raise returns for low-carbon technologies, and financing interventions should focus on narrowing the discrepancy between private and public payback horizons.

Scale economies

Economies of scale are an issue for many new technologies. Until enough units have penetrated the market, production costs are high and support services are scarce. Policies to address this barrier can legitimately help some new technologies gain acceptance and get off the ground, but they should be careful to avoid extended support for uneconomic technologies. An example is hybrid vehicle tax credits in the U.S., which phase out after a certain number of models are sold.

Networks and infrastructure

Some technological options require new infrastructure and support networks in order to function. However, private actors are reluctant to take on activities that supply public goods, and most would prefer to wait for someone else to do it. The resulting network externalities are one important cause of "path dependence" or "technological lock-in," and public intervention may be required to change paths. Important examples lie in the distribution of fuels for transport: biofuels, hydrogen, compressed natural gas, or plug-in electric would require new fuel (or battery) distribution and storage equipment, as well as new vehicle engines. Here it may be costly to allow multiple new options and thereby difficult to avoid picking a winner, so the decision must be made deliberately. For costly network infrastructure investments, there is an option value to waiting for more information, in order to be confident in betting on the technology.

Some infrastructure investments for carbon-free generation technologies may also have network externalities. For example, real-time energy metering can allow for time-of-use pricing to better manage electricity demand. Direct current lines in buildings could allow solar cells to power many devices without inverters. Upgrades to "smart grid" transmission technologies can facilitate the incorporation of distributed generation and intermittent renewable energy sources. However, many infrastructure investments—like transmission lines for remote renewable energy sources—are better viewed as an additional cost to developing more capacity in those resources, although there may be other barriers related to siting or entry.

Trade-offs with other environmental issues

Many technologies that reduce GHGs may cause other environmental damages and risks. For example, nuclear generation creates radioactive waste and security concerns. Hydropower affects aquatic ecosystems, fish spawning, and cultural resource access rights. Battery waste involves toxic chemicals; transmission lines can disturb other land uses; most generation-siting raises "not in my backyard" (NIMBY) issues; and so forth. While these concerns are not new, policy makers should endeavour not to ignore other important social and environmental implications of technology in focusing on greenhouse gas emissions. These assessments are also related to the regulatory regime for deploying technologies, and assuring that the regime is appropriate but not unnecessarily long, cumbersome, or costly.

7.1.3 Rationale for Supporting Specific Technologies

In addition to addressing important market failures and barriers, policymakers may want to direct extra attention and support to certain kinds of technologies that have particular potential to reduce emissions. Some examples of especially desirable technologies are those that may have additional spillover benefits domestically and internationally, further reducing global emissions, improving the likelihood of more globally stringent GHG agreements, and potentially providing Canada with a competitive advantage.

Comparative advantage

Countries may have national research, development, and deployment (RD&D) policies, but the development of new technologies is a global effort. Consequently, there may be opportunities for coordination and for specialization. Technology oriented agreements can be aimed at knowledge sharing and coordination, research, development or demonstration, and even deployment.[84] Such commitments can increase the technological effectiveness of an agreement over emission reductions, although they are generally weak policies in terms of environmental effectiveness on their own. (Even at the international level, technology policies are complements to mitigation policies.) International agreements over technology standards can also be attractive from a competitiveness point of view, ensuring that trading partners have similar cost burdens.

On the other hand, some technologies might become a source of competitive advantage for Canada. Due to differing circumstances, some countries will enjoy a comparative advantage in certain technologies. In this case, not all countries will want to engage in the same RD&D portfolio, but rather wish to specialize to some extent. For example, countries with large availability of geological sequestration sites may prefer to invest more in CCS innovation. Canada could develop competitive advantages and international opportunities by developing domestic expertise through specific technology support.

Global spillovers

Technology spillovers do not respect borders, and they can inform priorities for dealing with global pollutants like GHGs. In particular, technological advances that support international agreements and efforts have additional value beyond what is appropriated at home. For example, some technologies may have better potential to be adopted among emerging economies that lack direct carbon regulation. Indeed, the availability of low-cost abatement opportunities may help encourage these countries ultimately to take on hard emissions targets. Thus, developed countries will want to engage not only in technology transfer agreements, but also RD&D efforts that are likely to produce technologies to be transferred.

84 de Coninck et al. (2008).

7.1.4 Summary and Key Conclusions for Technology Policy

Ultimately, the biggest driver of technological adoption will be pricing policy, which determines the demand for low-or zero-emitting technologies. However, there are barriers to the adoption of new technologies that can reduce the effectiveness of carbon pricing policy, and complementary technology policies may be necessary to ensure cost-effective emission reductions.

In developing complementary technology policies, it is important to note that not all barriers to the adoption of technology justify intervention. Cost, risk, reliability, and quality issues are all legitimate factors that should be allowed to affect how the market chooses cost-effective technologies. As a result, the main tools for encouraging climate-friendly technologies should be first those that encourage the market to enable good choices more generally: that means pricing carbon emissions, removing regulatory barriers to competition, and supporting R&D broadly. Information-based policies can have a role in influencing how cultural or value-based consumer preferences change through time.

However, more specific policies could also have a role. Some technologies face particular barriers, requiring society to take a decision of whether to support them, committing to major infrastructure investments or environmental risks. Other technologies may merit extra support, because they offer insurance against the possible need for deeper reductions, or because they have greater potential for being adopted in other parts of the world.

Several policy options are available to support technological development. Broad-based policies include R&D tax credits, funding universities and research institutions, and other public support for research through competitive grant processes. Scale economies can be supported through tax breaks, subsidies, performance standards (including tradable ones), or market-share mandates. While the latter two policies also create an implicit subsidy to the targeted technology (like renewable energy sources), paid for by the non-preferred sources, they have the advantage of requiring no public outlays, and naturally phasing itself out as the new technology becomes cost-competitive.

More specific policies would be required to address particular market failures and barriers, including information requirements, energy efficiency standards, building codes, etc. In these cases, policies will generally be more cost-effective where they target a specific market failure, as opposed to a specific technology. Standards perform better when they are flexible rather than prescriptive in terms of how the goal must be achieved.

Finally, for those technologies identified as being particularly desirable, some narrower R&D policies are available. Traditionally, most policies subsidize inputs to research, either through specific tax credits, grants or contracts, or directed research in publicly funded laboratories. If government lacks the expertise or impartiality, allocation of these research funds can also be outsourced to independent third-party institutions given specific mandates.[85] Technology prizes, on the other hand, offer financial inducement to an output, such as being the first to develop a specific advance or the contestant having made the most progress by a deadline. Such methods have been successful in the

85 An example is the Ontario Centres of Excellence, which operate somewhat like a publicly funded venture capital firm. See http://www.oce-ontario.org/

past and they could play a supportive role in climate policy, although attention should be paid to the design features, including the technological target, the size and nature of the prize, and the method for selecting the winner.[86]

This section has briefly explored the role of technology policies that complement a broader carbon pricing policy. However, technology policy is also a complex issue and more detailed study for Canada is required. Developing very specific policy recommendations for complementary technology policy is outside the scope of this report. Impacts of possible technology policy elements are explored in Section 7.2.2 using the CIMS model.

7.2 COMPLEMENTARY REGULATIONS: ENSURING FULL COVERAGE[87]

- **To fully unify policy across emissions, regulations are required for some sectors whose emissions are not easily addressed within a carbon pricing policy. These include landfills, upstream oil and gas emissions, pipeline emissions and agriculture.**
- **These complementary regulations can reduce the cost at which a carbon pricing policy achieves emissions targets.**
- **Command and control greenhouse gas regulations are not an effective first option to reducing emissions, compared to carbon pricing. They should be used only to meet specific shortcomings in a broad carbon pricing policy, such as market failures and limited coverage of emissions sources.**

Complementary regulations can play a key role in a unified carbon pricing policy. As established in Section 4.1, some emissions are difficult to include under a pricing policy instrument, including:

- High upstream oil and gas well venting and flaring;
- Pipeline combustion;
- Landfill gas; and,
- Agricultural emissions.

Complementary regulations can be used to broaden the scope of the carbon pricing policy to better unify prices across GHG emissions. Broadening coverage in this fashion can improve the cost-effectiveness of policy and allow Canada to reach its emission reduction targets at lower cost.

86 Newell and Wilson (2005).

87 Analysis in this section is drawn from Bataille et al. (2008).

7.2.1 Command and Control Policy Mechanisms

Carbon pricing is often posed as an alternative to so-called 'command and control' regulation. Such regulations (such as emissions standards) are generally considered environmentally effective, but not economically efficient if applied broadly. This is because they impose the same broad cost on all affected parties, while the costs of actual emissions abatement vary. Carbon pricing, which allows emitters to balance abatement costs and compliance costs, is thus preferred as the more efficient economy-wide approach to reducing emissions. However, where carbon pricing cannot include all emissions sources, there can be a role for command and control regulations to complement the carbon pricing policy.

Complementary regulations that extend coverage should align with the carbon price. That is, the regulations should be designed to achieve a similar level of abatement effort as if the pricing policy was covering the sector. If regulations are more stringent than the carbon price, or vice versa, the efficiencies of a unified carbon pricing policy are compromised, leading to greater overall costs.

7.2.2 Evaluating Potential Complementary Regulations

Complementary regulations, where they overcome barriers to the success of carbon pricing policy, can improve both the environmental effectiveness and the economic efficiency of carbon pricing. Regulations to extend coverage are a more administratively straightforward option than other approaches, such as offsets. Most of the complementary regulations explored in our research already have precedents in Canada. Regulations on the capture of landfill gas exist in several provinces, as do regulations concerning the handling of upstream emissions in the oil and gas sector. The existing precedents for regulations in these areas suggest that such approaches are politically acceptable.

Economic modelling demonstrates that complementary regulations can extend coverage and improve the effectiveness of carbon pricing policy. In Section 4.1, several emissions sources were identified that would be challenging to include in a carbon pricing policy. Complementary regulations are the most appropriate means for extending coverage of carbon pricing policy to these emissions, unifying the price over emissions. Below, some possible complementary regulations are identified. Given the focus of this project on carbon pricing, the research into these complementary regulations should be regarded as illustrative. Regulations include:

- **High upstream oil and gas venting, flaring, and pipeline leaks:** Regulations would require the phasing out of venting and flaring (other than for safety reasons), with fines for noncompliance. Similar regulations could be used for pipeline leaks, with perhaps lower stringency given the technical impossibility of completely eliminating pipeline leaks. Modelling for the NRTEE estimated that a program of regulation aligned with *fast and deep* pricing could cut emissions from these sources source by around 42 Mt CO_2e per year.

- **Landfill gas emissions:** Most abatement opportunities from the capture of landfill gas cost around \$15-\$25 / tonne CO_2e. Regulation could require the capture of landfill gas from all landfills (above a minimum size threshold). Modelling for the NRTEE estimated that 25-28 Mt CO_2e per year could be reduced this way.

- **Agricultural emissions:** Consultants for the NRTEE estimated that reductions of between 8 Mt in 2020 and 13 Mt in 2050 are available from changes to agricultural practices at marginal abatement costs similar to *fast and deep* carbon prices. Regulations relating to agricultural practises could be established to achieve these reductions, though this may be costly both to implement and enforce. Recommending specific regulations for the agricultural sector is beyond the scope of NRTEE's carbon pricing analysis.

Similarly, Section 7.1 suggested performance-based standards could be one element of technology policy that could improve overall cost-effectiveness of policy. Two possible complementary technology regulations were identified and modelled, as below. Again, these policies should be considered illustrative. Regulations include:

- **Standards to overcome principal-agent failures in the building sector:** A widely acknowledged market failure is the disconnect between those who determine the day to day use of energy in building structures, and those who own them. The owners of buildings cannot necessarily recover investments in energy efficiency, as they are reaped by renters or leaseholders who determine the energy load and pay the energy bills. Renters or leaseholders, on the other hand, have no incentive to make significant energy efficiency investments, as they do not usually have secure tenure to their residence. A LEED (Leadership in Energy and Environmental Design) standard or equivalent could be used as a base level for all new commercial buildings, and at least a 50% increase in shell efficiency for all residential buildings compared to current and planned codes.[88]

- **Vehicle emission standards in the transportation sector:** Transportation contributes a large share to Canada's emissions, and targets cannot be achieved without the transformation of vehicle technology. However, modelling suggests vehicles are slow to respond to carbon pricing. This inelastic response could be due to information market problems; it is challenging for consumers to determine savings from choosing more efficient vehicles. The complexity of gas prices and fuel efficiencies of different vehicles makes economic vehicle purchasing decisions more challenging. Regulations could involve the national adoption of California's GHG emissions intensity policy out to 2020, gradually increasing in stringency to a virtually zero GHG intensity policy by 2040. These regulations imply either complete electrification of the transport fleet or switching to an alternative liquid or gas motive fuel; biofuel and hydrogen are two candidates. The policy delivers 11 Mt CO_2e in 2015, gradually increasing to 68 Mt CO_2e by 2050.

88 The recent NRTEE report on energy efficiency in the Canadian commercial building sector, *Geared for Change: Energy Efficiency in Canada's Commercial Building Sector*, demonstrates the effectiveness of complementing a carbon price with regulations. NRTEE (2009).

In the modelling forecasts, these policies enabled the carbon price to be reduced by 30%, from \$300 / tonne CO_2e to \$210 / tonne CO_2e to reach the same target.[89] Figure 15, below, illustrates the effect of complementary regulations by sector in meeting the Government of Canada's GHG targets.

CONTRIBUTION OF COMPLEMENTARY REGULATIONS AND TECHNOLOGY POLICIES TO EMISSION REDUCTIONS

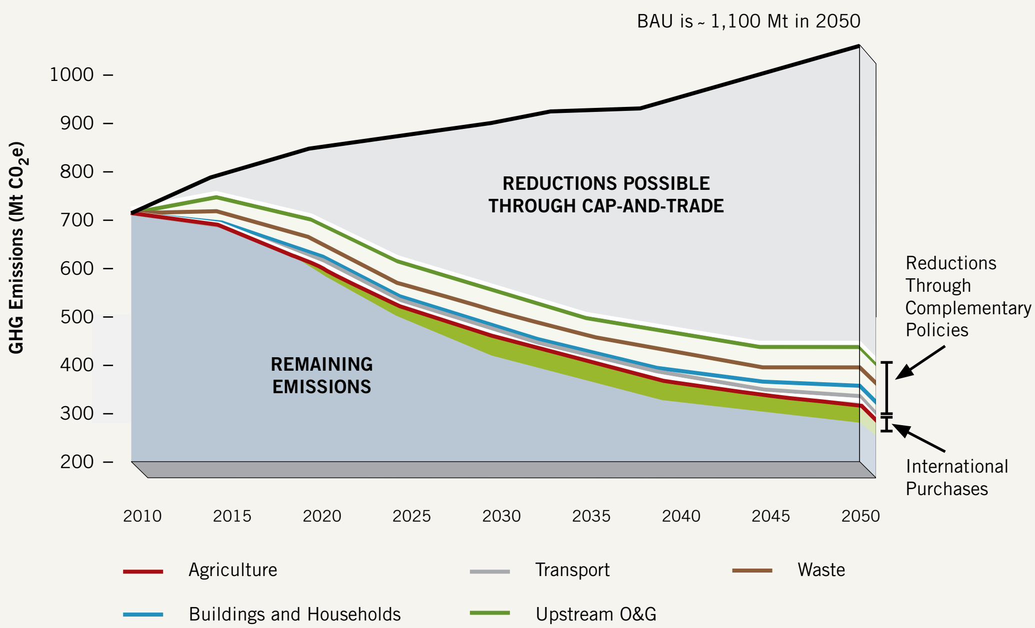

FIGURE 16

These NRTEE modelling results suggest a clear rationale exists for implementing complementary regulations and targeted technology regulations. They can improve the overall economic efficiency and environmental effectiveness of a broader carbon pricing policy.

89 Note, however, that higher costs were required in the medium-term to account for the lower long-term price (i.e. with an expectation of a lower carbon price in the future, less abatement in the short-term occurs, and so the carbon price must rise to hit the *same target).*

7.2.3 Summary and Key Conclusion for Complementary Regulations

Complementary regulations should be developed on the basis of a clear economic rationale. This will typically mean that their use will be limited to areas where regulations extend coverage beyond the scope of the carbon pricing policy or address a market failure. They should also be designed so as to align with the unified carbon price signal.

7.3 EDUCATION, INFORMATION AND MARKETING POLICY MEASURES

The Government of Canada's emission reduction targets imply a substantial change in the way in which energy is produced and used in Canada. This change has major implications for investment in new technologies, and it has implications for Canadians as a whole. Informing Canadians about climate change, and climate change policy, should be undertaken alongside carbon pricing policy.

