

The Meaning and Measurement of Burden

Report for the NAICC-CC Working Group on Emission Allocation and Burden Sharing

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Table of contents

EXECUTIVE SUMMARY.....	2
<i>Meaning of burden</i>	3
Interpretation.....	3
Aggregations.....	4
<i>Measurement of burden</i>	4
Baseline.....	4
Indicators for aggregations.....	5
<i>Equitable distribution of burden</i>	6
Types of equity.....	6
Outcome-based equity principles.....	6
Equity principles for aggregations.....	7
1. INTRODUCTION.....	8
1.1 <i>Structure of the report</i>	9
1.2 <i>The relationship between burden and equity</i>	10
2. THE MEANING OF BURDEN.....	12
2.1 <i>What is a burden?</i>	12
2.1.1 What costs should be included in the definition of burden?.....	12
2.1.2 What about costs resulting from the implementation of measures to mitigate climate change in other countries?.....	14
2.2 <i>Who bears the burden?</i>	15
2.2.1 Where does the burden of mitigation measures fall?.....	15
2.2.2 Aggregations to facilitate the assessment of burden.....	16
2.3 <i>Summary of key conclusions for EABSWG</i>	19
3. THE MEASUREMENT OF BURDEN.....	21
3.1 <i>Baselines for measuring burden</i>	21
3.1.1 Should voluntary action be included in the baseline?.....	22
3.1.2 Other baseline issues.....	25
3.2 <i>Start and end dates for assessing burden</i>	25
3.3 <i>Indicators of burden</i>	26
3.3.1 The link between indicators and aggregations.....	27
3.3.2 The availability of the indicators.....	31
3.4 <i>Summary of key conclusions for EABSWG</i>	32
4. WHAT IS AN EQUITABLE DISTRIBUTION OF BURDEN?.....	34
4.1 <i>Equity principles</i>	35
4.1.1 Types of equity.....	35
4.1.2 Outcome-based equity principles.....	37
4.2 <i>Relation between different principles and aggregations</i>	41
4.3 <i>Policy measures to redistribute burden</i>	43
4.4 <i>Summary of key conclusions for EABSWG</i>	44
5. CONCLUDING NOTE ON ASSESSING THE EQUITY OF BURDEN DISTRIBUTION.....	45
APPENDIX 1. SOME NON-MONETARY COSTS AND BENEFITS OF CLIMATE CHANGE MITIGATION MEASURES.....	46
APPENDIX 2. MECHANISMS THROUGH WHICH THE IMPLEMENTATION OR NOT OF CLIMATE CHANGE MITIGATION MEASURES IN OTHER COUNTRIES CAN LEAD TO COSTS AND BENEFITS IN CANADA.....	49
FIGURE 1. Options for equity-relevant baselines.....	51
FIGURE 2. Equity-relevant baselines over the transition.....	52

Executive summary³

First Ministers have agreed that Canada will address climate change "in such a way that no region is asked to bear an unreasonable burden". Federal and provincial/territorial Ministers of Energy and Environment have also adopted, as a guiding principle for Canada's National Implementation Strategy, an Equitable Approach defined as follows:

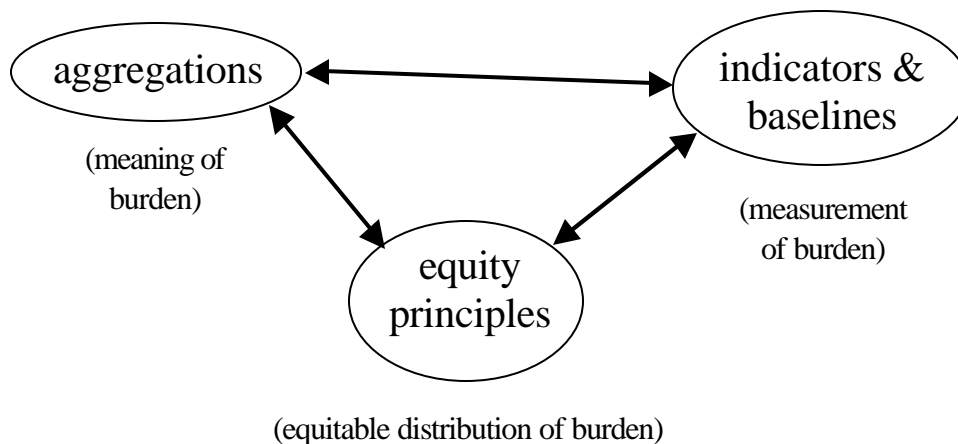
All sectors and regions should do their share, but no region or sector should be asked to bear an unreasonable burden such that actions would prevent economic growth.

The October 2000 Joint Ministers' Meeting further "directed officials to conduct analytical work... on the issue of possible provincial/territorial or sectoral allocation of any Canadian target, and how any resulting burden would be shared." The National Air Issues Coordinating Committee on Climate Change (NAICC-CC) has established a Working Group on Emission Allocation and Burden Sharing (EABSWG) to carry out this task.

The EABSWG commissioned the present report to obtain information and advice on:

- options for a definition and measurement of burden in a jurisdictional⁴ or sectoral context — i.e., aggregations of bearers of burden;
- potential interpretations of "equitable" — i.e., equity principles for assessing the distribution of burden; and
- the appropriate definition and measurement of burden — i.e., indicators of burden and baselines against which to measure them.

The core of what this report does is (i) to identify and discuss the composition of these three key groups of concepts/quantities — aggregations, equity principles and indicators/baselines — and (ii) to examine how they relate to one another, as illustrated below. This is done sequentially under the headings "meaning of burden" (chapter 2), "measurement of burden" (chapter 3), and "equitable distribution of burden" (chapter 4). Additional important questions are also discussed under these headings in the present summary and in the respective chapters.



³ The reader is invited to refer to the chapters and sections cross-referenced in this summary for more detailed discussion of particular topics, as well as references to source materials. The sections entitled "Summary of key conclusions for EABSWG" at the ends of chapters 2, 3 and 4 may also be useful.

⁴ In this report, "jurisdictions" refers to federal, provincial or territorial governments.

The report goes a considerable way in selecting particular aggregations of burden bearers and indicators of burden (but without providing a single answer). The report does not, however, attempt to select particular equity principles and baselines: both of these concepts entail ethical considerations, and political negotiations and decisions will therefore be needed to make specific choices.

The interrelations between aggregations and indicators are elaborated in table 2 (section 3.3.1). The interrelations between indicator-aggregation combinations and equity principles are elaborated in table 6 (section 4.2). Table 2 shows which burden indicators are relevant to selected aggregations of burden bearers; table 6 shows which equity principles are applicable to the same selected aggregations of burden bearers.

Meaning of burden (chapter 2)

Interpretation

This report takes the view that the burden of a package of climate change mitigation measures adopted by Canadian governments is the difference in costs between a future scenario including the measures and a baseline that does not. The identification of burden with costs results from a decision to shift equity considerations from the definition of burden into the assessment of burden distribution. This has been done in the interests of clarity and the authors believe that nothing is lost in so doing. For example, even if "ability to pay" is not included in the definition of burden, it can be given full consideration when one assesses the equity of burden distribution. (sections 1.2 and 2.1)

The report emphasizes that non-monetary costs are a legitimate component of burden in addition to monetary costs. However, monetary and non-monetary costs (and the different kinds of non-monetary costs) are fundamentally different quantities. As they also vary dramatically in their uncertainties and the degree of agreement about how they should be calculated and the weight that should be accorded to them, they should always be stated separately, so as not to conceal these differences. Criteria of potential magnitude, political importance, direct relevance to climate change and availability from standard economic models lead to four types of non-monetary costs being retained for consideration: (section 2.1.1)

- change in unemployment
- loss of consumer surplus
- health benefits of reduced air pollution
- changes in stocks of natural resources (fossil fuels and biomass)

It is also important to note that the implementation or not of climate change mitigation measures in other countries will lead to costs and benefits in Canada. This can happen through two categories of mechanisms: (section 2.1.2)

- **Price and demand effects** result from the implementation of climate change mitigation measures in other countries. Since the resulting costs and benefits in Canada do not result from Canadian policy, they *are not* considered part of the burden addressed by this report, i.e., such effects should be either included in both the baseline and "with-measures" scenarios or excluded from both when making projections of the burden with models.
- **Loss of competitiveness** of Canadian products sold into an international market will result from the difference between the implementation in Canada of climate change

mitigation measures and their absence in countries that are significant producers in that market. Since the resulting costs and benefits in Canada are a result of Canadian policy, they *are* considered part of the burden addressed by this report.

It is also important to recognize that the costs of climate change mitigation measures will ultimately be borne by individuals (who are thus said to feel the *incidence* of the measures). Costs that initially fall on firms are either passed on to suppliers, customers or employees, or borne by firms' shareholders. Ultimately all these costs fall on individuals in their capacities as consumers, employees and shareholders. Costs that initially fall on governments will subsequently be transmitted to individuals in their capacities as taxpayers and beneficiaries of government services. However, the transitional costs borne by governments and firms are of obvious political importance because ministers will resist negative changes to government balances, firms will resist reductions in profits, and both are powerful players in society. (section 2.2.1)

Aggregations (section 2.2.2)

When designing the broad lines of policy, firms and individuals are too numerous for their burdens to be examined individually, so they must be aggregated into more manageable groupings. The report considers several obvious criteria for aggregating individuals or firms, and lists some corresponding aggregations in each case (table 1). From this point onwards firms are used to represent their shareholders. Consideration of which aggregations recur in this analysis or correspond to the most important criterion — members of the aggregations are likely to suffer similar burdens — leads to selection of the following aggregations:

- individuals grouped by jurisdiction
- individuals grouped by disposable income
- firms grouped by industry sector
- employees grouped by industry sector
- consumers grouped by product (for relevant products)

Measurement of burden (chapter 3)

Baseline

The report takes the view (see above) that the burden of a package of climate change mitigation measures adopted by Canadian governments is the difference in costs between a future scenario including the measures and a baseline that does not. Selection of the baseline is critical in determining the magnitude and distribution of the burden. In order to understand clearly where equity, as opposed to technical considerations can enter into the measurement of burden, we introduce the following distinctions: (section 3.1)

- **"Raw burden"** refers to the difference between a **"with-measures scenario"** including the package of measures being assessed and a **"without-measures scenario"** in which there are no climate change mitigation measures in Canada.
- **"Relevant burden"** refers to the difference between the with-measures scenario and an **"equity-relevant baseline"**, i.e. a baseline that is relevant for purposes of assessing the equity of the distribution of burden. The equity-relevant baseline could include "voluntary" government measures in the absence of international binding agreements; and/or "voluntary" corporate or individual actions in the absence of federal or provincial/territorial regulations or financial incentives. The equity-relevant baseline could alternatively simply coincide with the without-measures scenario.

The motivation for including such voluntary action in the baseline (thereby preventing its cost from being included in the relevant burden), is a view that governments, firms and individuals are/were responsible for undertaking such action on their own initiative. Two obvious reasons can be identified for conferring such a responsibility: (section 3.1.1)

- knowledge of the probability that climate change caused by greenhouse gas emissions is a real and serious problem — justifying a "responsible action baseline"; and
- the risk that Canada would in due course seek to meet a national emissions limitation target — justifying a "prudent action baseline".

The report suggests that the burden of climate change mitigation measures be considered over a transition period of adjustment to climate change mitigation measures. Views on the start date of the transition are likely to mirror closely views on whether or not the equity-relevant baseline should include voluntary action. Those who believe it should will see the transition beginning at the date (e.g., 1990, 1992, 1995 or 1997) when governments, firms and individuals began to be considered responsible to take such action. Those who believe that the equity-relevant baseline is the without-measures scenario will tend to see the transition beginning at the date of implementation of the climate change mitigation policy package. The adjustment — and therefore the transition — can be considered complete when all existing capital stock will have been created after the date of implementation of the policy package. (section 3.2)

The choice of a baseline is clearly not straightforward: the authors believe that it will be unlikely that agreement can be reached on a single equity-relevant baseline. They recommend that a variety of equity-relevant baselines be used to provide a range of measures of burden. (section 3.1.1; see also figures 1 and 2 at the end of the document)

Indicators for aggregations (sections 3.3, 3.3.1)

The report considers 13 categories of cost indicators and assesses which are relevant to each of the five different aggregations selected previously plus governments⁵ (table 2). The criteria used for determining the relevance of an indicator are (i) members of the aggregation are likely, at least to some degree, to suffer similar burdens as measured by the indicator; and (ii) the indicator has meaning for that aggregation.

The indicator-aggregation combinations that are relevant are narrowed down by applying several criteria to the indicators, notably: measurement of changes in total costs rather than partial costs; political importance/sensitivity; and potential magnitude. This leads to selection of the following nine combinations:

- change in disposable income by jurisdiction and disposable income
- change in government balance
- change in GDP by sector and jurisdiction (including per capita)
- change in value of capital assets by sector
- change in consumers' energy prices by jurisdiction
- change in air quality, or a measure of health derived from it, by jurisdiction and income
- change in profits of firms by sector (but the data is not likely to be available)
- change in unemployment by income, jurisdiction and sector (but data on flows of job losses and gains are not likely to be available)

⁵ We consider governments as pseudo-aggregations that represent and have control over the collective wealth and emissions of their jurisdictions.

- loss of consumer surplus (but a comprehensive approach is unlikely to be achieved)

The fourth, fifth and sixth of these indicators carry the caveat that the data would be highly uncertain. The final three indicators appear to be somewhat problematic to use for the reasons given in parentheses above.

Equitable distribution of burden (chapter 4)

Types of equity (section 4.1.1)

Three distinct types of equity are important in relation to the mitigation of climate change:

- *procedural equity* relates to the fairness of participation in, and the process of, decision-making;
- *allocation-based equity* relates to the fairness of the allocation of rights to emit greenhouse gases or responsibility to reduce emissions; and
- *outcome-based equity* relates to the fairness of the impacts of climate change mitigation measures on welfare.

Allocation-based equity principles (table 4) can be directly implemented by emissions trading systems or jurisdictional emissions limitation targets. But they are unlikely to lead to an equitable distribution of burden because of the complex difference between the point of imposition and the incidence of policy measures. Application of outcome-based equity principles, on the other hand, first requires an understanding of the effect of a policy package, either via projections or observations. Such principles can then be implemented by adjusting measures in the package or augmenting it with additional redistributive measures (section 4.3) to compensate for the effects of the measures initially included. Allocation-based equity principles have received more attention in the literature discussing the equity of climate change mitigation because that literature overwhelmingly addresses the international situation, where institutions and mechanisms to redistribute wealth are weak or non-existent. In Canada, allocation-based principles can help guide the allocation of legal responsibility for securing emission reductions and/or emission permits, while outcome-based principles will be required to assess the equity of the resulting burden distribution. The scope of this report is limited to outcome-based equity alone.

Outcome-based equity principles (section 4.1.2)

The report presents a comprehensive range of seven outcome-based equity principles and describes some obvious advantages and disadvantages for each (the reader is referred to table 5 for details):

- egalitarianism
- ability to pay
- redistribution
- accept the market outcome of full pricing of emissions
- transitional compensation for excessive burden
- historical beneficiaries of the absence of full pricing of emissions pay
- exporter pays

Two principles will always conflict when applied to the same aggregation. Pairs of principles can also conflict in any circumstances, e.g., "Egalitarianism" and "Ability to pay" or "Accept the market outcome..." and "Transitional compensation...". But pairs of principles can be compatible

when applied to different aggregations, e.g. "Ability to pay" can be applied to individuals grouped by disposable income while "Transitional compensation..." is applied to firms grouped by sector. One principle can conflict with itself when applied to different aggregations, e.g., "Ability to pay" will give different results when applied to individuals grouped by disposable income and firms grouped by industry sector (because firms represent their shareholders and the shareholders of a given firm will not belong to a single income group). Where principles conflict, there is likely to be interest in using a compromise blend of different principles.

Equity principles for aggregations (section 4.2)

The report assesses which of the outcome-based equity principles above are applicable to each of the five different aggregations selected previously plus governments⁶ (table 6). The criteria used for determining applicability of a principle are (i) the quantity (wealth/income etc.) needed to apply the principle has meaning for an aggregation or governments; and (ii) the members of an aggregation possess similar values of that quantity (wealth/income etc.).

There is at least one principle that can be used with each aggregation, which means that there is also a basis for designing measures to redistribute burden for each aggregation. Looked at the other way round, each principle can be used with at least one aggregation except possibly for "transitional compensation...", which may need to be used with individual firms. The choice among principles will depend partly on whether Canadian governments are primarily concerned about the distribution of the ultimate burden on individuals or the distribution of the initial burden on industry sectors and firms, or on jurisdictions. If governments decide that efforts to redistribute the burden should focus on individuals, industry sectors *and* governments, compromises will have to be made and the result of an effort to redistribute the burden will be partial progress towards meeting a number of different equity objectives.

⁶ We consider governments as pseudo-aggregations that represent and have control over the collective wealth and emissions of their jurisdictions.

1. Introduction

Immediately following the adoption of the Kyoto Protocol in December 1997, Canada's First Ministers agreed that Canada would address climate change "in such a way that no region is asked to bear an unreasonable burden".⁷ At their subsequent joint meeting in April 1998, federal and provincial/territorial Ministers of Energy and Environment adopted four guiding principles for Canada's National Implementation Strategy on climate change: Phased Approach, Balanced Approach, Equitable Approach and Comprehensive Approach. The Equitable Approach is defined as follows:

*All sectors and regions should do their share, but no region or sector should be asked to bear an unreasonable burden such that actions would prevent economic growth.*⁸

The October 2000 Joint Ministers' Meeting further "directed officials to conduct analytical work... on the issue of possible provincial/territorial or sectoral allocation of any Canadian target, and how any resulting burden would be shared."⁹ The National Air Issues Coordinating Committee on Climate Change (NAICC-CC) has established a Working Group on Emission Allocation and Burden Sharing (EABSWG) to carry out this task.

The EABSWG commissioned the present report to obtain information and advice on:

- options for a definition and measurement of burden in a jurisdictional¹⁰ or sectoral context;
- potential interpretations of "equitable"; and
- the appropriate definition and measurement of burden.

While the EABSWG has indicated that it is concerned with the concept of burden in a jurisdictional or sectoral context, it is important to recognize that the costs of climate change mitigation policy will ultimately be borne by individuals (as discussed in section 2.2.1). Costs that initially fall on firms are either passed on to suppliers, customers or employees, or borne by firms' shareholders. Ultimately all these costs fall on individuals in their capacities as consumers, employees and shareholders. Costs that initially fall on governments will subsequently be transmitted to individuals in their capacities as taxpayers and beneficiaries of government services.

The authors recognize, however, that the transitional costs borne by governments and firms are of obvious political importance because ministers will resist negative changes to government balances, firms will resist reductions in profits, and both are powerful players in society. In addition, there may be a time lag, possibly as long as a number of decades, before the transmission of costs from firms and governments to individuals is fully realized. Accordingly,

⁷ Canadian Intergovernmental Conference Secretariat (1997), *Joint Communiqué First Ministers' Meeting Ottawa, December 12, 1997*. Available at http://www.scics.gc.ca/cinfo/80003606_e.html.

⁸ Cheminfo Services Inc. (1999), *Development of Criteria and Indicators for Decision-Making on Actions for Meeting Canada's Target on Reduction of Greenhouse Gas Emissions*, report for Principles and Criteria Subcommittee, NAICC-CC, p.1.

⁹ National Climate Change Secretariat (2000), *Record of Decision – Canada's National Implementation Strategy*. Available at http://www.nccp.ca/NCCP/pdf/media/jmm-4-Oct-17-18-2000_en.pdf.

¹⁰ In this report, "jurisdictions" refers to federal, provincial or territorial governments.

this report discusses the definition and measurement of burden in the context of jurisdictions, sectors and individuals.

A key intended use of the report is to assist in the specification of runs and output of economic modelling related to the issues of allocation and burden.

1.1 Structure of the report

This report is structured on the premise that meeting the objectives of the EABSWG would require Canadian governments to answer the following three questions. First, what is the meaning of burden? Second, how should burden be measured? Third, what equity principles should be used to assess the distribution of burden? This report addresses each of these questions in turn.

Chapter 2 focuses on the meaning of burden. Based on a discussion in section 1.2, the report removes equity considerations from the definition of burden. It then defines the burden of measures taken by Canadian governments to mitigate climate change as the difference in costs between a future scenario that includes the measures and a baseline (discussed in section 3.1) that does not.

If this broad definition is accepted, Canadian governments still have to reach agreement on a number of additional questions before the meaning of burden is clear. These questions are:

- What costs should be included in the precise definition of burden?
- How should the impact on costs/burden of measures taken to mitigate climate change in other countries be addressed?
- Who is considered to bear a burden?
- How should burden bearers be aggregated for purposes of analysis?

Chapter 2 discusses each of these questions and offers suggested responses for the consideration of EABSWG.

Once burden has been defined, it will need to be measured. Chapter 3 focuses on the measurement of burden. To measure burden, Canadian governments will have to reach agreement on the following questions:

- What is the baseline against which burden should be measured and to what extent should voluntary action be incorporated into the baseline?
- What is the timeframe over which burden should be assessed?
- What indicators, relevant to selected aggregations of burden bearers and characterized by good data quality and availability, should be used to measure burden?

Chapter 3 discusses each of these questions and offers suggested responses for the consideration of EABSWG.

Once Canadian governments have agreed on the meaning and measurement of burden, it will become possible to assess the equity of the distribution of the burden. This is the focus of chapter 4. To assess the equity of the distribution of burden, Canadian governments will have to consider the following questions:

- Which equity principles should be used to assess the fairness of the distribution of burden?
- Which equity principles should be applied to the assessment of the specific burdens faced by different aggregations of burden bearers?
- What policy options are available to address an inequitable distribution of burden?

Chapter 4 discusses each of these questions. This report outlines different potential equity principles but does not offer recommendations to the EABSWG on which principles should be used to assess burden. The brief discussion of policy options to address inequitable burdens is similarly non-prescriptive.

Chapter 5 provides a brief concluding note on the issues covered in the report.

1.2 The relationship between burden and equity

The EABSWG's direction for this paper is deceptively simple: describe how the burden of climate change mitigation measures can be defined and measured and outline principles for assessing the equity of the distribution of that burden across different aggregations of economic agents.

In reality, however, the meaning and measurement of the burden resulting from climate change mitigation measures, and assessment of the degree to which the distribution of that burden is equitable, entails both technical and ethical questions. While it may be reasonable to hope for a high degree of consensus on technical questions, many contradictory perspectives exist on ethical ones. As a result, individuals can hold strongly differing views on the appropriate definitions of both burden and equity.

The authors believe that intermixing the concepts of burden and equity can significantly increase the complexity of discussions with regard to the equity of the distribution of the burden of policy alternatives. Accordingly, it is important to clearly separate discussion of these two concepts to the extent possible, and to clearly indicate what assumptions are being made about the relationship between burden and equity.

This report organizes the location of ethical/equity principles in the following way.

1. The authors have chosen not to discuss equity principles when examining potential definitions of burden in order to facilitate clarity of analysis. Some may view this as inappropriate, arguing that definitions of burden must incorporate ethical considerations such as "ability to pay". By making this proposal, however, the authors are not seeking to exclude equity principles from the analysis, but rather to focus on the consideration of equity issues in discussions assessing the equity of burden distribution. It is the view of the authors that nothing is lost in so doing. For example, even if "ability to pay" is not included in the definition of burden, it can be given full consideration when one assesses the equity of burden distribution.
2. The authors have chosen not to discuss equity principles when examining methodologies to measure burden. Nonetheless, we have identified one critical methodological issue where choices will need to be made that will have significant implications for equity. This issue is

the extent to which voluntary¹¹ measures should be assumed to be in the baseline against which burden will be measured. Choices made here will have implications for the relative burdens borne by entities that took voluntary actions to reduce greenhouse gas emissions prior to the implementation of a package of climate change mitigation measures and those that did not. Differing views on the "solution" to this question will be based on ethical, not technical, considerations.

3. By making the choices identified above, the authors have placed the discussion of equity principles outside discussions on the meaning and measurement of burden. Instead, we have assumed that it is only once burden has been defined and measured, that equity principles should be examined and applied to assess the equity of the distribution of the burden associated with the implementation of a package of climate change mitigation measures.

¹¹ In the sense of resulting from no direct legal obligation or incentive. In the case of governments, this means no binding international agreement. In the case of individuals and firms, this means no federal or provincial/territorial regulations or financial incentives.