Examples of information and education campaigns with little discernable impact on consumer behaviour are common in environmental policy in general, and in energy and climate policy in particular.[90] Climate policy analysts are justifiably sceptical of the value of such initiatives. However, while many argue that people are relatively insensitive to education campaigns and moral arguments as consumers, such programs play a broader role in educating people as citizens. Information and education can play a role in shaping norms, supporting policy goals, and establishing a social consensus for policy action. Furthermore, it is unlikely the public will continue to support major carbon pricing policy without a sense that they have a stake in a shared social purpose. As a result, there is a case for ongoing investment in public education about climate change and climate policy, as a complement to carbon pricing policy. This approach includes changes in the formal education system and broader investment in public education; it also includes a role for government, industry, and others in showing leadership.

In addition to the broader targeted role of information and education on climate policy, investment in more specific information policies may be justified. Consumer behaviour and purchasing decisions are informed by habit, routines and social norms, as well as by conscious considerations of relative price.[91] For example, consumers may have difficulty identifying the cost savings associated with energy-efficient appliances. The use of mandatory energy labelling (such as the Energy Star label) for consumer goods can enable consumers' response to price signals, increasing the effectiveness of a carbon pricing policy.

90 McKenzie-Mohr (2000) cites a case in which a utility in California spent more on advertising the benefits of home insulation than it would have cost to install the insulation itself in the targeted homes.

91 Jackson (2005).

7.4 REMOVING MARKET DISTORTIONS

The effectiveness of carbon pricing policy may be affected by existing incentives for energy technologies. Subsidy structures may need to be reviewed, to ensure that the incentives provided by carbon pricing policy are not diminished. For example, some existing subsidies to the oil and gas sector may prevent a carbon price from providing the necessary incentive to transition to low or zero-emitting technologies. In OECD countries, for example, there have been instances in which subsidies for fossil-fuel production have distorted the energy market.[92] Similarly, another kind of implicit subsidy is the lack of policy to reflect the cost of other environmental damages, besides GHG emissions. Regulating conventional air and water pollutants with market-based mechanisms could improve market signals, moving further toward full-cost pricing, and make clean energy sources relatively more competitive to their fossil-fuel counterparts.

The impact of removing distortionary subsidies was not modelled for the purposes of this report, nor how they could co-exist in some fashion with a carbon pricing policy assessed. Detailed analysis of this issue is outside the scope of this report.

92 In the U.S., half of energy subsidies go to fossil fuels, compared to 5% for renewables. IEA (2006).

8.0 OUTCOMES AND IMPACTS OF BROAD, UNIFIED CARBON PRICING

- **Cost-effective carbon pricing policy can lead to some adverse impacts that should be addressed by specific elements of policy design and other measures.**

This chapter first shows how the carbon pricing policy recommended by the NRTEE, that implements a broad, unified price on carbon emissions, can achieve Canada's emission reduction targets. Economic modelling demonstrates how the *fast and deep* carbon pricing policy can drive changes in technology adoption toward low-carbon technologies. While the modelling scenario presented is only one possible pathway toward a low-carbon future, it illustrates clearly that such a carbon pricing policy, based on an economy-wide emissions price signal, can achieve its goals.

At the same time, modelling also suggests that implementation of a broad and unified carbon pricing policy across all emissions may have adverse impacts. This section explores possible distributional impacts to sectors, regions, and households. Possible macroeconomic and competitiveness impacts of carbon pricing policies are also explored. These impacts highlight additional issues that must be addressed in the detailed design and implementation of the carbon pricing policy.

8.1 TECHNOLOGICAL AND BEHAVIOURAL CHANGES DRIVEN BY CARBON PRICING POLICY[93]

- **Economic modelling suggests that broad, unified carbon emission pricing will drive deployment of low-carbon technologies, so that Canada's carbon emission reduction targets can be achieved.**

Economic modelling illustrates that the emission reductions targets of 20% below 2006 levels by 2020, and 65% below 2006 levels by 2050, can be achieved by implementing a long-term carbon pricing policy. This section explores the technological outcomes forecasted by the CIMS model analysis of *fast and deep* carbon pricing. The forecast illustrates one scenario by which Canada's 2020 and 2050 emission reduction targets can be cost-effectively achieved through the deployment of low-carbon technology, as driven by pricing policy.

93 Analysis in this section is largely based on NRTEE analysis of the outputs of the *fast and deep* CIMS simulation prepared by J&C Nyboer (Peters, J. et al, 2008).

8.1.1 A Scenario for Technological Deployment

This scenario is one possible way in which the Canadian economy could transform in response to carbon pricing. The scenario presented here is not necessarily the most likely outcome, nor is it the NRTEE's recommended mix of technologies. After all, the purpose of carbon pricing is to allow the market to respond in the most efficient way, not to prescribe the best technological solutions. New innovations and new technologies will almost surely result in a different technological mix in 2050 than predicted by the model. Nevertheless, the scenario illustrates how carbon pricing policy can realistically drive the market penetration of low-carbon technologies to achieve Canada's emission reduction targets. The modelling scenario should be considered as providing important directional insight into these key elements of the transformation of the energy system that policy makers must consider, rather than a definitive description of the technology mix resulting in 2020 and 2050 from carbon pricing policies.

Major trends of the forecast are illustrated in Figure 17. The figure illustrates how different emission reduction measures contribute to the forecasted reductions in Canada over time. Energy efficiency, carbon capture and storage, and fuel switching to electricity and biomass are the major technological contributors to emission reductions.[94]

TECHNOLOGY DEPLOYMENT RESULTING FROM THE *FAST AND DEEP* CARBON PRICING SCENARIO

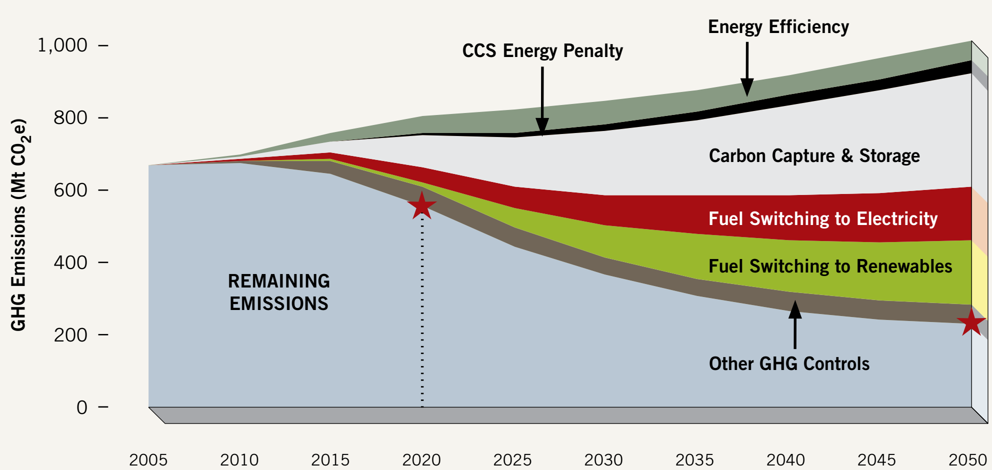

FIGURE 17

★ Government of Canada Emission Reductions Targets in 2020 and 2050

94 IPCC (2005). Capturing carbon dioxide waste streams make up the bulk of CCS costs. For example, in a review of carbon capture cost estimates, the Alberta Carbon Capture and Storage Development Council (2008) provides a range of about \$60 to \$140 / tonne of CO_2, the broad range reflective of differing plant installations, choice of CCS technology, and uncertainty in price reductions over time.

The *Energy Efficiency* wedge includes the adoption of more energy efficient technologies such as ground source heat pumps and hybrid vehicles. The *Carbon Capture and Storage* wedge includes the adoption of CCS in a variety of applications such as hydrogen production, electricity generation, and oil sands upgrading. The *CCS Energy Penalty* wedge represents the additional energy required to implement CCS; though CCS enables reductions overall, this added energy effectively reduces the size of the energy efficiency wedge. The *Fuel Switching to Electricity* wedge represents the emissions reductions that result from a combination of the decarbonization of electricity generation (through technologies such as renewables and CCS) and the increased use of electrical technologies (such as electric heating systems in buildings). The *Fuel Switching to Renewables* wedge includes increased use of biofuels in applications such as passenger and freight vehicles. *Other GHG Controls* represents reductions from the implementation of other technologies and processes such as landfill gas capture and flare and leak detection and repair at oil and gas wells and pipelines.

Figure 18 maps main components of the scenario in more detail and illustrates how the forecast predicts the phase-in of low-carbon technologies as the carbon price increases over time. For example, CCS market penetration starts gradually around 2015 in the forecast, but rapidly scales up in electricity generation and other applications by 2020 and 2030 as the price of carbon increases. This result is consistent with literature which suggests CCS can become competitive at a price within a range of \$20 to \$200 / tonne CO_2e.[95] Recent Canadian industry estimates suggest that a threshold price of around \$80 / tonne could result in a rapid ramp up of CCS activity.[96]

In the transportation sector, decarbonization is achieved through a combination of electrification (through plug-in hybrids and electric vehicles), biofuels and energy efficiency (through the adoption of lighter vehicles). While there is some shifting away from private cars towards public transit, this is a relatively small contributor to emission reductions in the forecast scenario.

Figure 19 also highlights the acceleration of current technology trends. The market growth of hybrid cars, for example, continues in the forecast with rapid adoption in the medium term, with plug-in hybrids showing substantial growth in the longer term. Growth in biofuels continues, with significant increases in biodiesel and cellulosic ethanol. The forecast thus suggests that carbon pricing policy can result in the targeted emission reductions in Canada without dramatically different technologies (CCS is perhaps the very notable exception). This trend is partly a result of the model's limited ability to forecast penetration of technologies that do not yet exist. However, this result does also suggest that a largely evolutionary technology path can lead to deep reductions. The transformation is large in scale, but does not necessarily imply dramatic disruptions to the basic ways in which Canadians use energy.

The modelling clearly shows that the diffusion of a range of technologies will be necessary, and that no single technology enables cost-effective decarbonisation. The variety of technologies, and their specific contributions to emission reductions, is shown in Figure 19. This figure provides a snapshot of the forecasted emission reductions in 2020. Again, CCS contributes significant reductions in 2020 in the forecast, particularly in the oil sands up-grading and electricity generation sectors. Electricity emissions actually increase as a result of the carbon pricing policy, due to the electrification of the economy, as set out below. In Figure 19, this increase in emissions is shown as a negative contribution to emission reductions of -14%.

95 IPCC (2005). Capturing carbon dioxide waste streams make up the bulk of CCS costs. For example, in a review of carbon capture cost estimates, the Alberta Carbon Capture and Storage Development Council (2008) provides a range of about \$60 to \$140 / tonne of CO_2, the broad range reflective of differing plant installations, choice of CCS technology, and uncertainty in price reductions over time.

96 ico2n (2007). Note that the cost estimates provided in this report are tonnes of CO_2, not CO_2e, and include capture and transportation costs, but not storage costs, which they assume to amount to “a few dollars per tonne”.

DETAILED TECHNOLOGY DEPLOYMENT SCENARIO

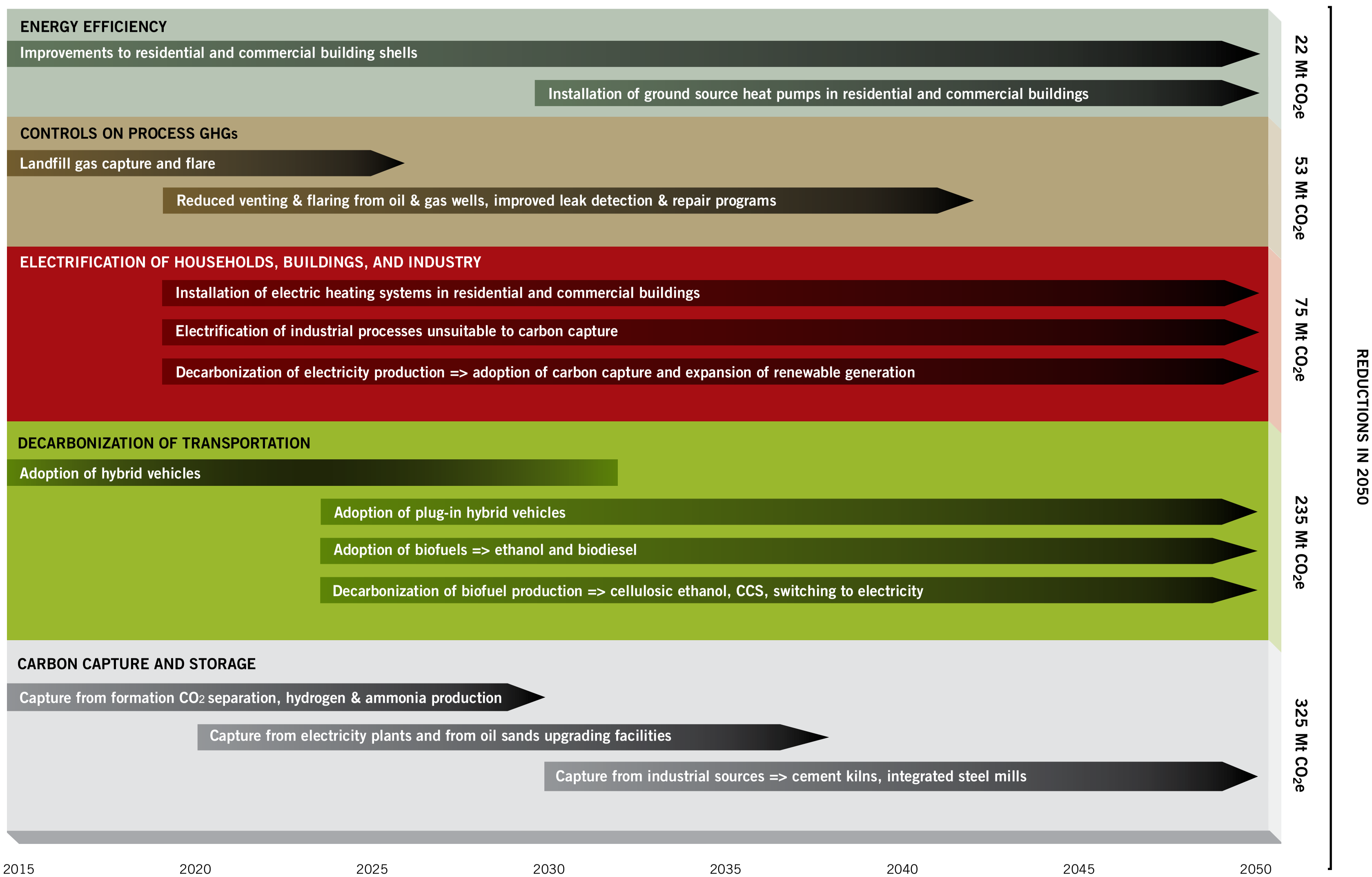

FIGURE 18

This technology scenario results from the *fast and deep* carbon pricing pathway. As such, it focuses on technology deployment under carbon pricing with limited deployment resulting from complementary policies and none from international trading costs.