2. The meaning of burden

A comprehensive meaning or definition for burden will require Canadian governments to agree not only on what burden is, but also on who bears the burden. This chapter addresses each of these two issues in turn.

2.1 What is a burden?

This report takes the view that the burden of climate change mitigation measures adopted by Canadian governments is the difference in costs between a future scenario including the measures and a baseline that does not. Selection of the baseline scenario is critical; it will be discussed in depth in section 3.1.

The identification of burden with costs results from a decision to shift equity considerations from the definition of burden into the assessment of burden distribution (see section 1.2). This has been done in the interests of clarity. The authors also note that the terms "burden" and "costs", as used in this report, can be positive or negative. While meeting Canada's Kyoto target (for example) is likely to reduce Canada's overall economic growth up to 2012 compared to a business-as-usual scenario, it is important to note that individual measures can have monetary and/or non-monetary benefits (see section 2.1.1). Some sectors (e.g. coal) are expected to suffer from measures to address climate change while others (e.g. services) are expected to benefit, and the same could be true of jurisdictions/regions in Canada.¹²

The authors note that burden will be highly sensitive to policies unrelated to climate change that redistribute wealth within Canada. Pre-existing policies such as unemployment insurance, progressive income tax rates and equalization payments will change the burden of climate change mitigation measures. As a result, that burden should be evaluated after the effect of such policies.

A climate change mitigation policy package is also likely to include measures having the sole or primary purpose of redistributing the burden resulting from other measures in the package (see section 4.3). Insofar as such redistributive measures are adopted as an integral part of climate change policy, burden should be defined net of these measures also. However, when analysis of the effects of such policy packages is conducted, it will likely be desirable to conduct some model runs with the redistributive measures removed precisely to understand the need for them.

Finally, an assessment of the burden of measures that generate government revenue will have to make assumptions about how that revenue is used. (One obvious use is to redistribute burden.)

2.1.1 What costs should be included in the definition of burden?

If the broad definition of burden proposed above is accepted, there is then a need to discuss what costs should be considered part of the burden. Costs can have both monetary and non-monetary

¹² Analysis and Modelling Group (2000), *An Assessment of the Economic and Environmental Implications for Canada of the Kyoto Protocol*, National Climate Change Process; Intergovernmental Panel on Climate Change (2001a), *Summary for Policymakers – Climate Change 2001: Mitigation*, p.10-11 (available at <http://www.ipcc.ch>).

components. Most broadly, economics is concerned with the welfare (also known as utility) of individuals. In this perspective the cost of something is the change it causes to welfare. Climate change mitigation measures will affect prices, salaries, taxes and so on; these monetary changes certainly have a strong effect on welfare. But many people will argue that social, environmental or other non-monetary changes also affect welfare. These might include, for example, changes in unemployment or the quality of public services, or health and environmental benefits of reduced air pollution. The inclusion of such non-monetary components in welfare depends both on technical questions of how to evaluate such components and ethical preferences about their relative importance.

A summary of the nature and potential magnitude of some key non-monetary costs and benefits of climate change mitigation measures is provided in Appendix 1. Many of these non-monetary quantities are currently subject to disagreement about how they should be calculated, large uncertainties, and considerable challenges in being modelled. The remainder of this report will therefore be mainly restricted to those that can be extracted from standard economic models. Of the various non-monetary costs, only change in unemployment and loss of consumer surplus fall into this category. However, we will also retain for consideration (i) health benefits of reduced air pollution, in light of their potential magnitude and political importance; and (ii) changes in stocks of natural resources (fossil fuels and biomass), since these are well-defined and have direct relevance to climate change.

Before moving on, it is important to stress the following points regarding non-monetary costs.

- Non-monetary costs are a legitimate component of burden. They may also be large and negative, i.e., a net benefit: according to the Intergovernmental Panel on Climate Change (IPCC), "in the short term, ancillary benefits of GHG policies under some circumstances can be a significant fraction of private (direct) mitigation costs and in some cases they can be comparable to the mitigation costs."¹³ Quality of life issues are clearly very important to many people, and good policymaking depends on being able to analyse them adequately. Refinement of how non-monetary costs are defined and measured and improvements in how they are modelled should be a priority.
- Monetary and non-monetary costs (and the different kinds of non-monetary costs) are fundamentally different quantities. As they also vary dramatically in their uncertainties and the degree of agreement about how they should be calculated and the weight that should be accorded to them, they should always be stated separately, along with their estimated uncertainties — even when the non-monetary costs have been converted into dollar terms — so as not to conceal these differences.
- However, there is a need to consider a combination of monetary and non-monetary costs in decision-making. Non-monetary costs do not necessarily have to be converted into dollar terms to do this. Multicriteria decision-aid methods provide a means of integrating into the decision-making process quantities with different units as well as qualitative considerations.¹⁴ These methods invite further investigation in relation to climate change mitigation because they allow diverse criteria to be considered simultaneously.¹⁵

¹³ Intergovernmental Panel on Climate Change (2001b), *Technical Summary – Climate Change 2001: Mitigation*, p.58. Available at <http://www.ipcc.ch>.

¹⁴ See, for example, L.A. Maystre et al. (1994), *Méthodes multicritères ELECTRE – Description, conseils pratiques et cas d'application à la gestion environnementale*, Presses Polytechniques et Universitaires

2.1.2 What about costs resulting from the implementation of measures to mitigate climate change in other countries?

It is also important to note that the implementation or not of climate change mitigation measures in other countries will lead to costs and benefits in Canada. This can happen through a number of distinct mechanisms in international trade which are set out in Appendix 2. Those mechanisms fall into the following two categories.

Price and demand effects resulting from the implementation of climate change mitigation measures in other countries. Since the resulting costs and benefits in Canada do not result from Canadian policy, they *should not* be considered part of the burden addressed by this report,¹⁶ i.e., such effects should be either included in both the baseline and "with-measures" scenarios or excluded from both when making projections of the burden with models (see section 3.1). An important case arises where demand for Canadian products whose use is relatively emissions-unintensive but whose production results in significant emissions rises in countries implementing climate change mitigation measures. The obvious example is natural gas exported to the US to displace use of coal there. The resulting increase in Canadian emissions would necessitate additional Canadian mitigation measures and related additional costs. When the exports are competing only with products from countries also implementing climate change mitigation measures, it may be possible to pass on these costs to the foreign customers. If that is not possible, the prospect of these costs being borne by Canada as a whole, as opposed to by the producers alone, might be considered an inequitable subsidy to the producers and/or the foreign customers.¹⁷ These costs would not be considered part of the burden addressed by this report, but they can be taken into account when the equity of the distribution of that burden is considered (see section 4.1.2).

Loss of competitiveness of Canadian products sold into an international market resulting from the difference between the implementation in Canada of climate change mitigation measures and their absence in countries that are significant producers in that market. Since the resulting costs and benefits in Canada are a result of Canadian policy, they *should* be considered part of the burden addressed by this report. A Canadian climate change mitigation policy package could be designed to prevent these competitiveness effects, for example by exempting a "benchmark" level of emissions in the affected sectors from measures to put a price on greenhouse gas emissions.¹⁸

Analysis of the effects of the possible permutations of other countries' climate change mitigation policy packages is difficult in view of the number of such permutations. However, those effects

Romandes, p.323; B. Roy (1985), *Méthodologie multicritère d'aide à la décision*, Economica, Paris, p.423; P. Vincke (1989), *L'aide multicritère à la décision*, Editions de L'Université de Bruxelles et Editions Ellipses, p.179.

¹⁵ K. Vaillancourt (2001), *Équité et efficacité dans les scénarios mondiaux de réduction des émissions de gaz à effet de serre : Une approche multicritère dynamique*, Université du Québec à Montréal, doctoral thesis in preparation.

¹⁶ We are not saying that these costs and benefits do not give rise to a burden requiring analysis. However, the complexities of such an analysis are beyond the scope of this report.

¹⁷ A possible solution would be for governments to implement measures to limit exports to a level where emissions from their production are comparable to those in the absence of the foreign climate change mitigation measures. Canadian governments could do this, for example, by ensuring that the export prices reflect the costs of mitigating any related increase in Canadian emissions.

¹⁸ Tradeable Permits Working Group (2000), *Using Tradeable Emissions Permits to help achieve domestic greenhouse gas objectives*, National Climate Change Process, p.46.

could be captured approximately when modelling the costs by assuming — in both the baseline and "with-measures" scenarios — that all other industrialized countries adopt comprehensive measures to put a price on greenhouse gas emissions.¹⁹ Estimates of the impacts on the international competitiveness of Canadian producers as a result of differences between climate change mitigation policies implemented in Canada and elsewhere could be obtained by using the same assumption in global economic models.²⁰ The evidence currently available suggests that these impacts will be negligible (as measured by the impact on prices) for all but a small part of the Canadian economy — the part that is likely to be the most affected by domestic policies as well.²¹

It is also important to note that the burden of measures to mitigate climate change is incurred to reap the benefits of lessened climate change. These benefits (or their absence) and their distribution therefore clearly have important burden and equity implications. The extent to which these benefits occur in Canada is highly dependent on the extent to which climate change mitigation measures are adopted in other countries. The benefits of lessened climate change are difficult to compare to the Canadian burden (costs) of climate change mitigation measures: the benefits will occur over a much longer time horizon than the costs; the benefits are distributed globally while the costs are national and sub-national; and the benefits have important non-monetary components.²² The benefits of lessened climate change are beyond the scope of this report, although they are touched on in Appendix 1.

2.2 Who bears the burden?

There is a complex relationship between the design of climate change mitigation measures, who is directly affected by them, where the emission reductions occur and who is ultimately affected following repercussions throughout the economy. This makes determination of who bears the burden a challenging task. The first step is to try and understand the complex relationship between climate change mitigation measures and their ultimate burden. Second, one must determine whether or not it is necessary to aggregate those bearing the burden for purposes of analysis.

2.2.1 Where does the burden of mitigation measures fall?

Those who are directly affected by a policy measure are said to be at its *point of imposition*. The point of imposition can be the same as the point where the emission reductions occur,²³ as in the example of vehicle efficiency standards. The point of imposition can alternatively be quite different from the point where the emission reductions occur, as in the case of a tradeable

¹⁹ E.g., a carbon tax or a tradeable emissions permit system.

²⁰ Such estimates would only be rough unless a global model were used that represented Canadian industry accurately.

²¹ See, for example, J.A. Hoerner and J. Mutl (undated), *Good Business: A Market Analysis of Energy Efficiency Policy*, Center for a Sustainable Economy (<http://www.SustainableEconomy.org>).

²² Canada contributes only about 2.3% of global greenhouse gas emissions (although this is a large amount on a per-capita basis). Canadian mitigation measures therefore have a very small impact on Canada, while mitigation measures taken in the rest of the world have a very large impact on Canada.

²³ The point where reductions occur might be called the *point of implementation*. Where reductions occur is of no consequence for long-lived greenhouse gases, but it is important for emissions of air contaminants, whose reduction can represent a health benefit resulting from climate change mitigation measures.

emission permit system. Under such a system, emitter A on whom a requirement to submit permits is imposed may acquire some of them as a result of emission reductions physically achieved by emitter B who then has surplus permits to sell.

Those who ultimately bear the costs of policy measures are said to feel their *incidence*. The point of imposition and the incidence may be similar or quite different, depending on the extent to which, for example, a firm is able to pass costs caused by the measure on to its customers, suppliers and employees. Economic models are needed to determine the incidence of policy measures and the physical distribution of emission reductions for given points of imposition.

It is important to recognize that the costs of climate change mitigation policy will ultimately be borne by individuals. Costs that initially fall on firms are either passed on to suppliers, customers or employees, or borne by firms' shareholders. Ultimately all these costs fall on individuals in their capacities as consumers, employees and shareholders. Costs that initially fall on governments will subsequently be transmitted to individuals in their capacities as taxpayers and beneficiaries of government services. However, the transitional costs borne by governments and firms are of obvious political importance because ministers will resist negative changes to government balances, firms will resist reductions in profits, and both are powerful players in society. In addition, there may be a time lag, possibly as long as a number of decades, before the transmission of costs from firms and governments to individuals is fully realized.²⁴

Some costs of Canadian climate change mitigation measures may be borne outside Canada by, for example, foreign shareholders of firms operating in Canada. Also, costs associated with Canadian exports of products whose production results in significant emissions can be passed on to foreign customers if the exports are not competing with products from countries without climate change mitigation measures.

2.2.2 Aggregations to facilitate the assessment of burden

The burden of climate change mitigation measures is borne transitionally by governments and firms and ultimately by individuals. When designing the broad lines of policy, firms and individuals are too numerous for their burdens to be examined individually, so they must be aggregated into more manageable groupings. (This is not necessary for governments, whose burden will therefore not be discussed in this section.²⁵) However, specific policy measures could certainly be designed to redistribute burden on the basis of formulae dependent on the specific circumstances of individuals or firms.

Table 1 presents several obvious criteria for aggregating individuals²⁶ or firms, and lists some corresponding aggregations in each case. Starting with table 1, for the remainder of this report we will no longer refer explicitly to shareholders, preferring instead to use firms to represent their

²⁴ Time lags could arise both from government borrowing and, for example, when environmental contamination caused by a firm has a delayed effect on individuals.

²⁵ On the other hand, governments are pseudo-aggregations in that they represent and have control over the collective wealth and emissions of their jurisdictions. They will be considered alongside aggregations when aggregations are used later in this report.

²⁶ There may be value in replacing individuals by households in some of the following analysis. However, we will not refer explicitly to households.

shareholders. If shareholders were included in the analysis, they would appear in essentially identical fashion to firms.²⁷

Table 1. Criteria for aggregation of individuals and firms

Criterion	Approximately corresponding aggregations of individuals (as consumers, employees and taxpayers²⁸)	Approximately corresponding aggregations of firms
1) likely to suffer similar burdens	consumers grouped by product, e.g. homeowners, SUV owners, buyers of coal-fired electricity	firms grouped by industry sector
	employees grouped by industry sector	firms grouped by emissions per unit sales
	taxpayers grouped by jurisdiction	
	taxpayers grouped by marginal tax rate	
2) have similar needs or capacities	<i>see previous criterion; also:</i>	<i>see previous criterion; also:</i>
	individuals grouped by disposable income	firms grouped by rate of return on capital
	individuals grouped by other socioeconomic classification schemes (e.g. professional or manual worker)	firms grouped by marginal cost of emission reduction opportunities
	individuals grouped by type of location (large urban, medium urban, small urban, rural etc.)	
3) fall under the same authority with the power to impose measures that cause a burden and redistribute it	individuals grouped by jurisdiction	firms grouped by jurisdiction
4) interests are represented by the same entity	individuals grouped by jurisdiction	firms grouped by industry association (and possibly jurisdiction)
	employees grouped by trade union	
	individuals grouped by membership of other interest groups	
5) exert political influence as a cohesive group	<i>see previous criterion; also:</i>	<i>see previous criterion</i>
	voters grouped by party affiliation	
	individuals grouped by socioeconomic or value-based category used by political marketers	
6) mutually identify themselves as a distinct group	individuals grouped by jurisdiction or region (e.g. western Canada)	firms grouped by industry association
	individuals grouped by membership of organizations	
7) relevance to ultimate incidence	<i>see previous criteria</i>	<i>none</i>

²⁷ However, it is unclear whether or not costs borne by foreign shareholders of firms operating in Canada should be considered part of the burden addressed by this report. If the answer is that they should not, then indicators of burden that apply to firms or aggregations of firms are problematic because some of the shareholders represented by the firms in question are foreign.

²⁸ The category of "taxpayers", as used in the remainder of this report, will take account of the fact that taxpayers are also correspondingly beneficiaries of government services.

All the criteria listed in the table have significant value. Criterion 1 is probably of most value in the present context, since assessment of the equity of the distribution of burden requires that burden be measured at a level of aggregation where members of the aggregation bear similar burdens. The value of criterion 2 depends on the importance accorded to the equity principle of ability to pay (see section 4.1). Criterion 3 is relevant to burden to the extent that federal/provincial/territorial negotiations will result in different governments having (i) the responsibility to achieve different amounts of emission reductions and (ii) the discretion to deploy different policy measures. The value of criteria 4 and 5 (and, to some extent, criterion 6) depends on the importance accorded to political considerations when assessing the distribution of burden. The value of criterion 6 also depends on the importance accorded to the opinions of the individuals or firms being aggregated as to which aggregations are appropriate.

Criterion 7 is an important reminder that the ultimate incidence of burden is on individuals, not firms. It can be argued persuasively that, *in itself*, contraction of one industry sector and expansion of another is of no real consequence to burden, and that the only thing that matters is the burden borne by individuals in their various capacities.²⁹

Whatever relative importance is accorded to the different criteria, it is no surprise that the following aggregations recur (sometimes in different guises):

- individuals grouped by jurisdiction
- individuals grouped by disposable income
- firms grouped by industry sector
- employees grouped by industry sector

It would seem to make sense to provisionally retain for consideration these aggregations plus other aggregations in table 1 depending on the importance accorded to the various criteria.³⁰ Assuming that criterion 1 is widely agreed to be highly important, one other aggregation corresponding to it that should also be retained for consideration is:

- consumers grouped by product (for relevant products)

Some aggregations can also be combined, e.g., individuals grouped by jurisdiction and disposable income. While this has not been done in the following analysis, it is fairly easy to see from tables 2 (section 3.3.1) and 6 (section 4.2) how it could be.

This report will not narrow down this list of potential aggregations any further. Canadian governments may choose to monitor the impact of burden on all of these aggregations, or they may narrow the list further. A source of rationales for narrowing the list further may be the association of each aggregation with a specific set of indicators (see section 3.3.1) and equity principles (see section 4.2).

The criteria in table 1 are all reasons *for* aggregating individuals or firms. But there are also important arguments *against* aggregating in cases:

²⁹ I.e., the burden arising from the fact that labour can rarely move seamlessly from one sector to another is best assessed at the level of individuals.

³⁰ For example, if criteria 3 and 4 were considered particularly important, the aggregation of firms grouped by jurisdiction could also be retained.

- where members of an aggregation suffer significantly varying burdens. In this case, aggregating will conceal important information about the distribution of burden, thereby preventing an adequate assessment of the equity of the distribution. Another way of looking at this is that aggregation of members suffering varying burdens implicitly assumes that members with lesser burdens will compensate those with greater burdens, which is unlikely to happen in practice;
- where the aggregation prevents the application of an equity principle because the members of the aggregation do not possess similar values of those quantities needed to apply the principle (see section 4.2).

2.3 Summary of key conclusions for EABSWG

The authors have recommended that equity considerations be shifted from the definition of burden into the assessment of burden distribution (see section 1.2). This has been done to facilitate clarity of discussion. As a result, this report concludes that the burden of measures taken by Canadian governments to address climate change should be defined as the difference in costs between a future scenario that includes the measures and a baseline (see section 3.1) that does not. It is recommended that these costs be calculated net of pre-existing policies that redistribute wealth within Canada (e.g., unemployment insurance, progressive income tax rates and equalization payments), and net of any climate change mitigation measures that have the sole or primary purpose of redistributing the burden resulting from other measures in the package.

If this definition of burden is accepted, it is then necessary to determine what costs represent components of burden. This report suggests that both monetary and non-monetary costs should be considered part of the burden. Many non-monetary costs and benefits could be considered (see Appendix 1) and these are discussed throughout the report. While burden entails both monetary and non-monetary costs, they are different in nature and should be reported separately. When all costs cannot be quantified in dollar terms, multicriteria decision aids may be helpful.

This report defines burden as arising from the implementation of climate change mitigation measures in Canada alone. Nonetheless, the authors recognize that measures adopted in other countries to address climate change can also influence costs (see Appendix 2). For example, measures adopted in other countries can influence the price and demand for Canadian imports and exports, and can either strengthen or weaken the competitive position of Canadian firms. These factors are potentially quite important in a limited number of sectors in the Canadian context and the authors have suggested some mechanisms for understanding them. The report also notes that in the longer term, the extent to which climate change mitigation measures are implemented in other countries will also determine the benefits of lessened climate change in Canada.

To have a complete definition of burden, it is also important to answer the question of who bears a burden. This report concludes that the burden of climate change mitigation policy will ultimately be borne by individuals. Costs that initially fall on firms are either passed on to suppliers, customers or employees, or borne by firms' shareholders. Ultimately all these costs fall on individuals in their capacities as consumers, employees and shareholders. Costs that initially fall on governments will subsequently be transmitted to individuals in their capacities as taxpayers and beneficiaries of government services.

The authors recognize, however, that the transitional costs borne by governments and firms are of obvious political importance because ministers will resist negative changes to government

balances, firms will resist reductions in profits, and both are powerful players in society. In addition, there may be a time lag, possibly as long as a number of decades, before the transmission of costs from firms and governments to individuals is fully realized.

As firms and individuals are too numerous for their burdens to be examined individually, they must be aggregated into more manageable groupings for practical purposes. While the report notes the potential drawbacks of aggregation, it identifies seven criteria that could be used to justify an aggregation (e.g., members of the aggregation are likely to share a similar burden). Different potential aggregations are then assessed against these criteria. As a result of this work, the report recommends that Canadian governments should choose among the following aggregations to complete the definition of burden:

- individuals grouped by jurisdiction
- individuals grouped by disposable income
- firms grouped by industry sector
- employees grouped by industry sector
- consumers grouped by product

This report will not narrow down this list of potential aggregations any further. Canadian governments may choose to monitor the impact of burden on all of these aggregations, or they may narrow the list further. A source of rationales for narrowing the list further may be the association of each aggregation with a specific set of indicators (see section 3.3.1) and equity principles (see section 4.2).

3. The measurement of burden

Once a definition of burden has been agreed upon, it is necessary to consider how burden can be measured. If burden is defined as the difference in costs between a future scenario that includes Canadian governments' measures to address climate change and a baseline that does not, the first step in measuring burden is agreeing on a baseline. As discussed in section 1.2, this is not a straightforward process and requires discussion of equity considerations. For example, Canadian governments must consider to what extent (if at all) they want to include voluntary action to reduce greenhouse gas emissions in the baseline. Another key question that must be answered with regard to baselines is which policy measures to improve air quality should be included.

Second, Canadian governments will have to reach agreement on the timeframe over which burden is being assessed. This requires discussion of the start date and end date of a transition between a world where Canada has adopted no climate change mitigation measures to a world where Canada has fully adjusted to the measures implemented to limit greenhouse gas emissions to some target. The timeframe is important because the magnitude and distribution of burden will change steadily throughout this period as costs change and the populations of individuals and firms change.

Finally, there is a need to agree on indicators that can be used as measurements of burden. Overall changes in these indicators between the baseline and the "with-measures" scenario will provide information on the burden of Canadian governments' climate change mitigation measures at a national level. More importantly, changes in these indicators at a sub-national level (e.g., jurisdiction, industry sector and income class) will provide the information required to determine the distribution of the burden within Canada.

This chapter addresses each of these issues in turn.

3.1 Baselines for measuring burden

This report addresses the burden resulting from actions induced by a package of climate change mitigation measures implemented by Canadian governments. The burden is interpreted as the difference in costs (see chapter 2) between a future scenario including the measures and a baseline that does not. Selection of the baseline is critical in determining the magnitude and distribution of the burden. This section asks: relative to what baseline should burden be measured?

In order to understand clearly where equity, as opposed to technical considerations can enter into the measurement of burden, we introduce the following distinctions in the hope that they will be operationally useful for analysis and discussions.

- **"Raw burden"** refers to the difference between a **"with-measures scenario"** including the package of measures being assessed and a **"without-measures scenario"** in which there are no climate change mitigation measures in Canada. More specifically, for the purposes of model simulations, the proposed without-measures scenario assumes that individuals and firms act in a way that maximizes utility, minimizes costs and maximizes profits on the

assumption that there have not been, are not and never will be climate change mitigation measures in Canada.³¹

- **"Relevant burden"** refers to the difference between the with-measures scenario and an **"equity-relevant baseline"**, i.e. a baseline that is relevant for purposes of assessing the equity of the distribution of burden. The equity-relevant baseline could include, for example, corporate or individual actions based on knowledge of the risk of climate change in the absence of government measures. The equity-relevant baseline could alternatively simply coincide with the without-measures scenario. This is further discussed in section 3.1.1 below.