CONTRIBUTIONS OF SPECIFIC TECHNOLOGIES TO EMISSION REDUCTIONS IN 2020

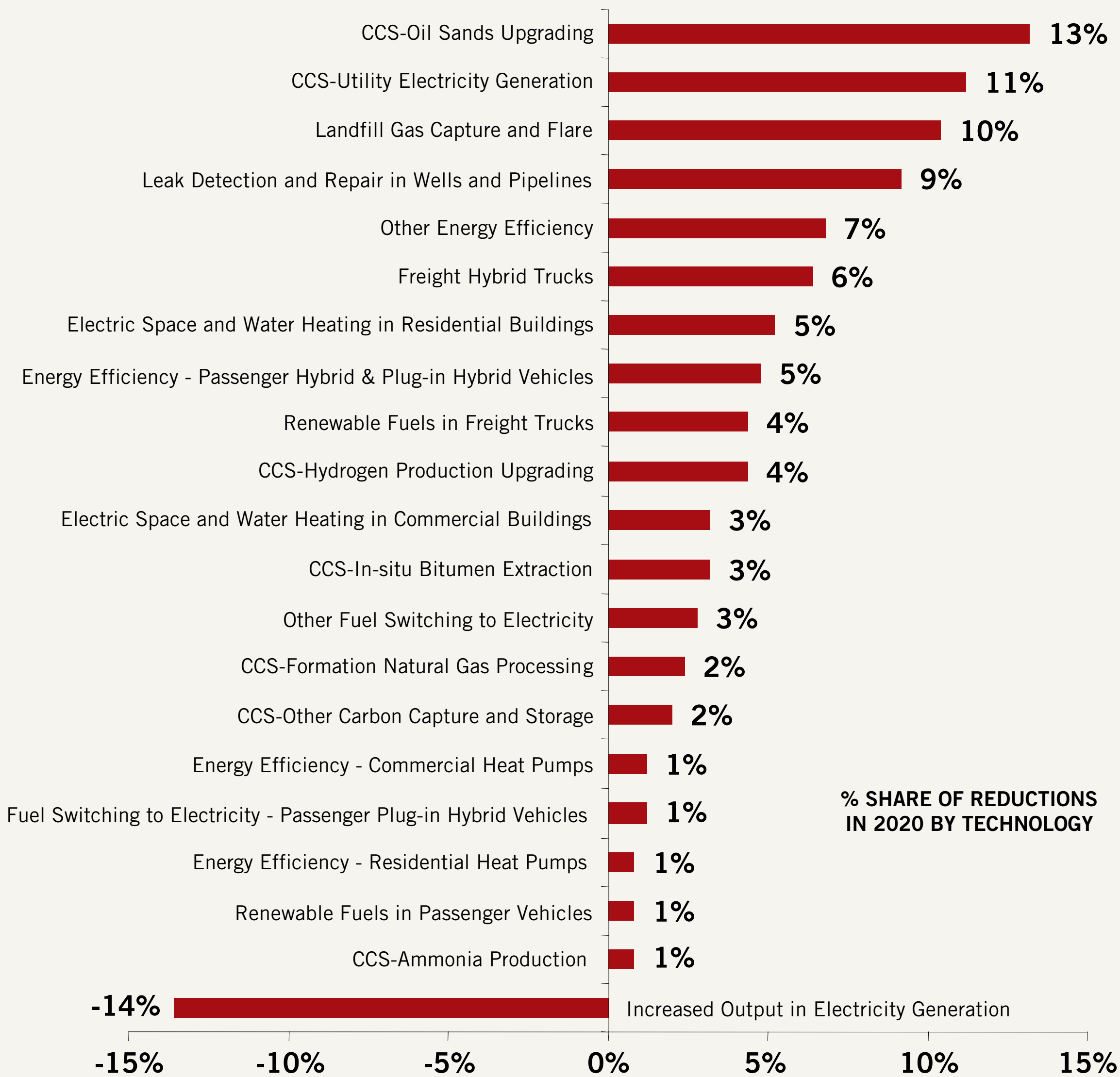

FIGURE 19

The remainder of emission reductions are attributed to a variety of other reduction measures with small contributions to overall reductions. Percentage figures have been rounded.

8.1.2 Electrification of the Economy

A major trend that emerges from the forecast is electrification of the Canadian energy system. Large growth in generation of electricity is projected, largely through low-carbon generation technologies such as CCS, hydroelectric power and wind, as shown in Table 9. This increase in low-carbon supply enables emission reductions through fuel-switching to electricity, particularly in the transportation, residential and commercial sectors. Although the large growth in electricity generation results in an *increase* in emissions from this sector, this increase is offset by overall greater reductions elsewhere in the economy as electricity replaces fossil fuel combustion.

FORECASTED PENETRATION OF LOW-CARBON ELECTRICITY GENERATION TECHNOLOGIES UNDER *FAST AND DEEP* CARBON PRICING

	Total Generation (TWh)				Increase Due to Policy (%)			
	2020	**2030**	**2040**	**2050**	**2020**	**2030**	**2040**	**2050**
Hydro	505	633	759	890	17%	31%	37%	39%
Wind	33	63	91	110	84%	118%	104%	77%
Other renewables	3	7	10	13	117%	150%	144%	134%
Nuclear	124	168	204	232	26%	54%	64%	57%
Coal and gas with CCS	62	193	328	456	**NA**			
Total Generation	**868**	**1,166**	**1,445**	**1,712**	**24%**	**45%**	**53%**	**51%**

TABLE 9

Significant emission reductions from the transportation sector are achieved through the adoption of plug-in hybrids, which are cars that can be recharged with electricity. Similarly, the model forecasts substantial growth in baseboard heaters and ground-source heat pumps for heating in residential and commercial building sectors, reducing the use of natural gas and fuel oil for heating.

The forecasted increase of low-carbon electricity generation in energy supply combined with fuel-switching to electricity for energy demand allows for the decoupling of GHG emissions and GDP. As illustrated in Figure 20, the forecast suggests the emission reduction targets can be achieved even as energy use per GDP increases over time. Because the energy used is increasingly sourced in low-carbon electricity generations, emissions intensity falls dramatically; by 2050, the forecast suggests greenhouse gas emissions per economic output is almost 80% lower than it would have been without the carbon pricing policy.

TRANSFORMATION IN ENERGY AND EMISSIONS INTENSITY

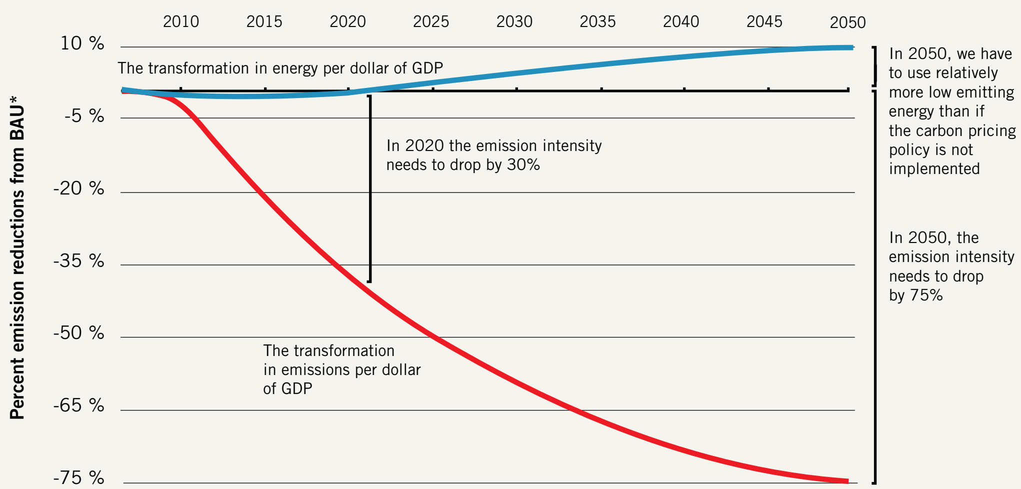

FIGURE 20

* Business as usual

8.1.3 Implications for Investment

The technology scenario forecast by the CIMS model is reflected in changes to patterns of investment, as illustrated in Figure 21. The forecast suggests carbon pricing policy will result in large technology investments in carbon capture and storage, in increased electricity capacity, and in the biofuels sector. The biofuels sector experiences huge growth (3,362% and 1,908% for biodiesel and ethanol respectively) because biofuel manufacturing is forecast to have only small growth in the *business as usual* scenario. Decreases in investment occur due to reduced output in sectors such as industrial minerals and petroleum refining, and a shift to smaller, less expensive vehicles in transportations sectors.

INVESTMENT CHANGES IN KEY ECONOMIC SECTORS IN 2020 AND 2050 RESULTING FROM CARBON PRICING

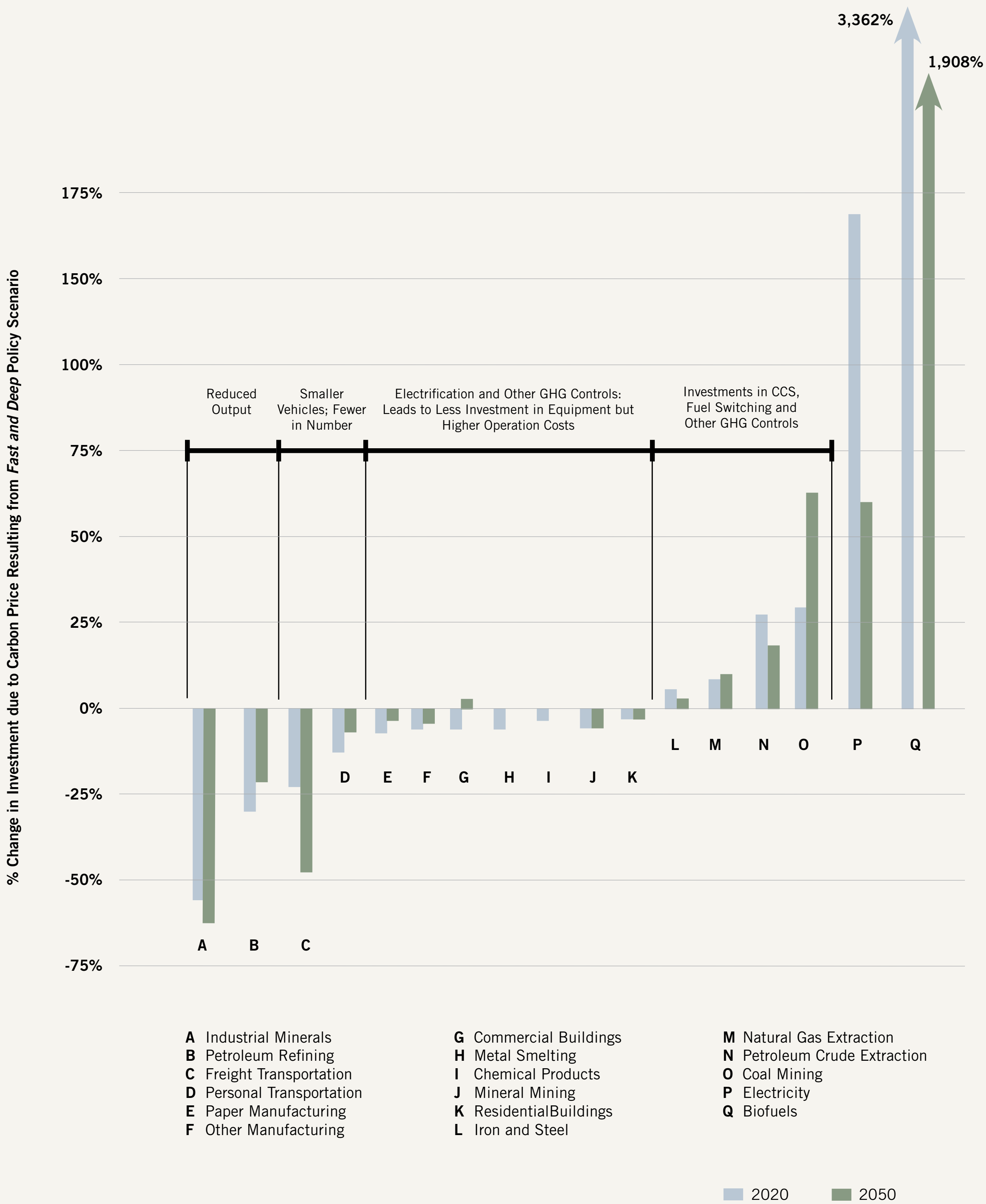

FIGURE 21

8.1.4 The Robustness of the Scenario

To ensure that the scenario is a plausible future technology path, the robustness of the technology scenario was explored through stakeholder engagement. Industry experts were consulted regarding the forecasted market penetration of some key technologies that contribute to emission reductions. Sectoral stakeholders were asked whether the market penetration rates and timing were pessimistic (i.e., an underestimate of the likely penetration rate of the technology) or optimistic (i.e., an overestimate of the likely penetration rate of the technology). The results are presented in Table 10. While the stakeholder feedback largely confirms that the scenario is plausible, it also cautions against taking any single technology forecast too literally. The results suggest that some technologies may face significant challenges in reaching the market penetration forecast by the model in the time suggested due to barriers to technological development and deployment. It points to technologies that may require additional, targeted efforts to ensure their full economic potential is exploited in time. The analysis therefore informs policy makers where focused thinking is required. It also identifies the need for barriers to technology development and deployment to be considered more directly by governments, industry and researchers.

STAKEHOLDER ASSESSMENTS OF THE TECHNOLOGY FORECAST PRODUCED BY CIMS

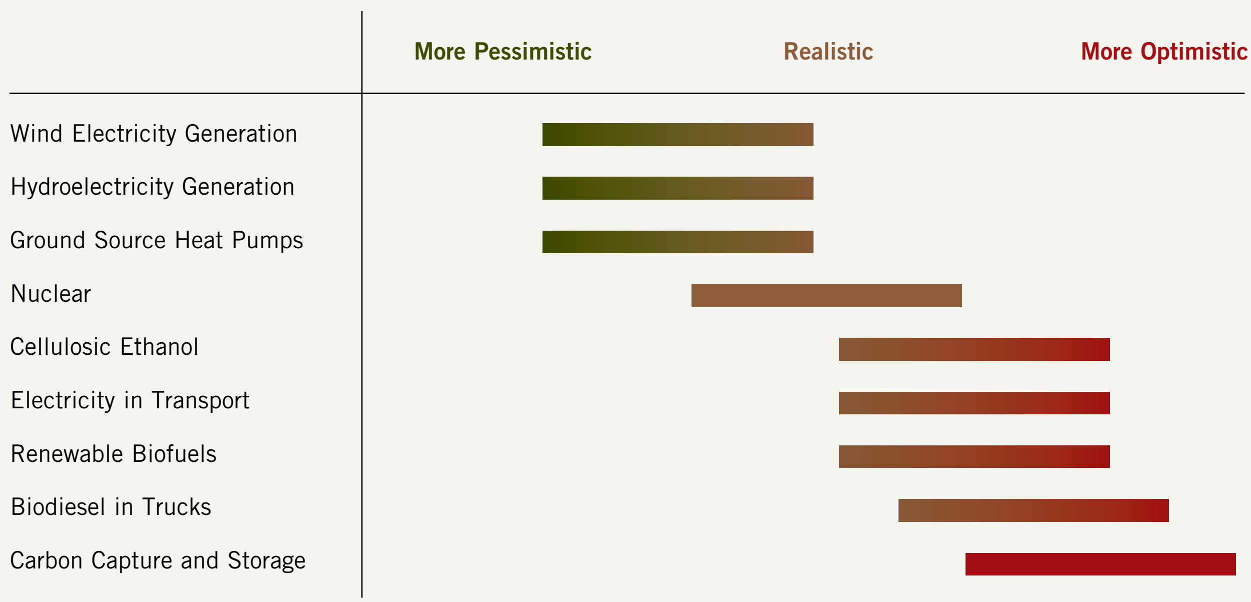

TABLE 10

If a technology was assessed as *optimistic*, stakeholders thought the forecast over-estimated likely penetration rates under the carbon price. If a technology was assessed as *pessimistic*, stakeholders thought the forecast under-estimated the likely penetration rates under the carbon price.

The future will inevitably look different from the technology scenario outlined above. The purpose of the scenario is not to present a most likely or recommended technology path, but to illustrate that Canada's emissions targets likely can be achieved with currently available or near-available technologies through implementation of *fast and deep* carbon pricing policy. Step changes in technology could advance this further and give us more confidence in meeting targets.

Carbon pricing policy is the most important instrument to drive deployment of low carbon technology. However, given the importance of technology to achieve the goal of carbon pricing policy, complementary policy measures to address barriers to technology identified in this sectoral engagement process may further improve the cost-effectiveness of the policy, as set out earlier in this report.

8.2 DISTRIBUTIONAL IMPACTS OF UNIFIED CARBON PRICING POLICY[97]

- **Under a broad, unified carbon pricing policy, distributional impacts will exist, including:**
  - **Sectors make different contributions to emission reductions with different levels of investment and also respond at different rates. Differences in sectoral responses may be a more important distributional issue than differences in regional responses.**
  - **Under a uniform national carbon price, modelling suggests relative emission reductions are roughly equivalent across provinces.**
  - **Carbon pricing can be regressive; lower income households may be more burdened by a price on carbon than higher income households, depending on the design of policy.**
  - **Northern and remote communities are highly dependent on carbon intensive goods and services, and will be particularly affected by carbon pricing.**

Implementing a unified carbon pricing policy across Canada can result in adverse distributional effects for some industry sectors, regions, and households, depending on the design of the policy. Equity, however, is a main principle for good governance, and carbon pricing policy should be no exception. In this section, equity implications of *fast and deep* carbon pricing are explored and the significance of distributional issues for a unified carbon pricing policy is assessed.

8.2.1 Asymmetric Rates of Emission Reductions across Sectors

Distributional effects of carbon pricing between sectors is an issue that carbon pricing policy must address. Figure 22 shows the contributions of different sectors to forecasted emission reductions. The differential sector contributions largely reflect the emissions profiles of existing industries: those that currently have high emissions contribute the largest reductions. The largest reductions come from the transportation and fossil fuel refining and extraction sectors. The fossil fuel refining and extraction sectors experience large reductions, largely due to the implementation of carbon capture and storage.

97 Analysis in this section is largely based on NRTEE analysis of the outputs of the *fast and deep* CIMS simulation prepared by J&C Nyboer (Peters, J. et al, (2008), and on in-house NRTEE research.