3.1.1 Should voluntary action be included in the baseline?

Canadian governments have to decide whether they want to use as a baseline a without-measures scenario or a different, equity-relevant baseline when considering the equity of the distribution of the burden resulting from the implementation of climate change mitigation measures in Canada. An equity-relevant baseline will differ from the without-measures scenario to the extent that the former includes:

- "voluntary" government measures in the absence of international binding agreements; and/or
- "voluntary" corporate or individual actions in the absence of federal or provincial/territorial regulations or financial incentives.

Some will make the case that the equity-relevant baseline should simply coincide with the without-measures scenario. Indeed, one could argue that it is only reasonable to expect governments, firms and individuals to incur costs when there is a legal obligation or financial incentive to do so. Even if past voluntary action is excluded from the baseline, it can still be recognized by applying the "historical beneficiaries..." equity principle (table 5 in section 4.1.2) when assessing the equity of the distribution of burden.

The motivation for including such voluntary action in the baseline, however, is a view that governments, firms and individuals are/were responsible for undertaking such action on their own initiative and bearing any associated costs. Inclusion of the voluntary action in the baseline prevents those costs from being included in the relevant burden.

Two obvious reasons can be identified for conferring a responsibility on governments, firms and individuals to act voluntarily to reduce emissions starting in some past year x . The first is their knowledge of the probability that climate change caused by greenhouse gas emissions is a real and serious problem demanding action by everyone to reduce emissions under their control. The second is the risk that Canada would in due course seek to meet a national emissions limitation target, implying that prudent conduct would be to manage that risk by taking some anticipatory action. The first reason could justify a "responsible action baseline"; the second reason could justify a "prudent action baseline". There is clearly an overlap between the two.

³¹ To date in Canada and the US, while there are some cases of governments directing utilities to incur costs to limit greenhouse gas emissions, there have been no broad policies that impose costs on greenhouse gas emissions. This without-measures scenario is much less complex than a guess at what would happen in the absence of the specific package of measures being assessed, since such a guess would have to address the complex question of what risk management emission reduction activities firms and individuals would undertake based on expectations of future measures.

If Canadian governments agree that voluntary action should be included in the baseline, they will need to consider two additional questions:

1. In which past year x should the voluntary action begin?
2. What level of voluntary action should be included at a given date?

For a "responsible action baseline", the answer to the first question depends on the date at which the probability of climate change caused by greenhouse gas emissions being a real and serious problem passed the threshold beyond which precautionary action was warranted. There are several possibilities here including 1992 (governments adopted the UN Framework Convention on Climate Change (UNFCCC)), 1990 (publication of the IPCC³²'s First Assessment Report, which provided the scientific basis for the UNFCCC), or 1995 (publication of the IPCC's Second Assessment Report, which for the first time clearly attributed observed warming to greenhouse gas emissions).

For a "prudent action baseline", the answer to the first question depends on the date at which it became clear that Canada would in due course seek to meet an emissions limitation target. This could be 1990 (the year in which the federal government first committed to return Canada's greenhouse gas emissions to their 1990 level by 2000), 1992 (the year of adoption of the UNFCCC, under which industrialized countries formally agreed to "aim" to return their greenhouse gas emissions to 1990 levels by 2000) or 1997 (the year of adoption of the Kyoto Protocol). Some might argue that it is still not clear today whether Canada will seek to meet an emissions limitation target.

Choice of a single date will depend on perceptions of: the trajectory of increasing scientific knowledge; the level of probability that warrants precautionary action; and the relative seriousness of Canada's unilateral commitment to stabilize emissions, the emissions stabilization aim of the UNFCCC, and Canada's commitment to the Kyoto Protocol. Different dates would probably be appropriate for governments, firms and individuals in view of their differing degrees of awareness of climate change.

Answering the second question above is even more difficult. One approach would be to gradually "switch on" emission-reducing action in the baseline from zero in year x to "full" in a future year y . "Full" here would mean action equivalent to what governments are seeking to induce through their package of climate change mitigation measures. In other words, the baseline would coincide with the with-measures scenario and the relevant burden therefore fall to zero in year y . The question of the date at which the assessment of burden ends will be revisited in section 3.2.

While answering the questions required to define an equity-relevant baseline will pose a challenge, the use of a simple without-measures scenario as a baseline is not free of problems. At first glance, the without-measures scenario is the straightforward, familiar "business as usual" case that does not require controversial decisions, dependent on different perceptions of equity, about what voluntary action governments, firms and individuals should have taken and when they should have started taking it. In reality though, it may not be straightforward to ensure that any historical portion of the without-measures scenario excludes voluntary action that did really occur when modelling this scenario.³³

³² Intergovernmental Panel on Climate Change.

³³ Because it will be difficult to verify claims that past actions were voluntary.

Responsible/prudent action and without-measures baselines are illustrated in a simplified way in figure 1 [at the end of the document], using the example of two identical entities E1 and E2, which could be governments, firms or individuals. E1 takes no voluntary action while E2 takes precisely the voluntary action included in the responsible/prudent action baseline, starting in year x . Figure 1 assumes, for the sake of simplification, that emission reductions are a proxy for costs incurred, that those costs are incurred once only, and that no discount rates are applied.³⁴

It is clear from figure 1 that both responsible/prudent action and without-measures baselines provide recognition³⁵ for the cost of past voluntary action (as long as it can be excluded from the historical portion of the without-measures baseline) and, conversely, avoid rewarding (in a relative sense) the inaction of those who did not act voluntarily. With the without-measures baseline, the cost of any voluntary action taken since year x is counted as part of the burden of those who acted; those who took no past action will have incurred no past burden. With a responsible/prudent action baseline, those who took voluntary action in the past are considered to have incurred no past burden, but that those who did not act voluntarily in the past are considered to have incurred a negative burden beginning in year x (i.e., they benefited relative to those who acted). The burden of those who did not act voluntarily in the past will only become positive when their future actions, as induced by the package of government measures, catch up with what the baseline says they should have been doing voluntarily.³⁶

Another consideration regarding recognition for the cost of past voluntary action is as follows. A responsible/prudent action baseline can incorporate the assumption that governments, firms and individuals should minimize the costs incurred from voluntary action to achieve a given emissions reduction, thereby avoiding giving recognition to inefficiency. A without-measures baseline, on the other hand, would recognize actual costs incurred from past voluntary action, whether efficient or not.

Finally, the question arises of how to apply a responsible/prudent action baseline to the relatively common situation in which firms or individuals fail to make emission reductions that have a negative cost. Such reductions would presumably be included in a responsible/prudent action baseline. Failure to implement them would therefore create a burden. In keeping with the "responsibility ethic" of these baselines, it would appear necessary to disregard a burden incurred in this way: costs that should not have been incurred should not be given recognition.

In summary, the choice of a baseline is not straightforward. Canadian governments will have to decide whether or not the baseline should include voluntary action. If the decision is that it should, more decisions are required on the start date for such action and the level of action to be included in the baseline. The authors recognize the challenge in achieving consensus on these issues and believe that it will be unlikely that agreement can be reached on a single equity-relevant baseline. As a result, the authors recommend that a variety of equity-relevant baselines be used to provide a range of measures of burden.

³⁴ If costs were recurrent, i.e., sustaining a given annual emission reduction required a corresponding cost to be incurred year after year, then burden would correspond to the area between the baseline and actual curves in figure 1 instead of the vertical distance between them.

³⁵ Here and subsequently we use this word to mean: measure a relatively larger burden for those who acted voluntarily compared to those who did not.

³⁶ This means that entities would not be compensated, according to some equity principle, for costs incurred as a result of implementation of the policy package until those costs exceeded the level the entities are considered to have a responsibility to bear themselves.

3.1.2 Other baseline issues

Governments are quite likely to implement measures that simultaneously address climate change mitigation as well as other policy objectives, for example air quality. It must be decided which such measures to include in the baseline and which to include only in the package of climate change mitigation measures. The decision will inevitably be somewhat arbitrary; it could be guided by the concept of "primary intent" of a measure. The decision could be controversial if a measure deemed not to be primarily a climate change measure, and therefore included in the baseline, gives rise to a burden that is distributed differently than the burden of the climate change policy package.

Redistributive measures adopted as an integral part of climate change policy should not be included in the baseline (see section 2.1).

As explained in section 2.1.2, price and demand effects resulting from the implementation of climate change mitigation measures in other countries should be either included in both the baseline and with-measures scenarios or excluded from both. Although there are many possible permutations of other countries' climate change mitigation policy packages, the effects of such packages could be approximately modelled by assuming that all other industrialized countries adopt comprehensive measures to put a price on greenhouse gas emissions.

3.2 Start and end dates for assessing burden

Over what period should the burden of climate change mitigation measures be considered?

In answering this question it may be helpful to think of there being a transition between a world with no climate change mitigation measures and a world which has fully adjusted to such measures to limit greenhouse gas emissions to some target.³⁷ One can expect that burden will be considered important and the equity of its distribution contentious during the period of this transition but not before and not afterwards. The start and end dates of the transition will also be start and end dates for assessing burden.

Views on the start date of the transition are likely to mirror closely views on whether or not the equity-relevant baseline should include voluntary action. Those who believe it should will see the transition beginning at the date when governments, firms and individuals begin to be considered responsible to take such action. Those who believe that the equity-relevant baseline is the without-measures scenario will tend to see the transition beginning at the date of implementation of the climate change mitigation policy package. However, as we saw in section 3.1.1, it is possible to use a without-measures baseline to recognize *past* voluntary action.

Views on the end date of the transition will depend on understanding of the concept of "full adjustment" to a climate change mitigation policy package. Adjustment depends on the lifetime of emissions-producing capital stock and is realized as this stock is replaced. The period of adjustment will differ in different sectors and even among different firms, depending on the age and lifetime of individual items of capital and the effect of climate change mitigation measures on

³⁷ For the sake of this discussion, we will ignore the possibility that there be a moving target, i.e. repeated reductions of the target, increases in the severity of climate change mitigation measures and/or increases in the price of greenhouse gas emissions.

the relative cost of using the existing capital or replacing it. Hence there is no single transition period.

There will, however, come a time when all existing capital stock will have been created after the date of implementation of the climate change mitigation policy package. At that time one could consider that there will be a "level playing field" between all individuals, firms and governments affected by the policy package. In this sense, although the world at that time will likely differ considerably from the "without-measures" scenario, there will no longer be any equity issues arising from the burden of the policy package.³⁸ Indeed, it will probably no longer be pertinent to consider that there remains a burden at all. This seems reasonable when one imagines our descendants 100 years from now still debating whether they are equitably sharing the burden of measures taken a century earlier.

Responsible/prudent action and without-measures baselines over the transition are illustrated in figure 2 [at the end of the document]. The without-measures baseline rejoins the with-measures scenario in a discontinuous step at the end of the transition. Responsible/prudent action baselines can be constructed to smoothly rejoin the with-measures scenario in some future year. But if that year is after the end of the transition, a responsible/prudent action baseline will also have a discontinuous step at the end of the transition.

The existence of a discontinuous step in a baseline raises a doubt as to whether such a baseline should really be used. This argues in favour of responsible/prudent action baselines that smoothly rejoin the with-measures scenario by the end of the transition. On the other hand, the discontinuous step is not a very serious problem in the short term if positive discount rates are used to evaluate the net present value of future burden (see section 4.1.2); such rates can make burdens from some future date onwards (e.g., prior to the end of the transition) appear vanishingly small.

While it is clear that Canadian governments should only be concerned about the burden of climate change mitigation measures in the transition period, it is important to recognize that the magnitude and the distribution of the burden is likely to vary throughout the transition period.

Two distinct factors affect the magnitude and distribution of the burden:

- the fact that costs change over time (a variation that can be directly adjusted by borrowing); and
- the fact that the populations incurring costs change over time (because the populations of individuals and firms change).

Both of these factors need to be taken into account when assessing the equity of burden distribution (see chapter 4), and it is important not to obscure them when using cost indicators (section 3.3) that are integrated (added up) over time.

3.3 Indicators of burden

Once Canadian governments have agreed on baselines and timeframes, they will need to consider what indicators will be used to measure burden. In section 2.2, this report suggested that the

³⁸ This view is consistent with the "accept the market outcome..." equity principle (see section 3.2) applied to the long term. It is also consistent with the "transitional compensation..." principle which will coincide with the "accept the market outcome..." equity principle after the end of the transition.

definition of burden should consider five different aggregates of bearers of burden. If these aggregations are to be useful, there is a need for relevant indicators.