GHG EMISSION REDUCTIONS BY SECTOR UNDER *FAST AND DEEP* CARBON PRICING

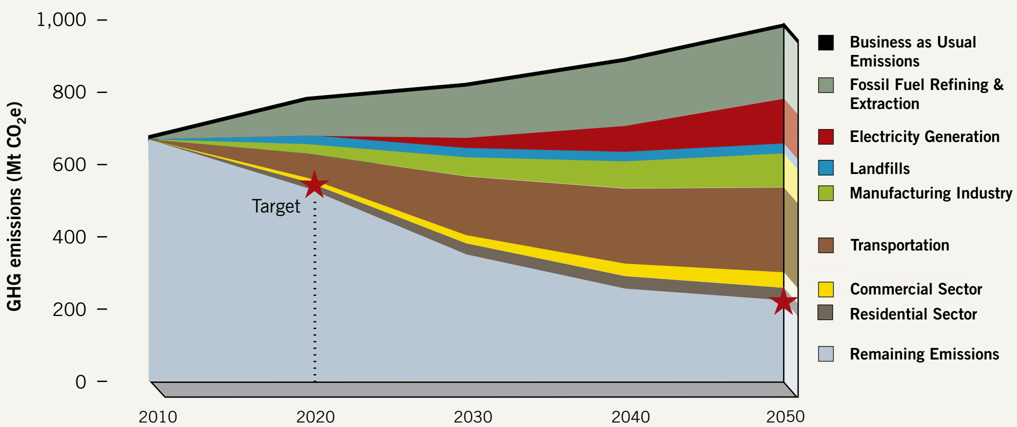

FIGURE 22

★ Government of Canada Emission Reduction Targets in 2020 and 2050

Even more importantly, sectors also show substantial variation in their forecasted emission reductions relative to the *business as usual* scenario. As illustrated in Figure 23, sectors vary in their forecasted speed of decarbonization, and in the extent to which the model suggests they will ultimately decarbonize in response to *fast and deep* pricing. Figure 23 shows the percent changes in emission reductions relative to the reference case for a few key sectors. It illustrates that sectors are likely to respond to the carbon pricing policy at different rates.

The rates of decarbonisation of sectors, as illustrated by the figure, suggest sectors will respond in very different ways to carbon pricing policy. Two major factors underpin these differential contributions to forecasted emission reductions. First, pricing policy results in changes in industry structure. Some industries shrink and others grow in relative size. This issue is discussed in the next section on competitiveness. Second, sectors differ in their technological responses to the carbon price signal. In the short term, for example, electricity generation actually increases its emissions under the policy scenario as electricity supply expands substantially to enable emission reductions in buildings, vehicles, and manufacturing in the short term. But deeper reductions are achieved in the forecast in the longer term as electricity generation becomes almost carbon neutral. Similarly, the electricity and fossil fuel sectors implement carbon capture and storage, decarbonising steadily after 2020. Commercial building and transportation sectors experience reductions through energy efficiency and fuel switching to biofuels and electricity.

RATE OF GHG EMISSION REDUCTIONS BY SECTOR, 2020 - 2050

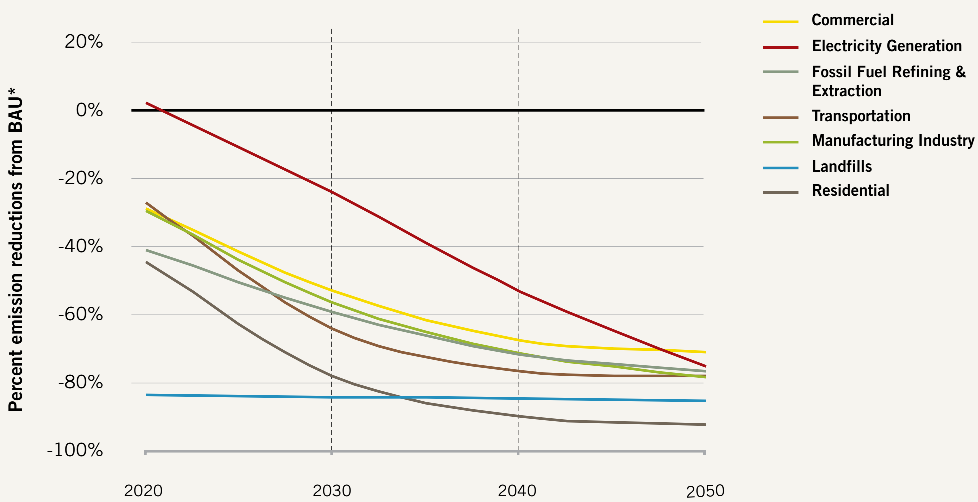

FIGURE 23

* Business as usual

8.2.2 Comparable Rates of Regional Emission Reductions

Canada's regions vary substantially both in the total amount of greenhouse gases they emit and in the emissions intensity of their economies. Variation results from several factors including differences in industry structure (some provinces have significant fossil fuel industries, others do not), electricity generating technologies (some provinces rely on hydro power, others on coal or nuclear). Total emissions are also affected by the size of a region's population and economy and the extent to which they are expected to grow. Regions' forecasted responses to a carbon price signal vary as a result of these differences in their energy systems. The NRTEE's economic modelling of the *fast and deep* pricing scenario illustrates the differences between regional responses. As illustrated in Figure 24, Ontario and Alberta contribute most to emission reductions in absolute terms, partly because their current and business as usual emissions are higher than other provinces.

Regional differences in electricity generation have an important effect on responses to carbon pricing policy. The larger size of forecasted emission reductions for Ontario relative to other regions, for example, is principally a result of emission reductions in the electricity generation sector, since renewables and generation with carbon capture and storage replace coal-burning generation and natural gas. The large share of forcasted emission reductions in Alberta is also partly due to the decarbonisation of Alberta's fossil-fuel-intensive electricity generation sector. Even more significantly for Alberta are forecasted changes in the petroleum crude extraction sector. In the *fast and deep* forecast, 53% of emission reductions from the reference case in Alberta are achieved in this sector.

Despite differences in total reductions, regions are forecast to respond similarly to unified carbon pricing. Alberta and Ontario provide larger shares of emission reductions as a result of pricing because these provinces are projected to have very large emissions in the absence of policy. The forecast suggests lower cost reductions are available in these regions. As Figure 25 illustrates, when the reductions made by provinces are compared relative to their *business as usual* emissions, it becomes clear that regions decarbonize at a similar rate, and to a similar 2050 level. The forecast thus suggests emission reductions in each region will be proportional to their current emissions profiles.

GHG EMISSION REDUCTIONS BY REGION UNDER *FAST AND DEEP* CARBON PRICING

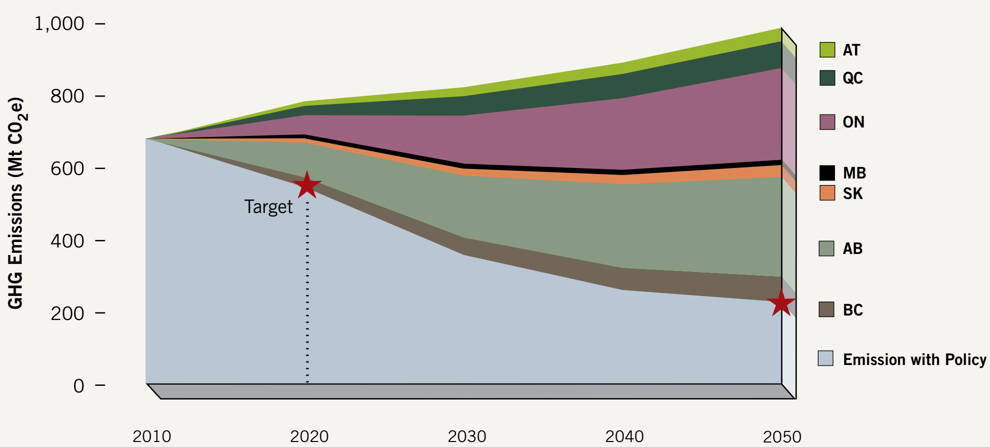

FIGURE 24

Emission reductions from Yukon, Nunavut, Northwest Territories and the individual Atlantic provinces are not shown separately due to the small magnitude of both their business as usual emissions and emission reductions under carbon pricing policy.

★ Government of Canada Emission Reduction Targets in 2020 and 2050

RATE OF EMISSION REDUCTIONS BY REGION, 2020 - 2050

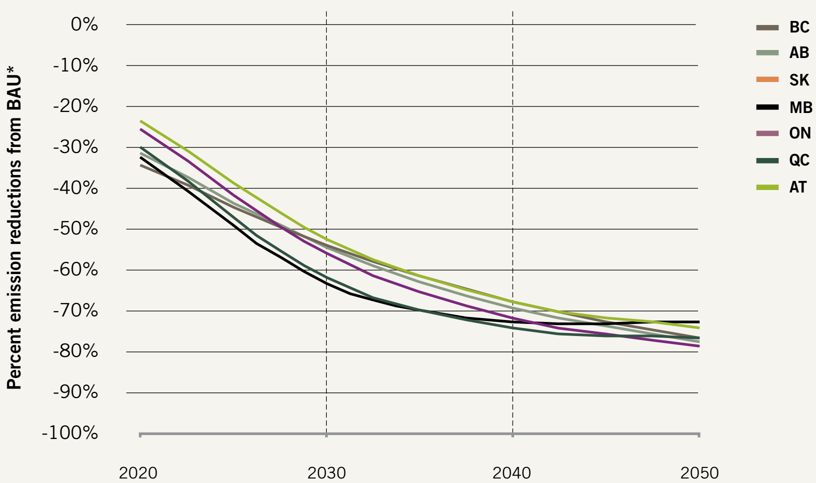

FIGURE 25

* Business as usual

8.2.3 Some Disproportionate Impacts on Lower-income Households

Carbon pricing alone may be regressive, with a disproportionate impact on low income households. This is true for both quantity and price setting approaches (that is, both cap-and-trade systems and carbon taxes), and equitable carbon pricing policy should address this issue. Revenue recycling mechanisms can be used to reduce or reverse regressive distributional effects, as discussed in Section 4.2.

The impact of *fast and deep* carbon pricing on Canadian households in 2020 is assessed. Data from Statistics Canada shows that income groups differ in their consumption patterns, and that as a result they differ in the greenhouse gas emissions they produce. The data suggests that for the lowest-income 20% of Canadians, a carbon price of $100/tonne could add around $1,000 a year onto living costs, just over 3% of average disposable income.[98] This analysis likely over-estimates the impact on households, because it assumes that consumption patterns in 2020 will be the same as they were in 2002, the most recent year for which data is available. However, households are expected to adjust their consumption patterns in response to carbon pricing, and firms will also decarbonize supply chains, reducing the impacts on households. The figures do, however, provide a sense of the scale of impact on households, and in particular of the differential effects of pricing according to household income.

98 This includes both direct and indirect emissions, that is, it includes the price changes that result from increases in the price of carbon-intensive goods and services, not just increases in carbon-based fuels. Data provided to NRTEE from Statistics Canada, September 11th 2008.

In general, higher-income households are responsible for more greenhouse gas emissions than their less well-off counterparts. Statistics Canada figures indicate that the highest earning 20% of Canadians are responsible for around four times more greenhouse gas emissions than the lowest earning 20%.[99] The highest-income Canadians will therefore pay four times more tax (or equivalent price increases resulting from cap-and-trade). But those with highest income earn six times more than the lowest, so the amount paid by the higher-income households is smaller as a proportion of income. As Figure 25 illustrates, it is estimated that lower-income households could pay nearly twice as much as higher-income households *as a proportion of income*, even though the price of carbon will cost less to them in absolute terms.[100]

Higher and lower income households also differ in their ability to respond to high prices through changing their behaviour. Lower-income households are disproportionately more likely to be renters – rather than owners – of their properties.[101] As a result, they may not be able to invest in a new efficient furnace or insulation, typically the role of the landlord. Lower-income households also may be less financial flexible to invest in new, low-emission technologies if they have high up-front capital costs, even if lower operating costs help to recoup the investment over time.

BURDEN OF A $100 / TONNE CO_2e PRICE ON HOUSEHOLDS AS EXPRESSED AS A PER CENT OF DISPOSABLE INCOME IN 2020

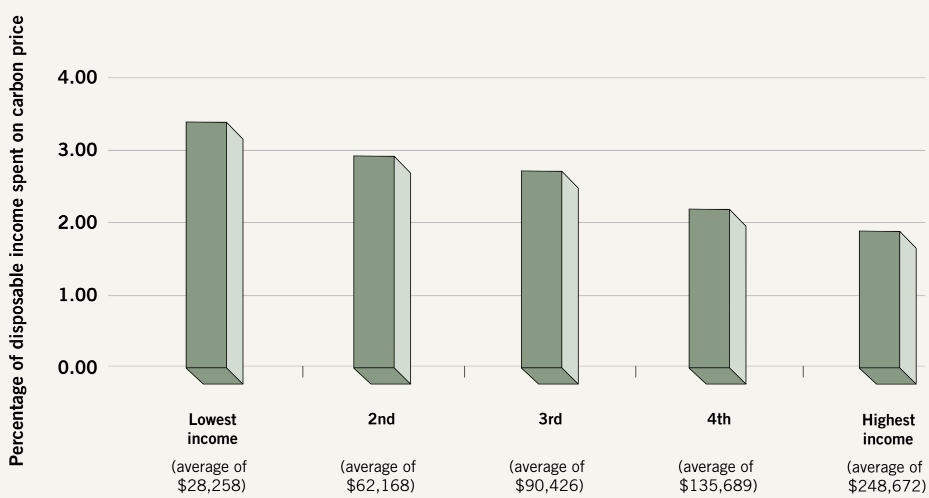

FIGURE 26

The figure assumes households make no abatement efforts. In reality, households will respond to the price signal to reduce their costs, and actual expenditures will be less than as illustrated in this Figure.

99 Data provided to NRTEE from Statistics Canada, September 11th 2008.

100 This finding is consistent with recent analysis of the BC carbon tax (Lee and Sanger 2008). Similar results have been found for the US (Burtraw et al 2008).

101 Statistics Canada (2007).

8.2.4 Different Impacts on Rural Households and Urban Households

Carbon pricing may also affect households differently depending on the type of community (e.g. rural or urban). However, the evidence for such differences is less clear than it is for differences between income groups. As illustrated in Figure 27 , data from Statistics Canada suggest that the average rural household could pay nearly 20% more, as a proportion of income, than inhabitants of major cities with populations greater than 500,000.[102]

BURDEN OF A $100 / TONNE CO_2e PRICE ON HOUSEHOLDS BY COMMUNITY SIZE IN 2020

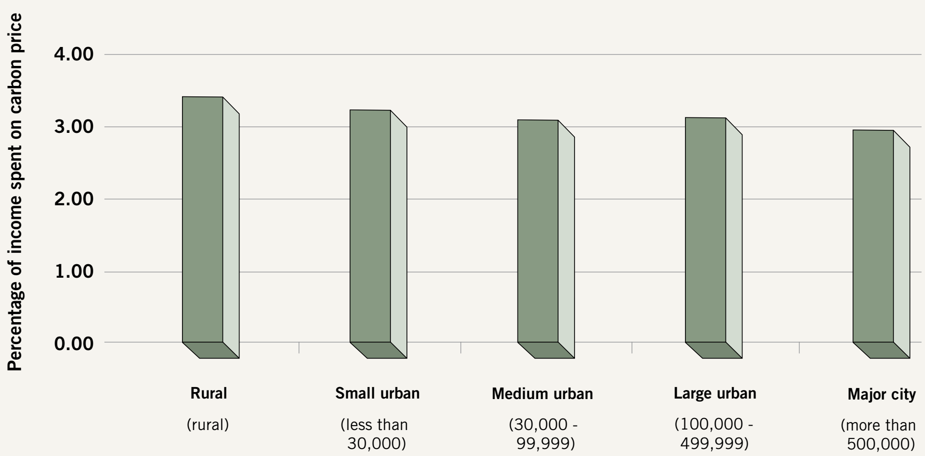

FIGURE 27

102 Data provided to NRTEE by Statistics Canada, October 1st 2008.

Several factors may contribute to the greater exposure of rural households. First, rural Canadians have lower average incomes than their urban counterparts.[103] As has already been seen, carbon pricing will have a disproportionate impact on lowest income households. However, the analysis in Figure 27 does not evaluate discretionary income, and costs of living (for example, property taxes) tend to be lower in some rural areas than urban ones. Second, it is also possible that rural lifestyles may be more emissions-intensive than urban lifestyles in some instances, however, the evidence for this is limited.[104]

In addition, rural and suburban dwellers may be less able to reduce their exposure to carbon pricing than those in urban areas. Lower-carbon transportation alternatives, such as public transit or cycling, are often unavailable or impractical in rural areas. In economic terms, rural households tend to have a lower degree of price elasticity than urban households.[105]

Northern and remote communities face a particular challenge from carbon pricing. Prices of goods and services in many remote communities are already heavily influenced by the high costs of transport and transport fuels, and carbon pricing will add to these transportation costs. In addition, many northern and remote communities are dependent on carbon-intensive energy sources, in particular diesel generators. Using the Northwest Territories as an example, it is noted that electricity prices for households there are typically at least three times higher than those in Vancouver or Winnipeg.[106] Fuel prices are similarly high. In the Northwest Territories, domestic heating oil is 15-50% more expensive, and diesel is 20-80% more expensive than in southern Canada.[107]

103 Alasia and Rothwell (2003).

104 Evidence from BC suggests that urban households actually tend to commute longer distances on average than rural households. (Rivers 2008).

105 Houthakker (1974), cited in Bernstein, M.A. and Griffin, J. (2006).

106 Prices for the Northwest Territories from Arctic Energy Alliance (2008); other prices from National Energy Board (2008).

107 Prices for the Northwest Territories from Arctic Energy Alliance (2008); other prices from Natural Resources Canada (2008).

8.3 COMPETITIVENESS RISKS AND MACROECONOMIC IMPACTS RESULTING FROM BROAD, UNIFIED CARBON PRICING POLICY[108]

- **Competitiveness issues are driven by sectors': 1) trade exposure; and 2) carbon exposure, or emissions intensity.**
- **Overall, the net impacts of competitiveness issues on the Canadian economy as a result of carbon pricing policy will likely be small. Potential small structural changes in the economy may result from leakage. However, under carbon pricing policy the economy still grows, and is forecast to be twice as large in 2050 than it is now.**
- **With implementation of an increasing carbon price in Canada, competitiveness and leakage risks change over time. Risks tend to be larger in the medium term, as the stringency of the policy is increased, but before international linkages harmonize prices with major trading partners.**
- **Modelling suggests some sectors will likely be better off (e.g., electricity generation, office machinery and equipment) and some likely worse off (e.g., natural gas, refined petroleum, and crude sectors), compared to a business as usual scenario.**
- **In the short to medium term, domestic climate policies and carbon emissions pricing policies can be expected to be implemented by many of Canada's trading partners, moderating the impact of competitiveness issues.**

Competitiveness and "carbon leakage" are consistently raised as critical issues for any carbon pricing policy. If Canada were to implement a pricing policy while its trading partners did not, Canadian industries could be competitively disadvantaged by the added cost burden. Competitiveness issues could impose additional costs on the Canadian economy if these added costs led to firms shutting down or shifting production abroad to jurisdictions with a substantially weaker carbon pricing policy. By reducing demand for Canada's exports and increasing Canada's demand for imports, Canada's trade position would be weakened and its overall level of economic activity decreased.

Further, competitiveness issues could also affect the efficacy of a carbon pricing policy through carbon *leakage.* Leakage occurs when firms relocate to jurisdictions without carbon pricing policy or with less stringent policies and then continue to produce greenhouse gas emissions in the new location. In this case, a Canadian carbon pricing

108 Analysis in this section is drawn from reports commissioned by the NRTEE: Informetrica (2008) and Rivers (2008).

policy would not have reduced emissions overall, merely dislocated them outside its borders. Global emissions might then remain unchanged (or even increase) despite a decrease in Canada's emissions and the costs of such reductions to the Canadian economy.

The twin issues of leakage and competitiveness are best thought of as risks associated with implementing a Canadian carbon pricing policy. There is some uncertainty as to how and when Canada's trading partners will implement carbon pricing policy. There is also uncertainty as to the magnitude of the impact on global emissions and Canada's economy, were Canada to implement policy independent of its trading partners**.** Yet these issues again arise from fragmented policy, in this case *international* policy fragmentation. Competitiveness and leakage issues result when carbon pricing policy is non-uniformly applied across different countries, and industry experiences a different price and different rules in different jurisdictions.

The significance of competitiveness and leakage risks therefore depends on: 1) the likelihood of trading partners implementing policy of their own; and 2) the magnitude of potential impacts on the Canadian economy should differences persist between the policy in Canada and internationally. The concerns of competitiveness and leakage based on this formulation that they are an implementation risk for carbon pricing policy are explored. First, the international context is assessed to indicate current and likely future states of climate policy in Canada's major trading partners. When applying economic models, it is discovered that some sectors will likely experience clear competitiveness effects. Forecasts suggest that the Canadian economy as a whole, however, will not experience significant adverse economic effects from competitiveness issues. Finally, the modelling results are used to develop a framework for thinking about competitiveness and identifying potentially vulnerable sectors of the Canadian economy.

8.3.1 International Context: Policies of Canada's Trading Partners

Risks of competitiveness and leakage issues are driven by differences between stringencies of climate policies in Canada and its international trading partners. Under a negotiated global policy framework with a consistent price on carbon across the global economy, for example, competitiveness issues would, in theory, be substantially mitigated.[109] While future climate policies in other jurisdictions are uncertain, a survey of international climate strategies suggests it is highly unlikely that Canada would face a scenario in which it acted entirely independently from its trading partners.

Competitiveness risks are thus moderated by the plans for implementing climate policies in the short to medium term in countries that are Canada's major trading partners. The United States, for example, (the source of 54.9 % of Canada's imports and the destination of 81.6% of its exports in 2006) is by far Canada's largest trading partner. Given that President Obama has publicly advocated a cap-and-trade approach to climate policy, an American carbon pricing policy is likely. Similarly, major trading partners such as Japan and South Korea are developing climate policies. Members of the European Union (EU) have implemented carbon pricing policies through the EU emissions

109 Under a global price, Canadian industry would face a level playing field. However, emissions-intensive industries specific to Canada (e.g. the oil sands) might still face competitiveness issues given that it would experience high carbon costs. Less intensive industries could have a competitive advantage, due not to a difference in carbon price but to a difference in emissions intensity.

trading scheme as well as additional domestic programs. Development of regional programs such as the Western Climate Initiative and the Regional Greenhouse Gas Initiative further indicate the global movement toward implementing pricing policy.

Table 11 provides an overview of Canada's trading partners and their status in developing carbon pricing policy, while Appendix A provides a more detailed assessment of current and planned policies in Canada's most important trading partners. They indicate, that many of Canada's top trading partners are considering implementing climate policies before 2020, representing 86% of Canada's exports and 72% of its imports in 2006 figures. The details and timing of implementation, the specifics of the design, and particularly the stringency of these policies, however, remain uncertain.

PRICING POLICIES OF CANADA'S MAJOR TRADING PARTNERS

Country	% share of imports (2006)	% share of exports (2006)	Carbon Pricing Policy
United States	54.9	81.6	Proposed
China	8.7	1.7	No
Japan	3.9	2.1	Limited program
United Kingdom	2.7	2.3	Yes
Mexico	4	1	No
Germany	2.8	0.9	Yes
Norway	1.4	1.4	Yes
South Korea	1.5	0.7	Proposed / Planned
France	1.3	0.7	Yes
India	< 1.2	< 0.5	No
Australia	< 1.2	< 0.5	Yes; implemented by 2010

TABLE 11

8.3.2 Macroeconomic Modelling Results: Small Effects on Economy as a Whole

Economic modelling provides insight as to possible impacts of competitiveness issues. Outputs from the CIMS model were used to inform the TIM and D-GEEM models, which, as macroeconomic models, are well-suited to explore possible effects of carbon pricing on the Canadian economy as a whole. Overall, model forecasts suggest very small macroeconomic implications of pricing policy for the Canadian economy as a whole. Table 12 highlights forecasts of GDP impacts of *fast and deep* carbon pricing from the D-GEEM forecast. As the table illustrates, overall, all sectors are forecast to be larger in 2050 than they are today, even under *fast and deep* pricing policy. While the forecast does project a loss of GDP relative to the *business as usual* case, it is important to remember that substantial growth of the economy still occurs: The D-GEEM results suggest that even under carbon pricing, the economy would grow 133% by 2050.

GDP GROWTH FORECASTS USING D-GEEM (RELATIVE TO 2006)

	2020	2050
Growth of the economy (GDP) under business as usual	39%	144%
Growth of the economy (GDP) under fast and deep pricing	34%	133%

TABLE 12

Table 13 and Table 14 show more detailed macroeconomic forecast results from the TIM and D-GEEM model respectively. The forecasts generally corroborate each other, suggesting moderate impacts on the economy as a whole, but larger, more significant impacts on specific industries.

In the TIM forecast, overall domestic final demand is changed from the *business as usual* (BAU) case in all years by less than one percent. Household incomes are strengthened slightly in real terms largely because of a small positive effect on employment, primarily due to added employment in manufacturing. TIM forecast results suggest no major overall impacts on real demand, productivity and labour markets, or real incomes as a result of pricing policy. The impacts on the economy overall are therefore forecasted to be small. In the TIM forecast, some of Canada's trading partners are assumed to also implement comparable carbon pricing policies.[110] The NRTEE's assessment of the climate policies of Canada's major trading partners, presented above, suggests this assumption is reasonable and reinforces the need for coordinated global action by all emitters, including Canada.

110 This scenario of some global policy action is modelled by reducing trade elasticity parameters in CIMS and linking CIMS outputs to TIM. While this modelling approach is not an ideal representation, it provides a reasonable indication of macroeconomic impacts without running a complex global model.

MACROECONOMIC IMPACTS OF *FAST AND DEEP* CARBON PRICING FROM TIM FORECAST: *CANADA ACTS IN CONCERT WITH SOME TRADING PARTNERS (% CHANGES FROM BUSINESS AS USUAL)*

Macroeconomic indicator	2007	2011	2020	2030	2050
GDP	0.17 %	0.51 %	-0.52 %	-1.37 %	-0.76 %
Domestic Final Demand	0.07 %	0.23 %	-0.04 %	-0.23 %	0.07 %
Exports	0.25 %	0.84 %	0.04 %	-1.64 %	-0.86 %
Imports	-0.04 %	0.08 %	1.49 %	1.71 %	1.55 %
Output per Employee	0.06 %	-0.11 %	-1.9 %	-2.63 %	-1.35 %
Employment	0.06 %	0.45 %	0.97 %	1.17 %	1.13 %
Unemployment Rate	0.00 %	-0.10 %	-0.30 %	-0.30 %	-0.30 %
Disposable Personal Income	0.13 %	0.52 %	0.38 %	0.85 %	0.46 %
Pre-tax Corporate Profits	-0.42 %	-1.38 %	-3.12 %	-3.74 %	-6.94 %

TABLE 13

D-GEEM modelling also highlights possible macroeconomic impacts of *fast and deep* pricing policy. However, in contrast to the TIM forecast described in Table 13, which modelled *fast and deep* pricing in Canada in the context of comparable pricing policy from some major trading partners, the D-GEEM forecast assumes that Canada acts alone. As noted earlier, it seems unlikely that none of Canada's trading partners would implement pricing policy before 2050. Indeed, the EU has already implemented carbon pricing. This scenario thus represents a 'worst case' for competitiveness and leakage issues. Table 14 shows the changing impact of carbon pricing policy on gross domestic product and consumer welfare through the forecast period under this scenario. Both welfare and economic output increase slightly before falling as a result of gross domestic product, which is 5% lower in 2050 than in the BAU case. The early increase is a result of a shift by consumers from investment to consumption, reflecting the lower returns to investment as a result of the policy. By 2050, both welfare and output are decreased as the economy responds to the strong carbon price signal. Note that consumer welfare in this case does not include the benefits of a policy (i.e. avoided effects of climate change and other co-benefits).

MACROECONOMIC IMPACTS OF *FAST AND DEEP* CARBON PRICING FROM D-GEEM FORECAST: *CANADA ACTS ALONE (% CHANGES FROM BUSINESS AS USUAL)*

Macroeconomic indicators	2020	2050	Comments
Consumer welfare	0.15%	-3.19%	Consumer welfare measures the consumption of goods and services as well as leisure, but does not include increases in welfare due to a cleaner environment. The forecast projects increases in welfare in the short- to medium-term due to shifts from investment to consumption.
Gross Domestic Product	-3.26%	-4.83%	The forecast projects decreases in GDP relative to BAU; however, under the *fast and deep* scenario, GDP grows 34% by 2020 and 133% by 2050; the economy still grows under carbon pricing policy.
Gross output	-3.71%	-6.02%	
Net wage rate	-4.98%	5.64%	The net wage rate measures wages after (direct) income tax has been paid.
Return on new capital investments	-3.04%	-3.02%	
Labour force size	-1.31%	2.48%	
Total trade	-3.25%	-3.94%	Total trade is a sum of imports and exports.
Price of foreign exchange	0.05%	-0.59%	
Greenhouse gas emissions	30.87%	52.70%	

TABLE 14

While the results of the two model forecasts are directionally consistent, the differences between the forecasts are also informative. Since the D-GEEM forecast assumed that Canada would implement carbon pricing policy independent of its trading partners, the forecast represents a 'worst-case' scenario. Different assumptions about revenue recycling in the model scenarios also affect GDP impacts. TIM recycles revenue back to each sector, while D-GEEM recycles revenue to labour taxes in this forecast.

As illustrated in Table 15, the D-GEEM and TIM forecasts are consistent with these differences between the scenarios, with TIM predicting smaller GDP impacts. Together the forecasts suggest that carbon pricing will not have a large overall impact on the growth of Canada's economy in the long term.

GDP IMPACTS OF *FAST AND DEEP* CARBON PRICING POLICY FORECASTS

		D-GEEM (Canada acts alone)	TIM (Some trading partners implement pricing policies)
Percent change in GDP from business as usual due to *fast and deep* pricing	2020	-3.3%	-0.5%
	2050	-4.8%	-0.8%

TABLE 15

8.3.3 Sectoral Analysis of Competitiveness and Leakage Risks

While overall impacts of carbon pricing policy are likely to be modest in the long-term, individual sectors will be more, or less, impacted as a result of policy. Modelling results suggest that the vulnerability of sectors is defined by the degree to which they are trade-exposed and cost-exposed. Table 16 – showing results from the TIM model – highlights sectors that experience the most significant effects from differential policy in the forecast.

SECTORS WITH MOST SIGNIFICANT FORECASTED TRADE IMPACTS (TIM) AS A RESULT OF *FAST AND DEEP* CARBON PRICING POLICY

	Exports	Imports
Sectors with negative forecasted effects on trade of 10% or greater	Refined petroleum Natural gas Copper and alloys	Crude petroleum Coal and coal products Natural gas
Sectors with positive forecasted effects on trade of 10% or greater	Electric power Freight truck transportation	Metal fabricated basic products Office machinery and equipment Printed matter Business and personal travel Commercial services

TABLE 16

Again, results from the D-GEEM model generally corroborate results from TIM in that similar sectors are identified as likely to be impacted. Figure 28 shows forecasted impacts of $100 / tonne CO_2e on exports in Canada in 2020. Recall that because the D-GEEM scenario assumes Canada implements policy independently of its trading partners, these results represent 'worst case' impacts. Both oil and gas extraction sectors are likely to see significant reduction of exports as a result of carbon pricing policy. Importantly, significant economic rents being collected by Canadian producers are not included in the model; as a result, the analysis likely overestimates the negative impact of carbon pricing on exports of oil and gas. Coal exports are expected to decline significantly as well, though these exports are very small to begin with. Impacts on other sectors are forecasted to be less severe, but heavy manufacturing sectors – petroleum refining, cement production, chemical production, and primary metal manufacturing – are also forecasted to see exports decline somewhat. In contrast, non-energy intensive sectors, which make up most of Canada's output, are forecasted to have increased exports upon the implementation of carbon pricing policy.

IMPACTS OF $100 / TONNE CO_2e PRICE ON CANADIAN EXPORTS IN 2020

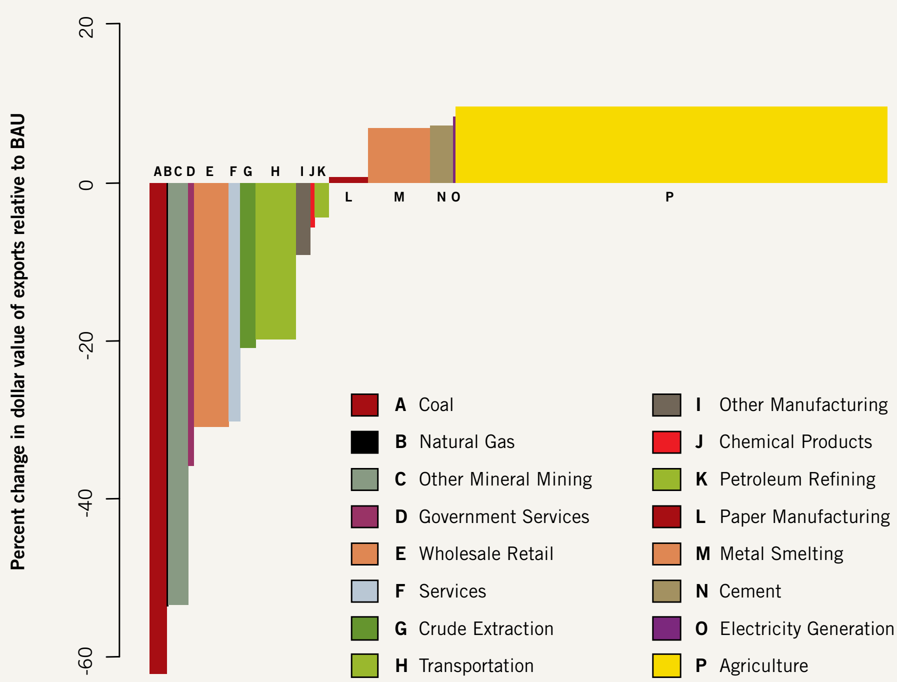

FIGURE 28

The figure shows estimated reduction in exports by commodity resulting from a $100 / tonne price applied on all emissions in Canada, as forecast using D-GEEM. The height of the bars indicates the magnitude of the forecasted impact on exports in 2020 in terms of percent change relative to business as usual. The width of the bars reflects the relative size of the export market for each commodity, illustrating the contributions of each to Canada's trade exports.