For a given aggregation, the criteria that should be used for determining the relevance of an indicator are (i) members of the aggregation are likely, at least to some degree, to suffer similar burdens as measured by the indicator; and (ii) the indicator has meaning for that aggregation. The first of these criteria reflects the first of the two arguments against aggregating presented at the end of section 2.2.2.

In addition, the indicators must be: (a) observable, (b) available through the economic models that will be used to assess burden and its distribution, and (c) characterized by a relatively high degree of certainty.

3.3.1 The link between indicators and aggregations

There are many types of costs (see section 2.1.1). Table 2 presents several categories of cost indicators used or referred to in the literature³⁹ that can be extracted from standard economic models, plus (health benefits of) reduced air pollution, which require special models. The table shows which of these cost indicators are relevant to each of the five different aggregations provisionally retained for consideration in section 2.2 plus governments.

Governments are a special case in table 2. For several indicators they are pseudo-aggregations representing and having control over the collective wealth of their jurisdictions. As governments can and do redistribute wealth within their jurisdictions, they are exempted in the table from criterion (i) (specified near the beginning of section 3.3) for determining the relevance of an indicator.

Note that the word "change" in table 2 refers to the difference between the scenario with climate change mitigation measures and the baseline scenario.

³⁹ The categories presented are inclusive of the views of NAICC-CC members on appropriate cost indicators in relation to the criterion of "least-cost first" under the Phased Approach principle, except for indicators of cost-effectiveness, which are not relevant to the definition of burden used in this report. See Cheminfo Services Inc., *op. cit.*, p.36, 95.

Table 2. Cost indicators relevant to different aggregations of individuals and firms plus governments

	individuals grouped by jurisdiction	individuals grouped by disposable income	firms grouped by industry sector	employees grouped by industry sector	consumers grouped by product	governments
1) change in (net) income	change in disposable income ⁴⁰	change in disposable income	change in profits	change in salaries		change in government balance ⁴¹
2) change in monetary value of assets			capital assets, including freehold fossil fuel and biomass resources		homes, automobiles	fossil fuel and biomass resources under the control of the jurisdiction
3) change in GDP ⁴²			for the sector			for the jurisdiction
4) indicators of a change in competitiveness ⁴³			change in total factor productivity, imports and exports, net investment flows, real unit costs for the sector relative to foreign producers			change in real GDP per capita, total factor productivity, imports and exports, net investment flows for the jurisdiction
5) change in investment			yes		yes (e.g., in home insulation)	yes
6) change in operating costs / cost of living	yes		change in costs of fuel, electricity, material inputs, labour		change in costs of fuel, electricity, other emissions-intensive products	
7) change in tax burden	yes	yes	yes		yes	
8) marginal cost of implementing emission reductions			for the sector			for the jurisdiction
9) cost of acquiring emission permits			for the sector			revenue from any sales of permits, net cost for the jurisdiction
10) change in unemployment ⁴⁴	yes	yes		yes		for the jurisdiction

⁴⁰ It must be decided which taxes and other adjustments this is net of.

⁴¹ This should be normalized using standardized assumptions to address gaming.

⁴² Or possibly separate components of GDP.

⁴³ These indicators have been taken from Analysis and Modelling Group, *op.cit.*, p.62.

⁴⁴ An additional, related indicator that could be considered is retraining costs for displaced labour.

	individuals grouped by jurisdiction	individuals grouped by disposable income	firms grouped by industry sector	employees grouped by industry sector	consumers grouped by product	governments
11) loss of consumer surplus					e.g., for home heating, transportation	
12) (health benefits of) reduced air pollution ⁴⁵	yes	yes (low-income individuals likely to benefit more)				for the jurisdiction
13) change in stocks of natural resources			freehold fossil fuel and biomass resources			fossil fuel and biomass resources under the control of the jurisdiction

All the cost indicators listed in the table are relevant to one or more of the five suggested aggregations. Some initial conclusions that can be drawn include:

- Indicators that appear to be particularly relevant for aggregations of individuals include: change in net income, change in cost of living, change in tax burden, change in unemployment, loss of consumer surplus, and (health benefits of) reduced air pollution.
- Indicators that appear to be particularly relevant for industry sectors include: change in net income, change in monetary value of assets, change in GDP, change in competitiveness, change in investment, change in operating costs, change in tax burden, marginal cost of implementing emission reductions, cost of acquiring emission permits, and change in stocks of natural resources.
- As governments are pseudo-aggregations representing and having control over the collective wealth of their jurisdictions, most of the indicators have some relevance for them.

It appears that all of the proposed indicators have some value. At the same time, it is unlikely that Canadian governments will want to monitor 13 different indicators. The following criteria could be used to eliminate some of them from consideration as indicators of the burden of climate change mitigation policy:

- What is a manageable number of indicators for policymakers to use?
- To what extent does the indicator measure an aggregation's *total* costs rather than just one element of costs?
- To what extent does the indicator provide information on the aggregations of burden bearers ultimately chosen for analysis?
- To what extent does the indicator measure important non-monetary costs?
- To what extent is the indicator useful in revealing the equity of burden distribution?
- To what extent is the indicator useful in designing measures to redistribute the burden?
- How politically sensitive is the quantity being measured?

⁴⁵ This indicator could be simply a measure of air quality, or it could be a monetized measure of health derived from air quality.

Indicators in categories 1 to 3 that measure changes in *total* income or monetary wealth of individuals or entities are clearly more useful in assessing overall burden and the equity of its distribution than other indicators (in categories 4 to 9, for example) that relate only to part of the costs incurred by a particular aggregation. This implies that considering individuals separately as consumers, employees, shareholders or taxpayers — while in reality a given individual is likely to be all four at once — is not useful when assessing burden. However, specific policy measures could certainly be designed to redistribute burden on the basis of the specific circumstances of individuals. To implement such measures, burden indicators that do consider individuals separately as consumers, employees, shareholders or taxpayers may well be needed. Alternatively, redistributive measures targeted at shareholders could be applied via firms.

Change in GDP (category 3) is both a broad and politically important measure of cost, directly referenced by the Equitable Approach guiding principle of Canada's National Implementation Strategy on climate change: "...no region or sector should be asked to bear an unreasonable burden such that actions would prevent economic growth" (see chapter 1). GDP per capita⁴⁶ also arises for jurisdictions in category 4. It is not clear to what extent the other measures of competitiveness in category 4 are likely to provide additional insights.

Changes in the value of fossil fuel and biomass resources (category 2) could be considered important in view of their potential absolute magnitude or, alternatively, unimportant in view of the small relative magnitude of those changes compared to the much larger value of total assets.

While measuring only single elements of cost, taxes, fuel and electricity prices (categories 6 and 7), especially those borne by individuals, can also have very high political sensitivity, as illustrated by issues like gasoline taxes and electricity deregulation. Furthermore, experience suggests that governments may well want to consider measures to redistribute burden that focus on particular elements of cost (e.g. energy cost rebates) as well as total cost (e.g. allocation of emission permits). Changes in personal taxes are captured in disposable income.

Unemployment (category 10) is clearly an important indicator given the high social costs that are universally attributed to it and its political sensitivity. However, care needs to be taken in aggregating unemployment because small changes in aggregate unemployment can mask larger differences between those who lose jobs and those who gain them. Unemployment data therefore need to provide job losses and gains, ideally (dis)aggregated by jurisdiction, income and sector.

Loss of consumer surplus (category 11), health benefits of reduced air pollution (category 12) and change in stocks of natural resources (category 13) are problematic in that they are just three out of a large number of non-monetary costs and benefits arising from climate change mitigation policy (see section 2.1). On the other hand, loss of consumer surplus and health benefits of reduced air pollution are arguably the two most important such quantities.⁴⁷

It would therefore seem to make sense to provisionally retain for consideration the following indicators of burden/aggregations:

⁴⁶ The distinction between total GDP and GDP per capita for jurisdictions deserves some attention: a change in total GDP can result from increased population as well as from increased GDP per capita. Increases in population are often considered to be desirable, but most people likely consider increases in GDP per capita to be significantly more desirable. If this is true, then GDP per capita is a more important indicator for jurisdictions than total GDP.

⁴⁷ Based, for example, on opinions expressed by stakeholders to the Analysis and Modelling Group under the National Climate Change Process.

- change in disposable income of individuals grouped by jurisdiction and disposable income
- change in profits of firms by sector
- change in government balance
- change in value of capital assets by sector
- change in GDP by sector and jurisdiction (including per capita⁴⁸)
- change in consumers' energy prices by jurisdiction
- change in unemployment by jurisdiction, income and sector
- loss of consumer surplus by commuters, homeowners etc.
- change in air quality, or a measure of health derived from it, by jurisdiction and income

Once again, it is important to state the caveat that the ultimate incidence of burden is on individuals, not firms or governments. The burden falling initially on firms and governments will subsequently be transmitted to individuals in their capacities as consumers, employees, shareholders and taxpayers.

3.3.2 The availability of the indicators

It is not only important to assess the relevance of indicators to the burden-bearing aggregations selected in chapter 2. It is also important to examine each indicator to determine if it is available through economic models as well as to assess the level of uncertainty associated with the data. This is done in table 3 for the subset of the potential indicators identified at the end of section 3.3.1.

Table 3. Availability and reliability of the selected cost indicators

Potential indicator of burden	Availability in economic models (focus on MARKAL and TIMS)
Change in disposable income of individuals by jurisdiction and disposable income	Personal income and personal disposable income are available historically and are covered by TIMS but not by MARKAL.
Change in profits of firms by sector	It is not clear if this is available from the models. It is unlikely to be the case for many sectors.
Change in government balance	These are available historically and covered by TIMS.
Change in value of capital assets by sector	The data on the value of existing capital stocks by sector are not particularly reliable. However, simulations of MARKAL can provide information that can indicate the change in the value of existing capital stock from one simulation to another.
Change in GDP by sector and jurisdiction	This is available historically by sector and jurisdiction. All are covered by TIMS, some are covered by MARKAL. In both cases, not all are determined endogenously in the models.
Change in consumers' energy prices by jurisdiction	The models should be able to provide this although these numbers will likely have a high degree of uncertainty.
Change in unemployment by income, jurisdiction and sector	While the models can provide data on unemployment, they are not likely to provide important information on job flows between jurisdictions, regions and sectors. Although unemployment cannot easily be converted to a monetary cost, separate from personal income, unemployment will be of interest in itself and may lead to specific adjustment policies to reduce its burden.

⁴⁸ See footnote on previous page.

Potential indicator of burden	Availability in economic models (focus on MARKAL and TIMS)
Loss of consumer surplus by commuters, homeowners, etc.	The models may be able to provide highly uncertain estimates for some groups of consumers
Change in air quality, or a measure of health derived from it, by jurisdiction and income ⁴⁹	This information cannot be obtained from these models. Other modelling tools are available, but provide results with a wide range of uncertainty.

Based on this analysis, it is possible to conclude that a subset of our proposed indicators is readily available for analysis. These indicators are:

- change in disposable income by jurisdiction and disposable income
- change in government balance
- change in GDP by sector and jurisdiction (including per capita)

Another subset of our proposed indicators could be used for analysis, with the caveat that the data would be highly uncertain. These indicators are:

- change in value of capital assets by sector
- change in consumers' energy prices by jurisdiction
- change in air quality, or a measure of health derived from it, by jurisdiction and income

Finally, three of our proposed indicators appear to be somewhat problematic to use. These include:

- change in profits of firms by sector (because the data is not likely to be available)
- change in unemployment by income, jurisdiction and sector (because data on flows of job losses and gains not likely to be available)
- loss of consumer surplus (because a comprehensive approach is unlikely to be achieved)

Data availability issues are of course relevant to the indicators that were not selected for further analysis as well. Accordingly, indicators that may hold some attraction, such as change in investment or change in competitiveness, are simply extremely difficult to use at this time.⁵⁰

3.4 Summary of key conclusions for EABSWG

This report indicates that once Canadian governments agree on a definition of burden, they must answer a number of additional questions to facilitate the measurement of that burden. To begin with, Canadian governments must agree on a baseline against which burden can be measured.

⁴⁹ This indicator could be simply a measure of air quality, or it could be a monetized measure of health derived from air quality.