Figure 29 shows the forecasted impacts of policy on imports. Coal and natural gas imports are expected to decline somewhat as a result of reduced domestic demand for those products. Import impacts on other products are expected to be less severe. Overall the likely impact of carbon pricing on imports seems to be much less severe than the impact on exports.

IMPACTS OF $100 / TONNE CO_2e PRICE ON CANADIAN IMPORTS IN 2020

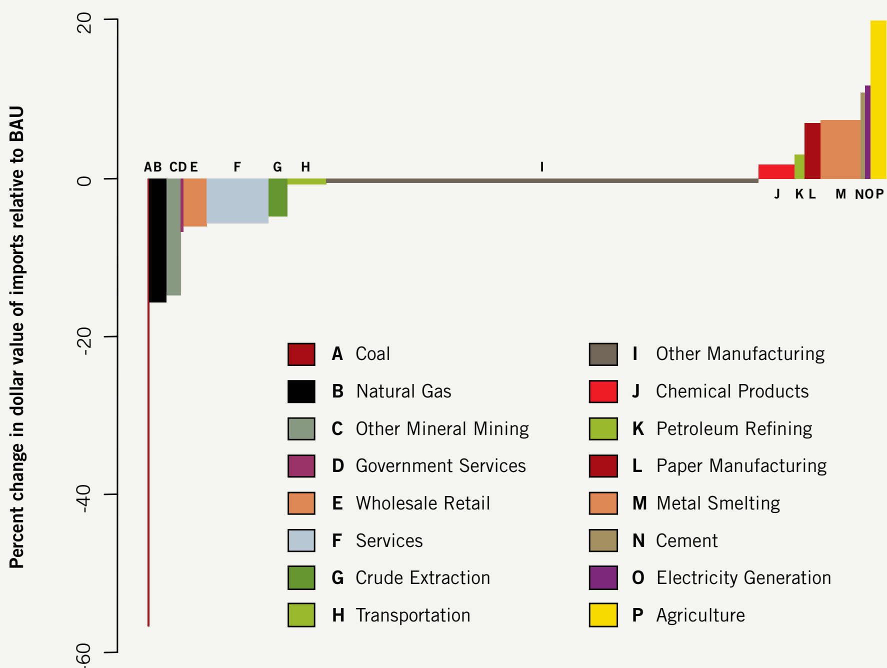

FIGURE 29

The figure shows estimated reduction in imports by commodity resulting from a $100 / tonne price applied on all emissions in Canada, as forecast using D-GEEM. The height of the bars indicates the magnitude of the forecasted impact on imports in 2020 in terms of percent change relative to business as usual. The width of the bars reflects the relative size of the import market for each commodity, illustrating the contributions of each to Canada's trade imports.

Decreased trade in specific sectors in the forecast suggests three main factors could be relevant. First, demand for products from some sectors is decreased due to technological shifts. The electrification of the economy in the CIMS scenario, for example, suggests that demand for fossil fuels such as coal and natural gas will be depressed as more energy is supplied through low-carbon electricity, reducing imports and exports. Second, domestic production could be replaced with production from jurisdictions with lower prices of carbon, increasing imports. Similarly, Canadian firms could relocate production outside of Canada to jurisdictions with less stringent policy, thus reducing exports. Without using a global trade model, these analyses cannot definitively identify how much leakage is likely to occur as a result of implementing Canadian pricing policy.

8.3.4 A Framework for Thinking about Competitiveness Impacts

The modelling results presented here suggest a useful framework for identifying sectors likely to be at risk. Competitiveness issues depend on the extent to which Canada's trading partners implement comparable climate policy. In the case of disparity between policies, differences in firms' costs result in competitive disadvantages for firms in jurisdictions with a higher carbon price. Whether a specific industry sector faces competitiveness problems as a result of carbon pricing therefore depends on: 1) the cost exposure of the sector (a greater emissions intensity increases the variation in cost burden between jurisdictions); and 2) the trade exposure of the sector (more international competition within a sector, whether in domestic or international markets, results in greater potential for competition between firms under different carbon price constraints).

This framework thus suggests a "tale of two economies," highlighting variability in the likely competitiveness impacts of a carbon pricing policy in different sectors. On one end of the spectrum, non-emissions-intensive and non-trade exposed sectors (such as the service and some light manufacturing industry) will face smaller competitiveness risks. At the other extreme, emissions-intensive and trade-exposed sectors (such as industrial non-ferrous smelting) will face more substantial competitiveness risks. A small segment of Canada's total economy will likely face concentrated exposure to competitiveness risks.

Figure 30 and Figure 31 illustrate how different sectors of Canadian industry fit into this framework for exports and imports respectively. The figures plot each sector according to both the extent to which a $100 / tonne carbon price increases firms' costs and the extent to which the sector relies on international trade. The figures suggest that sectors such as iron, gas, oil, chemical manufacturing, and coal – sectors that are both cost exposed and trade exposed – are most at risk.

If high carbon prices are applied in Canada, domestic producers might see export sales eroded due to loss of competitive advantage. Similarly, they might see imports substituted for domestic production in domestic consumption. Figure 30 and Figure 31 are useful indicators as to which sectors might be most adversely affected by Canadian carbon pricing in terms of their international competitiveness. They indicate where mitigating measures might usefully be directed. The economic modelling analyses reinforce the notion that specific sectors might respond to pricing policy by reducing their production within Canada.

CARBON AND TRADE EXPOSURE OF SECTORS FOR CANADIAN INDUSTRY EXPORTS

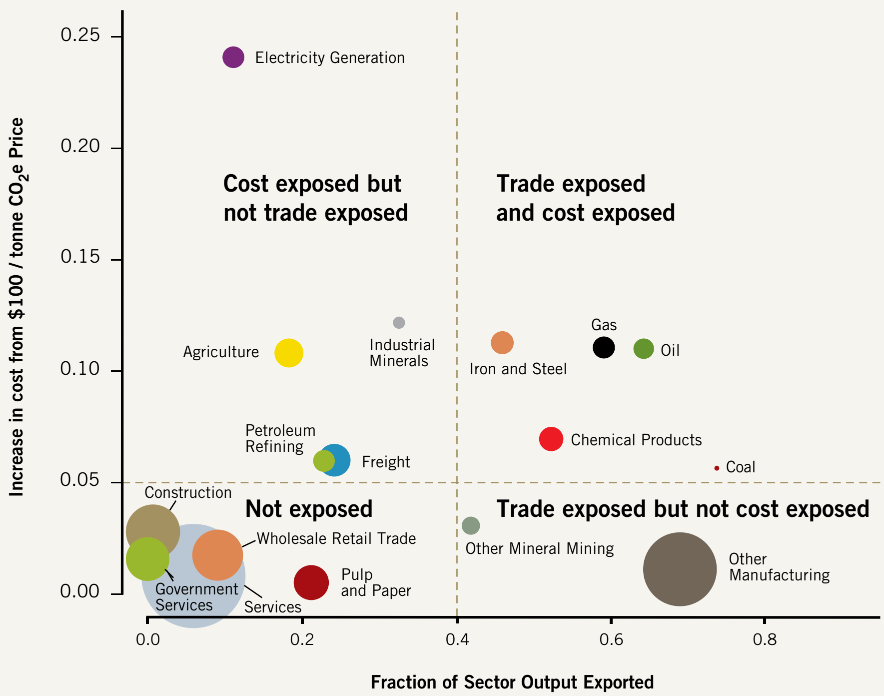

FIGURE 30

The horizontal axis shows the dollar value of sectoral exports as a share of total sectoral sales. The vertical axis shows the increase in costs associated with a $100 / tonne CO_2e price applied on all emissions. The area of each circle corresponds to the relative size of sectoral output.

8.3.5 Summary of Competitiveness Analysis: Changing Risks Through Time

While net impacts to the Canadian economy of pricing policy will likely be small overall, over time, competitiveness issues do pose significant risks for specific sectors that must be managed by policy. Risks to the competitiveness of these sectors could negatively affect the political acceptability of a policy. Leakage could still be an important issue. Even if overall economic impacts are small, movement of emission-intensive industries outside of Canada through leakage could have significant impacts on the overall effectiveness of the policy in reducing global emissions. Disentangling the actual competitiveness impact in a sector due to carbon pricing versus other, domestic or global economic policies is not easy.

CARBON AND TRADE EXPOSURE OF SECTORS FOR CANADIAN INDUSTRY IMPORTS

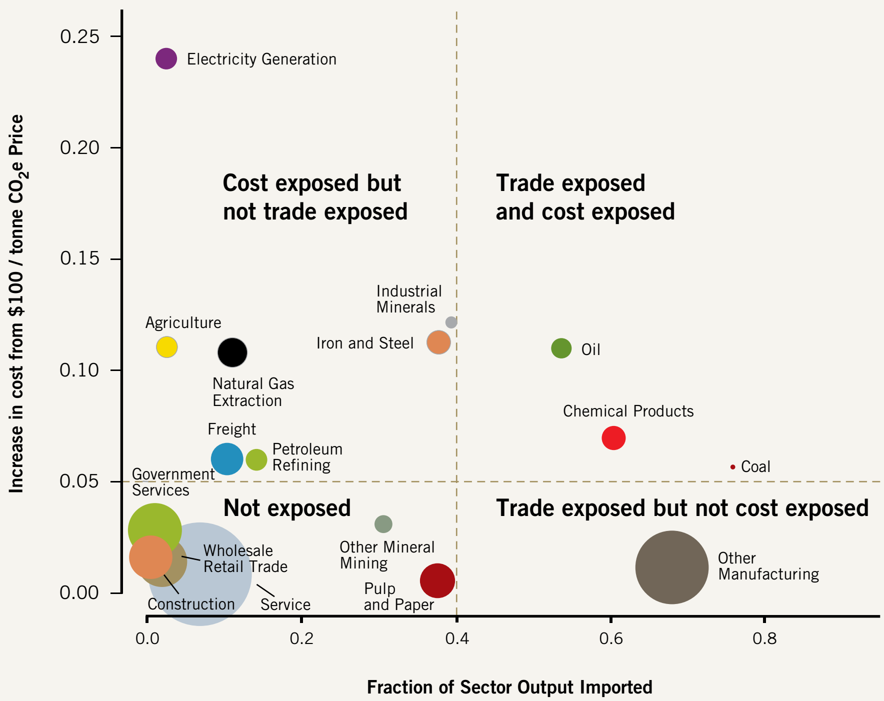

FIGURE 31

The horizontal axis shows the dollar value of sectoral imports as a share of total sectoral sales. The vertical axis shows the increase in costs associated with a $100 / tonne CO_2e price applied on all emissions. The area of each circle corresponds to the relative size of sectoral output.

The importance of competitiveness and leakage issues may also change between now and 2050. It appears unlikely that Canada would face an international trade environment in which trading partners would not also implement carbon pricing policy at some point in time. Similarly, in the long-term, some form of post-Kyoto global policy framework is likely. Various national cap-and-trade programs might link together, harmonizing the price of carbon and largely mitigating competitiveness issues.[111] In the short term, the relatively low prices of the *fast and deep* scenario are unlikely to have a significant impact on international carbon leakage or competitiveness. These implications suggest that addressing competitiveness is most critical in the medium term, as domestic carbon prices increase, but before international linkages harmonize prices with major trading partners.

111 See Section 6.1 for discussion of linkage issues.

9.0 IMPLEMENTATION OF A CARBON PRICING POLICY[112]

Policy *implementation* is at least as important as policy design. How can a carbon pricing policy be put into effect; how will it be managed over time? An effective long-term implementation strategy must answer two main questions. First, how will different levels of government collaborate to implement a unified pricing policy for Canada? Second, what kind of governance mechanisms are required to manage the pricing policy over time?

Throughout its year-long project on carbon pricing, the NRTEE consulted extensively with expert and broader stakeholders. At each consultation, the need for institutions and processes to govern and manage the carbon pricing policy over time was stressed. While there are some examples of carbon pricing governance frameworks at the provincial and international levels which provide some insight, overall this issue has received little attention or analysis in Canada carbon policy debate. This chapter seeks to highlight the importance of governance issues in designing and implying a unified carbon pricing policy for Canada.[113]

9.1 THE GOVERNANCE CHALLENGE: UNIFYING CARBON PRICES ACROSS JURISDICTIONS

- **Federal, provincial and territorial governments all have a role in climate policy. Governance mechanisms for enabling federal / provincial / territorial collaboration and co-ordination in policy implementation is critical to the success of long-term carbon pricing.**

The analysis presented in this report has argued that the Government of Canada's targets can be met at lowest cost only if carbon prices are unified across emissions and jurisdictions. This raises important questions on the governance of such a unified pricing regime, and the roles and responsibilities for the federal, provincial and territorial governments.

112 This issue was discussed in depth at the NRTEE's workshop on carbon pricing governance. See also Courchene (2008).

113 This chapter is informed by in-house NRTEE research and by the findings of a high-level workshop held by the NRTEE in December 2008 which discussed issues of governance and implementation of a potential carbon pricing policy.

Several issues frame this governance challenge:

- Federal, provincial and territorial governments share jurisdiction over greenhouse gas emissions.

- Carbon pricing policy has the potential to generate significant revenues. The management of these revenues (and/or the allocation of emissions permits) will be a central issue for the effective governance of carbon pricing policy in Canada.[114]

- Unifying carbon pricing policy across jurisdictions within Canada is essential for achieving cost effective emission reductions.[115]

The NRTEE consultations with expert stakeholders sought clarity and feedback on the following:

1. *The transition process and timing* – how do we move from the current patchwork of policy approaches to a carbon price that is unified across jurisdictions?

2. *Authorities* – how do we set and implement common, certain rules of engagement for governments, industry and consumers?

In response, participants focused on the need to explore the principles that should be used in developing institutions for carbon pricing policy, and the desirable characteristics of any proposed governance institutions. In particular, one objective of new institutions would be the creation of an appropriate federal/provincial/territorial governance mechanism and process to consider carbon pricing data and information, and propose market and pricing adjustments to ensure a unified, effective carbon pricing policy for Canada that meets national environmental and economic objectives.

Participants identified the following examples as potential models, or at the very least as examples from which to gain insight:

- From a jurisdictional perspective: the Canada-U.S. Air Quality Agreement.

- On shared data collections, independent forecasting and management: US. Energy Information Administration, Statistics Canada, Canadian Institute for Health Information.

Examples from other jurisdictions suggest a number of specific roles and responsibilities in the governance of carbon pricing systems.[116] An illustrative mapping of these roles and responsibilities to possible Canadian institutions is set out in Table 17. The table is illustrative only, and does not reflect the formal view of the NRTEE as to the appropriate roles and responsibilities for a Canadian cap-and-trade system. Rather, the table provides a guide as to the sort of roles that must be filled, and the kind of institutions that should take on these roles.

114 This issue was discussed in depth at the NRTEE's workshop on carbon pricing governance. See also Courchene (2008).

115 The need for a unified, national approach is emphasized as well in Gibbons and Roberts (2008).

116 Commonwealth of Australia (2008).

ILLUSTRATIVE ROLES AND RESPONSIBILITIES FOR THE GOVERNANCE OF A CANADIAN CAP-AND-TRADE SYSTEM

Role within cap-and-trade system	Possible institutional responsibilities for a Canadian cap-and-trade system
Set long-term targets for Canada	Parliament
Determine caps for each compliance period	Parliament
Determine balance between domestic abatement and international purchases to meet Canada's targets	Parliament
Decisions on which sectors and emissions are covered; decisions on expansion of coverage, (e.g. to international aviation and shipping)	Parliament
Set procedures for triggering price ceilings or safety valves	Federal Government
Set rules for inter-provincial equivalencies, and process for phasing towards standardized national system	Federal, provincial and territorial governments, determined through FPT process.
Determine rules for allocation	Federal, provincial and territorial governments, determined through FPT process
Establish criteria for assistance / free allocations	Federal, provincial and territorial governments, determined through FPT process
Establish complementary regulations consistent with carbon pricing	Provincial governments
Run auctions and collect auction revenues from emitters	Carbon Pricing and Revenue Authority
Monitor and enforce compliance; prevent market manipulation	Carbon Pricing and Revenue Authority
Determine which industries / entities meet criteria for assistance	Carbon Pricing and Revenue Authority
Set rules for reporting and measuring emissions, collect data	Carbon Pricing and Revenue Authority
Holds power to trigger relief mechanisms to avoid adverse economic impacts	Carbon Pricing and Revenue Authority
Advise on targets and caps	Independent Expert Advisory Body
Review and advise on adjustments to overall carbon pricing policy	Independent Expert Advisory Body

TABLE 17

As Table 17 illustrates, there is a hierarchy of responsibility, with Parliament providing the long-term direction and major policy decisions, governments establishing the relevant institutions and arrangements, and an independent regulator carrying out administrative decisions that should be outside political influence. Table 18 summarizes the roles that different possible institutions could play.