⁵⁰ Information on investment is available historically and is partially endogenous to the models, however, the key assumptions about the investment response to new policies are not well modelled and must be provided from outside the models. This is one of the main areas of focus of the competitiveness analysis being undertaken by Natural Resources Canada and Industry Canada. With regard to competitiveness, data on unit costs of sectors are not readily available and require specific studies. Simulations will require assumptions about foreign policies. To the extent that the models cover competing foreign sectors, simulations can provide information on changes in competitiveness, though they will no doubt require careful interpretation.

This is a challenging task because it is difficult to remove equity considerations from the discussion. Specifically, Canadian governments will have to determine the extent to which voluntary actions should be reflected in the baseline. This decision will have equity implications because it will influence the measurement of burden both for entities that took voluntary action to reduce greenhouse gas emissions and entities that did not.

If Canadian governments wish to include some voluntary action in the baseline, it will be necessary to reach agreement on the time at which voluntary action should have begun and the rate at which it should have occurred. While this report has highlighted these questions and offered some possible responses, it has recommended no single response for EABSWG in this area. In fact, the authors believe that it will be extremely difficult for Canadian governments to reach agreement on these questions. As a result, the report suggests that it may be necessary to develop multiple baselines and to consider multiple measures of the quantity and distribution of burden. The report also highlights a number of other choices Canadian governments need to make with respect to the policy measures that should be included in the baseline.

This report concludes that the concept of burden should only be applied to a "transition period" that extends between a world where Canadian governments have not implemented climate change mitigation measures and a world where Canada has fully adjusted to the mitigation measures implemented to limit greenhouse gas emissions to some target. For practical purposes, it is necessary to define the start and end points of this transition period. This report concludes that the start date will be closely tied to views on when voluntary action should have begun and that the end date will come at the point where all relevant capital stock was put in place after the implementation of a package of climate change mitigation measures.

While the concept of the transition period limits the scope of burden discussions, the report stresses that the magnitude and distribution of burden will vary significantly throughout the transition period as costs and the populations incurring costs change over time. These factors must be taken into account when assessing the equity of burden distribution (see section 4.1).

Finally, this report has considered a broad range of potential cost indicators that could be used to measure the level and distribution of burden. Each of these indicators has been assessed for its relevance to the aggregations of burden bearers identified in chapter 2 as well as for data availability and reliability. On the basis of this assessment, the report concludes that the following indicators should be used to measure the level and distribution of burden for the aggregations identified in chapter 2:

- change in disposable income by jurisdiction and disposable income
- change in government balance
- change in GDP by sector and jurisdiction (including per capita)
- change in value of capital assets by sector
- change in consumers' energy prices by jurisdiction, and
- change in air quality, or a measure of health derived from it, by jurisdiction and income.

4. What is an equitable distribution of burden?

Once Canadian governments have defined and measured burden, it is then possible to consider the equity of the distribution of that burden. It is clear that ensuring the equity of the distribution of the burden of climate change mitigation measures is a widely and strongly held concern. In Canada, First Ministers have given prominence to their direction that Canada should address climate change "in such a way that no region is asked to bear an unreasonable burden". Eight out of twelve jurisdictions represented in NAICC-CC ranked the Equitable Approach above the other three guiding principles (Phased Approach, Balanced Approach, Comprehensive Approach) of Canada's National Implementation Strategy on climate change (see chapter 1).⁵¹

Equity has also been a central issue of international climate change negotiations, particularly in the debates over which countries should be subject to emission limitation targets and the relative stringency of different countries' targets.

This is no surprise. Climate change is a problem whose causes and effects are inextricably shared by different countries and different sub-national units, and whose solution involves significant costs and benefits. Each participant therefore has a strong interest in making sure none of the other participants are free riding, i.e. getting more benefit from the solution than is warranted by the costs they are incurring, relative to other participants.

Despite the central importance of ensuring equity, it is far from the only important criterion used to choose policy measures. Other important overlapping criteria are political acceptability, economic efficiency (reducing total costs), administrative feasibility and technological feasibility. The equity of burden distribution is the focus of this report, but these other criteria need to be borne in mind as possible constraints on the extent to which equity can be ensured.⁵²

This chapter asks: how is the equity of burden distribution to be assessed? In other words, how fair is a given burden distribution? This is an ethical question about how people should be treated. There is no correct answer: many contradictory perspectives exist on ethical issues, often conditioned by self-interest, and negotiations between governments or other negotiators will need to aim at compromise rather than consensus on equity principles. However, clarifying the concepts and language should help to avoid confusion about where and why there are differences of view.

It is assumed that the assessment will be undertaken using the projections of economic models at the stage where policy measures are being designed. But in view of the likelihood of differences between projections and reality, the analysis in this chapter could also be used to make such adjustments "ex post" based on observations following policy implementation.

This chapter begins with a discussion of the equity principles that can be used to assess the equity of the distribution of the burden arising from the implementation of a package of climate change mitigation measures by Canadian governments. It then considers how these different equity principles can be applied to the aggregations of burden bearers identified in chapter 2 as well as

⁵¹ Cheminfo Services Inc., *op. cit.*, p.91.

⁵² Some policy measures can be designed to separate efficiency and equity, allowing an efficient solution to be chosen and independent decisions to be made on addressing equity. A tradeable emission permit system provides an example, with its independent components of coverage, permit allocation and revenue recycling.

how they relate to the indicators of burden identified in chapter 3. Some additional quantities are required to apply the equity principles and these are identified. Finally, the chapter briefly considers the policy tools available to government to redress inequities in the distribution of burden.

4.1 Equity principles

There are many different conceptions of equity based on different equity principles. This section will provide an overview of the key equity principles Canadian governments may wish to consider when assessing the equity of the distribution of the burden arising from the implementation of climate change mitigation measures. It begins, however, with a discussion of some of the different contexts within which equity principles are frequently discussed with respect to climate change.

4.1.1 Types of equity

Three distinct types of equity are important in relation to the mitigation of climate change.⁵³

- *procedural equity* relates to the fairness of participation in, and the process of, decision-making;
- *allocation-based equity* relates to the fairness of the allocation of rights to emit greenhouse gases or responsibility to reduce emissions; and
- *outcome-based equity* relates to the fairness of the impacts of climate change mitigation measures on welfare.

The scope of this report is limited to outcome-based equity alone. Specifically, as set out in section 2.1, we are concerned with the assessment of the equity of the distribution of the burden arising from a climate change mitigation policy package:

- including measures having the sole or primary purpose of redistributing the burden resulting from other measures in the package (see section 4.3); and
- net of pre-existing policies unrelated to climate change that redistribute wealth within Canada.

It should be noted in passing that procedural equity in relation to climate change mitigation policy is likely to take on increasing importance in Canada. This follows from the likelihood that Canada will be implementing climate change mitigation measures for the next several decades and that those measures will require frequent adjustments to circumstances,⁵⁴ which are bound to change significantly over time. One consequence is that the changes in circumstances will change the distribution of burden and its (outcome-based) equity. Another is that the procedural equity of the process used to make the adjustments to the policy package is likely to raise significant concerns.

⁵³ See, in particular, T. Banuri et al. (1996), "Equity and Social Considerations" in *Climate Change 1995: Economic and Social Dimensions of Climate Change*, J. Bruce et al., eds., Cambridge University Press, pp.79-124; and A. Rose et al. (1998), "International Equity and Differentiation in Global Warming Policy," *Environmental and Resource Economics*, vol. 12, p.25-51.

⁵⁴ This is the principal conclusion, in relation to the international burden distribution, of J. Edmonds et al. (1995), "Carbon coalitions: the cost and effectiveness of energy agreements to alter trajectories of atmospheric carbon dioxide emissions," *Energy Policy*, vol. 23, pp.309-335.

It is also instructive to briefly compare allocation-based and outcome-based equity. Allocation-based equity principles, of which some examples are given in table 4, translate directly into different allocations of rights to emit, i.e. emission permits, or legal responsibility to secure emission reductions.⁵⁵ They can therefore be directly implemented by emissions trading systems or jurisdictional emissions limitation targets. Application of outcome-based equity principles, on the other hand, first requires an understanding of the effect of a policy package, either via projections or observations. Such principles can then be implemented by adjusting measures in the package⁵⁶ or augmenting it with additional redistributive measures (see section 4.3) to compensate for the effects of the measures initially included.

Emphasis on allocation-based or outcome-based equity depends in principle on whether one believes that fairness should be assessed more on the basis of how rights/responsibilities are allocated or more on the basis of the ultimate effects of such an allocation.⁵⁷ Allocation-based equity principles have also undoubtedly received more attention in the literature discussing the equity of climate change mitigation because the literature overwhelmingly addresses the international situation, where institutions and mechanisms to redistribute wealth are weak or non-existent.

Table 4. Some allocation-based equity principles

Principle	Corresponding allocation of emission permits or jurisdictional emissions limitation target
Polluter pays	Full auction of permits
Historical responsibility	In inverse relation to cumulative past emissions
Egalitarianism	Equal per-capita or proportional to population
Ability to pay	In inverse relation to an indicator of wealth or income
Existing emitters have an acquired right to continue at their historical level ⁵⁸	Proportional to emissions in recent year x ("grandfathering")
Emitters should not be penalized for expanding production	Proportional to a sector-specific emissions-per-unit-production benchmark (performance standard) multiplied by current production

In practice, there are arguments for using both allocation-based and outcome-based equity principles in Canadian climate change mitigation policymaking.⁵⁹ Allocation-based principles will help guide the allocation of legal responsibility for securing emission reductions and/or

⁵⁵ Rights to emit and responsibility to secure reductions are equivalent: if one would normally emit amount x , then the right to emit amount y is the same as being responsible to secure an emission reduction of $(x-y)$.

⁵⁶ For example, adjusting the allocation of emission permits or the recycling of revenue from auctioning emission permits.

⁵⁷ Preferences in this regard may mirror ideological ones along an axis of right (rights/responsibilities) to left (ultimate effects). Those who prefer effects to rights/responsibilities may well consider that allocation-based equity principles are not equity principles at all, but rather simply allocation principles.

⁵⁸ Or, alternatively: existing emitters should not be penalized for having invested in the past in significant sources of emissions.

⁵⁹ An interesting analogy between the nature of climate change mitigation policy and that of structural adjustment in developing countries suggests that "blind" policies, analogous to allocation-oriented measures (carbon tax, tradeable emission permits) in the area of climate change, have to be supplemented with outcome-oriented policies to protect vulnerable groups and sectors. See T. Banuri et al., *op. cit.*, p.114.

emission permits (if they are implemented).⁶⁰ They are, however, unlikely to lead to an equitable distribution of burden because of the complex difference between the point of imposition and the incidence of policy measures (see section 2.2.1). Outcome-based principles will be required to assess the equity of the resulting burden distribution if redistributive measures (section 4.3) are to be designed to adjust it. A combination of policy measures derived from both allocation-based and outcome-based equity principles should help to provide sufficient overall flexibility to achieve political acceptability, economic efficiency and administrative feasibility as well as equity.

4.1.2 Outcome-based equity principles

Outcome-based equity principles are the focus of the remainder of this chapter. Table 5 presents a comprehensive range of such principles, some of which (or elements of which) appear in the literature — although sometimes in an allocation-based form or with different names.^{61,62} Some obvious advantages and disadvantages of the principles are described in the table.

The applicability of the principles in table 5 to different aggregations is examined methodically in section 4.2. It will be seen there that some principles apply more naturally to some aggregations than others.

Several kinds of conflicts and compatibilities can occur between principles as follows.

- Two principles will always conflict when applied to the same aggregation.
- Two principles can conflict in any circumstances, e.g., "Egalitarianism" and "Ability to pay" or "Accept the market outcome..." and "Transitional compensation...".
- Two principles can be compatible when applied to different aggregations. For example, "Ability to pay" can be applied to individuals grouped by disposable income while "Transitional compensation..." is applied to firms grouped by sector. Or, "Accept the market outcome..." can be applied to firms grouped by sector while using "Egalitarianism" to redistribute the revenue generated from pricing of emissions.
- One principle can conflict with itself when applied to different aggregations. For example, "Ability to pay" will give different results when applied to individuals grouped by disposable income and firms grouped by industry sector. This is because firms represent their shareholders (see section 2.2.2) and the shareholders of a given firm will not belong to a single income group.