NOTIONAL INSTITUTIONAL ROLES AND RESPONSIBILITIES FOR A CANADIAN CARBON PRICING POLICY

INSTITUTION	ROLES AND RESPONSIBILITIES
Parliament	Sets the long-term goals and targets, the choice of instrument, the principles of design and operation, and the roles and responsibilities
Federal government, co-ordinated with provinces and territories through FPT process	Establishes carbon authority and independent advisory body; establishes basis for permit allocation; establishes criteria for free allocations and/or rebates
Provincial governments	Establish complementary regulations consistent with carbon pricing
Carbon Pricing and Revenue Authority	Empowered with regulatory and operational decisions: monitors and enforces compliance, runs auctions and collects revenues from emitters, determines which industries/entities meet criteria for assistance, has power to trigger any relief mechanisms, and sets rules for reporting and monitoring emissions
Independent Expert Advisory Body	Advises on interim targets for each compliance period, provides ongoing evaluation, and advises on adjustments to carbon pricing policy
Office of the Auditor General of Canada	Reviews and reports on collections and disbursments of auction revenue for transparency and accountability purposes

TABLE 18

9.2
INSTITUTIONS FOR AN ADAPTABLE AND ROBUST LONG-TERM PRICE SIGNAL

- **Policy can be made adaptable by establishing institutions for monitoring and evaluating programs to enable learning.**
- **Well-designed institutions can provide not just policy certainty in the short term, but also policy credibility in the long term. By establishing clear and transparent processes for adjusting policy, institutions can reduce uncertainty for firms and households, allowing them to make better decisions.**
- **Clear communication of policy goals and a long-term strategy can further reduce investment risks without eliminating adaptability.**

Managing uncertainty is an issue of policy implementation. Because the timelines associated with meeting emission reductions objectives for 2020 and 2050 are very long, uncertainty is a critical issue for carbon pricing policy. Uncertainty in the timing and nature of policy gives firms and households incentive to delay investment in low-carbon technologies or solutions. Flexible pricing policy that could adapt through time could help manage international uncertainties regarding the policies of trading partners and the impacts of the policy. How then, can a permanent, long-term price signal be transmitted while ensuring the policy can adapt to new information and new circumstances?

A policy implementation strategy that can address uncertainty and ensure pricing policy is cost-effective over the long term. While *policy adaptability* and *policy certainty* are important objectives for a carbon pricing policy, there are trade-offs between the two criteria. If a policy has clearly been designed to be flexible or changeable at some future time, the future “rules of the game” are less certain. On the other hand, fixing policy in advance implies a failure to adapt to new information in the future, such as evolving climate science or the policies of Canada’s trading partners. [117] Given the apparent trade-offs between certainty and adaptability, minimizing risks to emitters from future policy changes through achieving credible policy may be a more pragmatic approach over the long run than providing absolute policy certainty.[118]

117 Quiggan (2005).
118 Our emphasis on the need for adaptive policy design is reflected by others, e.g. Swanson and Bhadwal (2008).

To be cost-effective over the long term, policy must provide a clear indication to firms and individuals as to the rules of compliance over the time period of the policy. Yet uncertainty increases dramatically through time as future policy implications are projected. Policy must also be able adapt to new information and new circumstances to be effective over the long term. While different options for policy design elements can affect the adaptability and durability of a carbon pricing policy, the way in which the policy is implemented and managed over time is most critical for ensuring adaptive policy that is effective over the long term. Balancing policy certainty and adaptability is thus an issue of the design of institutions associated with implementing and managing a pricing policy over time.

9.2.1 Institutional Approaches to Managing Policy over the Long-term: Rules versus Discretion

In developing institutions for carbon pricing Canada can learn from other jurisdictions and from the research literature. In these institutions, developed or suggested, a tension between rules-based and discretion-based policy adjustment mechanisms is identified. On one hand, if the institution can make discretion-based adjustments, it can better adapt and respond to new information. On the other hand, rule-based processes are more predictable and certain, so reduce uncertainty for firms and households. They also help ensure fairness and transparency in application. Several elements used in other pricing policies to manage this trade-off are surveyed.

Regular review periods: monitoring and evaluation

Whether an institution relies on a discretionary or rules-based approach to policy adjustment, regular, scheduled reviews of policy are an important process for policy adaptation. At each period of review, targets, policy stringency, or other policy design elements are adjusted.

The British Columbia carbon tax, for example, has declared an initial four-year schedule only for the taxation price of carbon emissions. In the first year, 2008, the tax is set at $10 / tonne, and the tax rises by $5 each year to $30 / tonne by 2012. The limited time horizon on the schedule allows the stringency to be adjusted after four years. At this point, more information will be available as to the policy actions of other jurisdictions, as well as international climate policy developments. The increasing stringency of the tax over the four-year period suggests that the tax would presumably continue to grow as long as other jurisdictions had implemented similar policies, thus mitigating competitiveness issues. Alternatively, the tax could be cancelled if a more comprehensive policy were implemented through a regional initiative like the WCI or through a Canada-wide, unified program.

The level of the BC carbon tax is set by legislation, thus establishing short-term certainty. To provide increased certainty over the long term, BC has legislated *targets* for 2020 and 2050 and has also set short-term targets for 2012 and 2016 to provide greater certainty. Without these longer-term signals, the increase over the four-year period alone is only an implicit signal to firms to provide certainty as to future prices over the longer term, and the existence of the review period could suggest policy backsliding is at least possible after 2012. Periodic regulatory interventions can lead to cyclical investment behaviour, as uncertainty in the future state of policy provides incentives for decision-makers to "keep their options open," particularly in the time period immediately preceding a scheduled policy readjustment.[119] More generally speaking, the longer the period of scheduled prices, the less credible it is, given the shorter cycles of elections and new governments.

An important prerequisite of review periods is regular monitoring of the impacts and effectiveness of the policy. Collecting this data is critical to ensure review periods are informed by good information—good policy evaluation depends on good policy monitoring mechanisms. The recently passed UK Climate Change Act, for example, created an independent, expert Committee on Climate Change that recommends five-year carbon budgets, and which reports annually on reductions and progress toward targets and rolling carbon budgets.

Contingent policies

One "rules-based" process for adapting policy to new information could be to specify policy changes that should be triggered if specific future events occur. These are contingent policies. An example under a cap-and-trade system is to allocate a fixed number of tradable permits initially, but provide additional permits if the market price of permits reaches a pre-determined trigger price, thus helping to moderate the price. [120]

While such adjustable allocations approach targets price and quantity uncertainty trade-offs, contingent policy design can also allow for changes in policy stringency. Examples of contingent policy design include:

- The European Union has moved toward a resilient design through a contingent target: an EU-wide target of 20% reductions by 2020 will be increased to 30% if other countries come on board. The EU is also considering adjusting the scope of its ETS to include the aviation sector as well as carbon capture and storage.

- Similarly, the UK Committee on Climate Change recommended contingent carbon budgets and targets for the UK, depending on the status of global negotiations.

- Australia's Garnaut Review of Climate Change proposes identifying four emission reduction trajectories of varying stringency. The trajectories would include schedules for allocation of tradable permits. In any year, the government could announce whether conditions had been met (as triggered by developments in international climate policy) for movement to a more stringent trajectory, which would occur five years after the announcement to allow for time to firms to adjust. Once a trajectory shift occurred, no change could occur for another five years.

Contingent policy approaches such as these could provide both policy certainty and adaptability. While adaptive changes to policy are possible under clear circumstances, the policy is not infinitely flexible and thus unpredictable. The approach therefore allows firms to better manage their risk by bounding the uncertainty in possible policy

119 Blyth (2007).
120 Kopp et al (1997).

changes, since the range of possible high-cost outcomes is limited. On the other hand, since contingent policies must essentially pre-specify conditions for policy adjustment, contingent approaches have limited flexibility to adjust to unanticipated future circumstances.

Closed-loop feedback policies and monitoring

To make adjustment processes even more rules-based, institutions could explicitly build in feed-back mechanisms to a policy design. Drawing from literature for the management of uncertain ecological systems, policies could be redefined as management rules.[121] For example, the stringency of a policy could be explicitly linked to metrics of system performance such as emissions reduced or the price of tradable permits.

This closed-loop feedback approach, however, has limitations in that it eliminates discretion altogether. An institution relying only on closed-loop adjustments might be unable to respond to unanticipated circumstances that require some level of discretion. Elimination of all political discretion in policy making is not credible and raises issues of accountability. Lack of clarity about the circumstances in which policy will be changed will add uncertainty, rather than reduce it.

Transparent and simple processes for policy adaptation

If a discretionary approach is taken to management of policy adjustment, uncertainty for firms and households can be reduced through the adoption of transparent policy practice, based on consistent principles. A clear process could ensure changes in policy result from new, unanticipated information, and generally not from short-term political pressures or from a change of government. The rules-based Australian example recommends the alternative trajectories and conditions for changing trajectories be clearly defined at the announcement of the policy[122]. One could, however, imagine other approaches to transparent policy adaptation and learning that are slightly less rules-based; a multi-stakeholder group or independent expert committee could be established, for example, with a mandate to assess options for policy adjustment with new information.

Under these circumstances, clear and transparent process may reduce investment risk. This approach sends the signal to firms that policy changes will occur only under specific conditions, reducing the uncertainty associated with future policy adaptations and reducing the probability of a high-cost policy change. Further, a clearly defined process with longer transition periods allows firms to better anticipate potential policy shifts and plan accordingly. Like the five-year adjustment period in the Australian proposal, increased flexibility reduces the expected costs of future policy shifts. Similarly, a simple process for policy shifts can reduce transaction costs associated with transitions. Simplicity can thus further reduce the expected cost of future policy shifts and thus further reduce investment risks for firms.

121 See de la Mare (1998) for a discussion on feedback mechanisms in fisheries management.

122 Garnaut (2008).

Communicating credibility and commitment

Expanding on the idea of regular review periods, the UK Climate Change Act requires the government to set five-year carbon budgets, starting with 2008-2012. However, the five-year budgets must be consistent with medium- and long-term targets, and are monitored by an independent body of experts. By linking the specific short term budgets with a more general planned trajectory for emission reductions, this approach could provide assurance of longer term policy without precluding adaptive capacity. Communicating credibility and ongoing commitment is a high level principle important for both rules and discretion-based approaches. The UK approach suggests longer-term policy confidence might to some extent complement shorter term policy certainty.

By communicating commitment more generally, a policy could potentially reduce the probability that any government would waver dramatically from a proposed carbon pricing policy. This approach would provide less policy certainty than a long-term schedule for carbon prices or cap levels, but could still reduce investment risk for firms and households. The approach also allows for more extensive adaptability within the context of adjusting policy to meet targets and adapting to new international policy developments.

9.2.2 Examples of Carbon Pricing Institutions

Other countries have faced similar institutional challenges in managing carbon pricing policy over time. Two such examples are reviewed in more detail below. Both the UK Committee on Climate Change and the proposed Australian Carbon Pollution Reduction Scheme Regulator address the issues of providing both a robust pricing policy and clear processes for adjustment.

Setting targets and updating expectations: the UK Committee on Climate Change

The UK's *Climate Change Act 2008* established a carbon budgeting system which caps emissions over five-year periods, with three budgets set at a time. [123] This helps the UK to balance the tension between policy certainty and adaptability. The Committee on Climate Change is a UK statutory body, established under the *Climate Change Act 2008* to provide advice on a range of climate policy matters including:

- The appropriate level of 5-year 'carbon budgets', consistent with the government's 2020 and 2050 targets and international obligations; and,
- The extent to which the UK should seek to meet emission reduction targets domestically or through overseas credits.

The Committee thus provides the institutional structure supporting the carbon budgeting system. While the decision on carbon budgets is ultimately in the hands of Parliament, the Committee on Climate Change is perceived by many to have strong influence in setting the UK's carbon budgets, in part because of the high-level expertise and credibility of its members, who are all appointed by the Prime Minister.

123 Defra (2008).

Institutions for regulating emissions trading: Australia's Carbon Pollution Reduction Scheme Regulator

In a 2008 white paper, the Government of Australia set out the details of its proposed cap-and-trade system for reducing greenhouse gas emissions.[124] The White Paper proposes the establishment of a Carbon Pollution Reduction Scheme Regulator, with powers to:

- Monitor, facilitate and enforce compliance with the Scheme;
- Determine procedures for the auction of permits, and arrange auctions; and,
- Determine the eligibility of individual entities to receive free permits, and the quantity of permits to be allocated to them.

The regulator's decisions must be based on principles set out in legislation. This structure ensures that questions of broad policy direction (such as long-term targets) are established by Parliament, while decisions concerning individual entities and auctions (with potentially significant financial consequences) are undertaken by an independent regulator on the basis of transparent rules and principles.

9.2.3 Summary and Key Conclusions for Adaptive Long-term Carbon Pricing

Policy makers have a range of approaches available for balancing adaptability and certainty in carbon pricing policy. Since a full and detailed design of an institution to manage a carbon pricing policy is outside the scope of this report, the exact design is not included here. However, from the trade-offs associated with these options, a set of practical governance considerations emerge to guide implementation and institutional design for effective and efficient carbon pricing policy over the long term. They are:

Build explicit mechanisms for long-term pricing into implementation strategy

The trade-off between price certainty and adaptive capacity for a carbon pricing policy is an issue of how the policy is defined over the long term. On the one hand, a fixed fifty-year carbon pricing schedule is neither practical nor politically acceptable. On the other, a pricing policy with a short time horizon only could be equally ineffective given the time required to transform Canada's energy system. A balance between these two extremes cannot be achieved without incorporating additional policy mechanisms. This issue should be considered explicitly in planning for policy implementation. Since literature and current carbon pricing policy design dialogue pays limited attention to trade-offs between certainty and adaptability, this high-level consideration is important.

124 Commonwealth of Australia (2008).

Ensure adaptability by establishing institutions for monitoring and evaluating programs to enable learning

Adaptive capacity should be an important priority for all elements of policy design. Carbon pricing policy is an evolving and uncertain science so policy should be able to learn from successes and failures and improve over time. An ability to adapt elements of policy design (i.e. policy stringency, as well as how permits are allocated in a cap-and-trade system, how border adjustments are applied, which emissions are included, etc.) is therefore important.

To enable adaptive capacity, policy design should require both *monitoring* and *evaluation.* Data regarding the performance of the policy needs to be collected. Key metrics could include, for each region and sector: price of emissions permits, number of permits traded, tax revenue generated, changes in sector output, emissions intensities, and changes in technology investment. Similarly, the pricing institution should evaluate impacts of the policy. Regular periods of evaluation could be scheduled at which adjustments to policy could then be implemented.

Establish a clear process for policy adjustments

A clear process should be established for making such adjustments. A transparent and clearly defined process would be particularly important for adjustments to the stringency of the policy for ensuring policy certainty. Transparency would increase predictability regarding how the price signal might change in time. Clear pre-conditions for adjustments to policy stringency would reduce the probability of dramatic changes to carbon pricing; it should be possible, but not too easy, to implement changes. The process for policy adjustment could be either discretionary or rule-based. Rule-based approaches can reduce uncertainty and should be pursued where possible. However, some discretion will be required in order to credibly manage unforeseen circumstances. Placing such discretionary authority in the hands of an institution independent of government could help ensure adjustments are made in a timely and transparent manner.

Articulate a long-term vision and timeline for pricing

Governments should communicate an approximate strategy through time for planned adjustments to policy. Conveying more than just medium- and long-term targets, but also a policy road map to meeting these targets will help build confidence and credibility. Certainty should still be conveyed in the short term, similar to the five-year UK carbon budgets or the four-year BC carbon tax schedule. To ensure adaptability, the road map would not be unduly prescriptive or detailed in the long term, but would provide the proposed direction for policy with timelines set for key milestones. For example, a future transition point could be established in the medium-term for linking with international systems.

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APPENDIX A: OVERVIEW OF CARBON PRICING POLICIES FOR CANADA'S MAJOR TRADING PARTNERS

This table surveys carbon pricing policies of major trading partners.

Country	% share of imports (2006)	% share of exports (2006)	Medium and long-term targets	Current and proposed carbon pricing policies
United States	54.9 **Key sectors:** • auto manufacturing • other vehicle parts manufacturing • vehicle engine and engine parts • aerospace product and parts • resin and rubber manufacturing • vehicle transmission and power train parts manufacturing • navigational, measuring, medical, and control instruments manufacturing • iron and steel mills and ferro-alloy manufacturing	81.6 **Key sectors:** • oil and gas extraction • auto manufacturing • petroleum refining • aluminum production and process • paper mills • aerospace product and parts • non-ferrous metal smelting and refining • sawmills and wood preservation • resin and rubber manufacturing	1990 levels by 2020 80% below 1990 levels by 2050 (Obama Proposal)	No federal carbon pricing Regional Greenhouse Gas Initiative Cap-and-trade system in North Eastern States, for CO_2 in the electricity sector. National Cap-and-Trade: • 100% auction or permits; and • some recycling for technology policy. WCI Western States signed up for an economy-wide cap-and-trade. Proposed national cap-and-trade system (Obama Proposal)
China	8.7 **Key Sectors:** • computer and peripheral equipment • doll, toy and game manufacturing • audio and video equip. manufacturing • clothing • furniture • footwear	1.7 **Key Sectors:** • pulp mills • other basic organic chemical manufacturing • non-ferrous metals smelting and refining • recyclable metal • other non-metallic mineral mining	No carbon target. Target to reduce energy use per unit of GDP by 20% by 2010 and of quadrupling GDP between 2000 and 2020 while only doubling energy use	No carbon pricing in operation Reportedly exploring domestic cap-and-trade, but no policy announced.

Japan	3.9 **Key Sectors:** • auto / light duty manufacturing • computer and peripheral equipment • construction machinery • motor vehicle transmission / power train parts • other industrial machinery • semiconductor / electronic component • aerospace products / parts	2.1 **Key Sectors:** • coal mining • oilseed farming • animal slaughtering / processing • sawmills / wood preservation • copper, nickel, lead and zinc ore mining • aluminum production / processing • pulp mills	Currently no formal interim target. 60-80% below 1990 by 2050	**Tradable Permits (2006):** • voluntary emissions trading system (JVETS); • facilities bid for subsidies by pledging emission reductions; • subsidy-based voluntary credit system; and • aggregate emission reduction goal, 276,380 tonnes, represents 0.02 percent of Japan's annual carbon dioxide emissions. current pilot to explore expansion of the voluntary emissions trading system.
United Kingdom	2.7 **Key Sectors:** • oil and gas extraction • aerospace product and parts • pharmaceutical and medical manufacturing	2.3 **Key Sectors:** • Gold and Silver Ore Mining • non-ferrous metal smelting / refining • other basic inorganic chemical manufacturing • aerospace product and parts • non-metallic mineral mining	26-32% below 1990 by 2020 80% below 1990 by 2050	**Climate Change Levy (2001):** • energy tax that adds 15% to typical energy bills in business and public sectors; • revenue recycled to 0.3% cut in National Insurance contributions; • rises with inflation after 2006; and • exemptions for: fuels used by the domestic (household) or transport sector, fuels used for electricity. **EU Emissions Trading Scheme:** • cap-and-trade system for large emitters within the EU.
Mexico	4 **Key Sectors** • automotive / light duty manufacturing • motor vehicle electrical and electronic equipment • oil and gas extraction • computer and peripheral equipment • electrical equipment manufacturing	1 **Key Sectors:** • automotive / light duty vehicle • iron and steel mills / ferro-alloy manufacturing • animal slaughtering and processing • semiconductor and other electronic component • computer and peripheral equipment	No interim or long term targets	None Several Mexican States are observers to the WCI.

Germany	2.8 **Key Sectors:** • automotive and light-duty vehicle • pharmaceutical and medicine • other industrial machinery • navigational, measuring, medical, control instrument • engine, turbine, power transmission	0.9 **Key Sectors:** • iron ore mining • aerospace product and parts • engine, turbine, power, transmission	40 % reductions from 1990 levels by 2020 60% reductions by 2050	**EU Emissions Trading Scheme:** • cap-and-trade system for large emitters within the EU. **Energy Tax (2006):** • tax on coal,coke, lignite • fully exempts energy-intensive industries - glass, ceramics and cement - as well as domestic burning • non-fuel uses of energy products are exempt from taxation.
Norway	1.4 **Key Sectors:** • oil and gas extraction • petroleum refining	1.4 **Key Sectors:** • non-ferrous metal smelting and refining • non-ferrous metal rolling/ drawing/ extruding/ alloying	30% below 1990 by 2020, carbon neutral by 2030 (includes international reductions)	**Norwegian Cap and Trade merged with EU ETS (2008):** • 2008-12 phase has 30% of emissions covered by free allocation, varying by sector (e.g. petroleum sector pays); aiming to have full auctioning in all sectors by 2013. **Carbon Tax (1991):** • as of 2006, applied to about 65 per cent of Norway's CO_2 emissions; • most greenhouse gas emissions from energy and emissions-intensive industries not subject to the CO_2 tax; • \$16 - \$63 per tonne of CO_2.
South Korea	1.5 **Key Sectors:** • automotive / light duty vehicles • semi-conductors / other electronics • radio and television broadcasting and wireless communications • iron and steel mills / ferro-alloy manufacturing	0.7 **Key Sectors:** • coal mining • pulp mills • non-ferrous metal smelting and refining • animal slaughtering and processing	Long term targets to be announced in 2009	**Announced December 2007: package of proposed measures to address climate change to keep the country's greenhouse gas emissions at 1990 levels.** • included an emissions trading scheme, a tax on carbon dioxide emissions, expansion of the use of nuclear power and increasing the amount of renewable energy to 5% in 2011 and to 9% by 2030, up from 2.3% in 2007.

France	1.3 **Key Sectors:** • pharmaceutical and medicine • aerospace • wineries • toilet preparation manufacturing	0.7 **Key Sectors:** • other basic inorganic chemical • aerospace product / parts • engine turbine / power transmission		**EU Emissions Trading Scheme:** • cap-and-trade system for large emitters within the EU. **White certificate trading:** • suppliers of energy (electricity, gas, heating oil, LPG, heat, refrigeration) must meet government-mandated targets for energy savings achieved through the suppliers' residential and tertiary customers; • It is intended that during this time, the scheme will result in 54TWh of cumulated energy savings.
India	< 1.2	< 0.5	None	None
Australia	< 1.2	< 0.5	60% reduction by 2050	No carbon pricing currently in place. national cap-and-trade system to be implemented by 2010.

APPENDIX B: GLOSSARY AND LIST OF ACRONYMS

Note: terms in CAPITALS are found elsewhere in the glossary.

TERM	DEFINITION
Abatement	Efforts to reduce greenhouse gas emissions are known as carbon abatement.
Administrative feasibility	A criterion evaluating the extent to which a policy is practical and can be easily implemented by government and coordinated among different government entities and across various levels of government.
Additionality	When funds are used to pay for technologies that reduce emissions, the resulting emission reductions are 'additional' only if the reductions would not have occurred in the absence of those funds.
Allocation	The method by which emission permits are distributed in a cap-and-trade system. The emission permits themselves are also sometimes known as "allocations". Typically, permits can be allocated freely or auctioned by government.
Border adjustments	An approach to address competitiveness issues through either: 1) requiring imported goods to pay for their un-priced emissions costs; and/or 2) relieving exports of their expected emissions costs. The goal of these approaches is to "level the playing field" for Canadian firms in either the domestic or international market so as to not place Canadian firms at a competitiveness disadvantage.
Cap-and-trade system	Also known as a "tradable permit system," a cap-and-trade policy involves setting the annual level of emissions by issuing emission permits (permits). If individual emitters produce more emissions than they have permits, they can purchase additional permits. Governments can fix the level of emissions (providing **quantity certainty)** by choosing the number of permits to issue, but the price of permits will be set by the market, and is thus uncertain.
Carbon tax	A carbon tax is a policy instrument that sets a per-unit charge on emissions. Typically the system involves a tax on fuels that emit carbon dioxide when burned and on other greenhouse gas emission. A schedule for future tax rates would be established, sending a long range price signal to the economy. The tax thus provides **price certainty** but leaves the annual level of emissions reductions uncertain.

Competitiveness	Competitiveness issues are possible adverse implications of carbon pricing that result if Canada implements a carbon pricing policy but its trading partners do not. Canadian firms thus have additional costs due to emissions that place them at a disadvantage relative to international competitors.
Coverage	A carbon pricing policy can be applied to different greenhouse gas emissions, different sectors of the economy, and different emissions sources. This is known as the coverage of the carbon pricing policy (see also SCOPE).
Distributional effects	A criterion evaluating the extent to which a policy design will result in disproportionate impacts on different regions, sectors, or households; the criterion assesses issues of equity.
Downstream	Carbon fuels typically change hands between producers, processors and refiners, distributors and final consumers who burn them. The final consumer, where fuels are combusted, is known as downstream in the fuel chain. (See also UPSTREAM and POINT OF REGULATION).
Economic efficiency	A criterion evaluating the extent to which a policy minimizes total costs, including the cost of compliance with the policy as well as transaction costs. Economic efficiency is also increased if a policy addresses other existing economic distortions or market failures.
Electrification	The shift of the energy system toward an increased use of electricity-using technology instead of fossil-fuel combusting technology. This shift on the demand side is enabled by a growth in electricity generation on the supply side to provide the required electricity.
Environmental effectiveness	A criterion evaluating the extent to which a policy design accomplishes its objective in reducing carbon emissions and lowering atmospheric concentrations of greenhouse gas emissions.
Fuel-switching	One kind of action that could reduce emissions. For example, in response to a carbon pricing policy, a firm could shift from coal-burning technology to natural gas-burning or electrical technology.
Free-ridership	Subsidies provide an incentive to change behaviour, or to invest in a new technology. Usually, some of those changing their behaviour would have done so even without the subsidy, but they still receive the money. Those who accept compensation for doing what they would anyway have done are free-riding on the subsidy.
Leakage	The relocation of greenhouse gas-emitting firms to other jurisdictions to avoid the costs of a carbon pricing policy. In this case, the policy has not reduced the total number of emissions, merely caused their point of origin to change. Since climate change is a global issue and the source of emissions does change their impact, leakage reduces the effectiveness of the policy.

Linkage	Linkages between carbon pricing systems (usually cap-and-trade systems) are explicit recognition of emission reductions in one jurisdiction by another jurisdiction. For example, a linkage exists between systems A and B if firms in jurisdiction A can receive credit for emissions permits allocated in jurisdiction B. Linkages can be one or two-way depending on whether both jurisdictions accept the other's credits as valid reductions.
Marginal abatement cost	Emission reductions usually involve some cost, often the cost of investing in new technologies or processes. The cost of reducing emissions is known as the abatement cost. The marginal abatement cost is an economic concept, which refers to the cost of one extra unit of reductions (that is, the cost of a marginal increase in abatement).
Offsets	Offsets are emission reductions that are 'created' outside any regulated system, and sold to regulated emitters. Regulated emitters can use offsets, instead of permits, to comply with the carbon pricing policy. For example Company A wants to reduce its emission to 500 tonnes a year. It invests in energy efficiency technologies, and reduces its emissions to 600 tonnes a year, but finds that further reductions would be very expensive. Instead of reducing another 100 tonnes itself, Company A pays for emission reductions in India, where there are more low-cost emission reductions opportunities.
Point of regulation	Carbon emissions arise predominantly from the burning of fossil fuels. Carbon-based fuels like oil pass from the oil well, to the refinery, to the distributor and finally to the consumer. Carbon pricing can be applied anywhere along this fuel chain, and the point at which it is applied is the point of regulation. The point of regulation is usually described as UPSTREAM or DOWNSTREAM.
Political and stakeholder acceptability	A criterion evaluating the extent to which a policy is acceptable to stakeholders, addresses the concerns of federal, provincial, and territorial governments, and will have public support.
Price ceiling	In a carbon trading system, the prices of emissions permits are determined by the market. If there are not enough permits, prices will rise, creating a strong incentive to invest in emission reductions. However, if prices rise too fast and too high, the system may produce unnecessary and damaging shocks to the economy. A price ceiling or SAFETY VALVE, sets a maximum possible price. When prices reach the price ceiling, the carbon trading system acts like a carbon tax.
Revenue recycling	An element of policy design determining how government revenue (accrued through either a carbon tax or the auctioning of permits in a cap-and-trade system) will be allocated. Possible approaches to revenue recycling include: reducing existing taxes, providing support for competitiveness issues, funding support for technological deployment and research and development, or addressing adverse distributional effects.

Safety valve	In a carbon trading system, the prices of emissions permits are determined by the market. If there are not enough permits, prices will rise, creating a strong incentive to invest in emission reductions. However, if prices rise too fast and too high, the system may produce unnecessary and damaging shocks to the economy. A 'safety valve' or PRICE CEILING, sets a maximum possible price. When prices reach the safety valve, the carbon trading system acts like a carbon tax.
Scope	A carbon pricing policy can be applied to different greenhouse gas emissions, different sectors of the economy, and different emissions sources. This is known as the coverage of the carbon pricing policy (see also COVERAGE).
Spillover	A spillover is an indirect effect of spending or investment. Spillovers occur when the investor cannot exclude others from the benefits of the investment. For example, investment in research produces new knowledge that often cannot be completely controlled. As a result, the benefits of investment 'spill over' into the rest of the economy.
Upstream	Carbon fuels typically change hands between producers, processors and refiners, distributors and final consumers who burn them. The producer, where fuels first enter the economy, is known as upstream in the fuel chain. (See also DOWNSTREAM and POINT OF REGULATION).

LIST OF ACRONYMS

BAU	**Business as usual**
CCS	**Carbon capture and storage**
CDM	**Clean Development Mechanism**
CO_2e	**Carbon dioxide equivalent**
EU ETS	**European Union Emissions Trading Scheme**
GHG	**Greenhouse Gas**
JI	**Joint Implementation**
NAFTA	**North American Free Trade Agreement**
RGGI	**Regional Greenhouse Gas Initiative**
WCI	**Western Climate Initiative**
WTO	**World Trade Organization**

APPENDIX C: EXPERT AND STAKEHOLDER CONSULTATIONS

WHO THE NRTEE CONSULTED

The NRTEE consulted extensively throughout this project:

- Expert advisory groups validated the main elements of the research agenda and subsequent findings;
- Targeted consultations were held to discuss the NRTEE's analysis and interpretation of the research;
- Regional stakeholder meetings in Vancouver, Calgary, Toronto, Ottawa and Montreal were held to review and discuss initial findings and outcomes; and,
- A high-level workshop was held in Ottawa to discuss issues of governance and implementation in relation to the NRTEE's carbon pricing policy package.

Stakeholder and expert input ensure the NRTEE's research findings and analysis are not only rigorous, but reflect regional and sectoral issues facing Canadians. While the Expert Advisory Committee provided key input into the research design and interpretation of results, the regional meetings were invaluable for testing the NRTEE's findings, assumptions and most importantly, the draft carbon pricing policy package. These sessions were invaluable in soliciting regional views and input on the NRTEE's work, ensuring that the final report of the carbon pricing project reflects regional considerations in the design and implementation of a carbon pricing policy for Canada. While, not surprisingly, stakeholder feedback varied among cities, there was consistent and strong approval and support of the NRTEE's approach and direction. The feedback from these meetings is reflected in the advice contained in this report.

WHAT THE NRTEE HEARD

While the NRTEE received considerable feedback on all aspects of the research and analysis, it was on one key issue - that the NRTEE's advice should not focus on an "either/or" proposition in recommending a carbon pricing instrument, but rather how to blend the desirable elements of carbon taxes and cap-and-trade systems to deliver the highest amount of emission reductions at the least cost – that generated considerable input.

On this issue, industry, understandably, prefers price certainty so that they can make long-term planning decisions. This has been voiced again and again, with permit price volatility being an oft-cited example of the challenges with cap-and-trade. Interestingly, environmental groups also have this preference, as they see a certain price signal as a pre-requisite for real reductions.

From the NRTEE's post-election consultations, it is interesting to note that many industry and other stakeholders still support the price certainty benefits of carbon taxes, or at least recognize that any cap-and-trade system must reflect the inherent price certainty in carbon taxes. This is reflected in the NRTEE's proposed policy of a national cap-and-trade system that balances the price certainty of a carbon tax with advantages of emissions trading. Some believed that the political aversion to carbon taxes may be transient, and that perhaps wider acceptance will change in time, especially as the complexities of cap-and-trade are revealed and the benefits of carbon taxes more widely understood.

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