⁶⁰ It would also be possible to dispense with allocation-based principles entirely. For example, the initial allocation of permits under a tradeable emission permits system could be repeatedly adjusted in an economic model until a cost outcome consistent with a chosen outcome-based equity principle was obtained.

⁶¹ See especially, T. Banuri et al., *op. cit.*; A. Rose et al., *op. cit.*; N. Martin et al. (1999), *Attribution initiale des droits d'émissions GES : évaluation des bases d'attribution*, Rapport de recherche réalisé pour le Ministère des Ressources naturelles du Québec, Direction de la planification et de la recherche, Secteur de l'énergie; K. Vaillancourt, *op. cit.*; Tradeable Permits Working Group, *op. cit.*

⁶² Some equity principles described in the literature that did not seem relevant or applicable have not been included in the table. In particular: willingness to pay (in anticipation of the impacts of climate change) does not seem to apply to intra-national equity given that over 97% of emissions causing climate change in Canada are emitted outside Canada; and "polluter pays" is seen to be an allocation-based, not an outcome-based equity principle when one considers that firms who pollute will in general be able to pass on part of any costs imposed on them to suppliers, customers or employees, with only a part being borne by firms' shareholders.

Where principles conflict, there is likely to be interest in using a compromise blend of different principles in designing a policy package, thereby providing some satisfaction to the supporters of each principle, rather than using a single principle that could well be seen by many as representing an extreme viewpoint.

Table 5. Outcome-based equity principles

Principle	How the burden should be (re)distributed
<ul style="list-style-type: none"> • Egalitarianism 	Equally to individuals or proportionally to population
This principle reflects a belief that contributions to collective tasks should be shared out equally among individuals. But it is likely to be widely criticized for not reflecting the facts (i) that some are more able to pay than others; and (ii) that some are more responsible than others for causing climate change in the first place.	
<ul style="list-style-type: none"> • Ability to pay 	Proportionally to an indicator of wealth or income
This principle can be seen as an adjustment of "Egalitarianism" to reflect the widely held belief that while all should contribute to collective tasks, they should do so according to means. But this principle is still open to criticism for not reflecting the fact that some are more responsible than others for causing climate change in the first place.	
<ul style="list-style-type: none"> • Redistribution 	Proportionally to a power greater than one ⁶³ of an indicator of wealth or income
This principle takes ability to pay a stage beyond "Ability to pay" by linking contributions even more strongly to wealth or income. As a result, its implementation would cause a redistribution of wealth beyond an equitable distribution purely of the burden of mitigating climate change. In this perspective, any opportunity to redistribute wealth is welcome; an opposing perspective advocates an equitable distribution of the burden of climate change mitigation with separate measures for redistribution of societal benefits and burdens unrelated to climate change.	
<ul style="list-style-type: none"> • Accept the market outcome of full pricing of emissions 	According to the market outcome of full pricing of emissions
According to this principle, the outcome generated by a climate change mitigation policy package consisting solely of putting a price on greenhouse gas emissions ⁶⁴ — as would be done by applying the "Polluter pays" allocation-based principle (see table 4) — is considered to be equitable. The outcome in question would consist of a burden distributed among individuals as consumers, employees, shareholders and taxpayers, in accordance with the market effects of putting a price on emissions. The principle is incomplete in that other principles would be needed to decide who would receive the revenue generated e.g. from a carbon tax or auctioning of emission permits. Both the "polluter pays" and "market justice" aspects of this principle are widely supported but not necessarily by the same people. As full pricing of emissions minimizes total costs, this principle could also be seen more as an efficiency principle than an equity principle. To be applied fairly, this principle would require reasonably accurate quantification of emissions, which may not always be straightforward.	

⁶³ Or some other accelerating function.

⁶⁴ E.g., through a carbon tax or a tradeable emissions permit system.

Principle	How the burden should be (re)distributed
<ul style="list-style-type: none"> Historical beneficiaries of the absence of full pricing of emissions pay 	Proportionally to the cumulative benefits enjoyed or costs incurred since some past date prior to implementation of the policy package, relative to a scenario in which there was full pricing of emissions.
<p>This principle is a generalization of the "Accept the market outcome..." principle. According to the "Accept the market outcome..." principle, those who <i>currently</i> benefit from the absence of full pricing of emissions should pay whatever costs they would incur if full pricing were introduced. The "Historical beneficiaries..." principle goes a step further by stipulating that those who have cumulatively benefited since some past year x from the absence of full emissions pricing⁶⁵ should bear the burden in proportion to those benefits. Conversely, those who have incurred relative costs as a result of the absence of full emissions pricing should receive compensation (a negative burden) in proportion to those costs. This principle entails elements of both "polluter pays" and historical responsibility. Application of this principle would require use of a model to estimate what effects full emissions pricing would have had if implemented in year x⁶⁶ — an approximate undertaking that would be feasible only at relatively high levels of aggregation (e.g. industry sectors or jurisdictions). Choice of year x is also likely to be controversial. An announcement made now by governments that this principle will be applied in the future would have the advantage of removing a current disincentive against making voluntary emission reductions.⁶⁷ The principle can also be used to provide recognition of the costs of voluntary action taken by governments, firms and individuals to reduce emissions since year x based on knowledge of the risk of climate change, if use of a baseline excluding such voluntary action (see section 3.1.1) prevents those costs from being counted as part of the burden. If such a baseline is used to measure burden, recognition of the costs of voluntary action might be better provided by using a variant of this principle that could be termed "Historical beneficiaries of the absence of voluntary action pay", where "voluntary action" is defined in the same way as it would be for an "equity-relevant" baseline (see section 3.1.1).</p>	
<ul style="list-style-type: none"> Transitional compensation for excessive burden 	Such that the burden borne by economic agents that suffer excessive transitional costs is reduced

⁶⁵ In theory, instead of referring to the absence of full emissions pricing, this principle could refer to the absence of some other climate change mitigation policy package. However, it would be difficult to agree on what that package might consist of. Full emissions pricing has the advantages of being straightforward to model and attracting widespread support since it minimizes total costs.

⁶⁶ The modelling would have to assume some prescription for recycling the revenue generated e.g. from a carbon tax or auctioning of emission permits.

⁶⁷ This is the purpose of "credit for early action" and the Baseline Protection Initiative.

Principle	How the burden should be (re)distributed
<p>This principle can be seen as a refinement to the "Accept the market outcome..." principle in which the market outcome of the policy package is considered to be equitable but only after a transitional period during which the economy adjusts to the package. According to the "Transitional compensation..." principle, compensation should be provided to those who suffer excessive burdens during the transitional period. A notable example is that of emitters who made previous capital investments (prior to the implementation of a package of measures or some other significant past date such as 1990, 1992 or 1997) in emissions-intensive activities and suffer losses of that capital as a result of climate change mitigation measures because they are not able to raise prices to pass on the costs of those measures.⁶⁸ In such cases, compensation could be provided to shareholders and possibly employees of the firms concerned. This principle seems likely to command significant support beyond the parties directly concerned to the extent that the circumstances in question are seen to be a result of misfortune as opposed to irresponsible behaviour. On the other hand it may be difficult to agree on an appropriate amount of compensation.</p>	
<ul style="list-style-type: none"> • Exporter pays 	<p>Such that Canadian producers of products whose production results in significant emissions carry the full costs of offsetting the emissions arising from increased exports of such products resulting from climate change mitigation measures implemented in the importing countries.</p>
<p>Demand for Canadian products (such as natural gas) whose use is relatively emissions-unintensive but whose production results in significant emissions will tend to rise in countries implementing climate change mitigation measures. If governments do not take measures to limit the resulting increase in exports, the corresponding increase in Canadian emissions will necessitate additional Canadian mitigation measures and related additional costs.⁶⁹ If it is not possible to pass on these costs to the foreign customers, then they will tend to end up being borne by Canada as a whole (see section 2.1.2). This might be considered an inequitable subsidy to the producers, in which case measures could be taken to ensure such producers bore these costs alone.</p>	

All of the outcome-based equity principles described above have supporters and critics. As noted earlier, there is no such thing as the "right" equity principle. Accordingly, the authors will make no recommendations to EABSWG supporting the use of some equity principles over others. Instead, we will work under the assumption that all of these principles are potentially valid and will address all of them in the rest of this chapter.

No matter what equity principles are ultimately adopted by Canadian governments, however, it is important to stress that their application to an assessment of the distribution of burden must be undertaken repeatedly over time. This is because the burden of climate change mitigation measures and its distribution will change over time (see section 3.2). Such changes may have important implications for assessment of the burden against different equity principles and the consequent design or adjustment of redistributive policy measures.

Time dependent changes in the burden distribution can be obscured, notably, when the present value of future costs is calculated using a discount rate.⁷⁰ The present value approach assumes

⁶⁸ Tradeable Permits Working Group, *op. cit.*, p.42.

⁶⁹ As explained in section 2.4, these costs are not considered to be part of the burden addressed by this report.

⁷⁰ The appropriate discount rates for individuals, firms and society differ and are the subject of debate. See, for example, K.J. Arrow et al., "Intertemporal Equity, Discounting, and Economic Efficiency," in *Climate*

that future costs are borne by the present population, which will generally not be the case, because the populations of individuals and firms change over time. Thus assessing the equity of the burden distribution using present value may not be considered appropriate by all.

4.2 Relation between different principles and aggregations

The outcome-based equity principles described above only apply naturally to aggregations:

- whose members are likely to suffer similar burdens;
- for which the quantities (wealth/income etc.) needed to apply the principles have meaning; and
- whose members possess similar values of those quantities (wealth/income etc.).

It is true to some extent of all the aggregations retained in section 2.2.2 that their members are likely to suffer similar burdens. Table 6 shows for which of these aggregations the quantities needed to apply the principles have meaning and, if they do, whether their members are also likely to possess similar values of those quantities. The table additionally includes governments, which are not strictly aggregations (see section 3.3.1); the applicability of principles to governments depends only on the quantities needed to apply the principles having meaning for governments.

Table 6. Applicability of equity principles to aggregations plus governments

Principle	Quantities needed to apply the principle ⁷¹	individuals grouped by jurisdiction	individuals grouped by disposable income	firms grouped by industry sector	employees grouped by industry sector	consumers grouped by product	governments
Egalitarianism	number of individuals	yes (but grouping irrelevant)	yes (but grouping irrelevant)	quantity has no meaning	yes (but grouping irrelevant)	yes (but grouping irrelevant)	yes, because governments represent the populations of jurisdictions
Ability to pay, Redistribution	income (individuals), return on capital (firms), GDP per capita (jurisdictions)	no	yes	to some extent	to some extent	no	yes, because governments represent the collective wealth of jurisdictions
Accept the market outcome of full pricing of emissions	results of economic modelling of full pricing of emissions	depends on how future policy measures differ from full pricing of emissions	depends on how future policy measures differ from full pricing of emissions	depends on how future policy measures differ from full pricing of emissions	depends on how future policy measures differ from full pricing of emissions	depends on how future policy measures differ from full pricing of emissions	yes (representing jurisdictions)

Change 1995: Economic and Social Dimensions of Climate Change, J. Bruce et al., eds., Cambridge University Press, p.125-144.

⁷¹ Application of the principles will depend on the availability and reliability of these quantities.

Principle	Quantities needed to apply the principle ⁷¹	individuals grouped by jurisdiction	individuals grouped by disposable income	firms grouped by industry sector	employees grouped by industry sector	consumers grouped by product	governments
Historical beneficiaries of the absence of full pricing of emissions pay	results of economic modelling of full pricing of emissions since some past date	no	no	yes	yes	yes	yes (representing jurisdictions)
Transitional compensation for excessive burden	capital losses	quantity has little meaning	quantity has no meaning	to some extent (may need to be implemented at level of firm)	to some extent (may need to be implemented at level of firm)	quantity has no meaning	quantity has no meaning
Exporter pays	increase in exports, induced by climate change mitigation measures in importing countries, of products whose production results in significant emissions	quantity has no meaning	quantity has no meaning	yes (may need to be implemented at level of firm)	quantity has no meaning (unless employees take responsibility for firms' emissions)	quantity has no meaning	to some extent, because governments represent the collective emissions and prosperity of jurisdictions

Table 6 can serve as a guide to how to assess the equity of the distribution of burden via a comparison of burdens borne by aggregations. The table shows which principles are useful for each aggregation and *vice versa*. There is at least one principle that can be used with each aggregation, which means that there is also a basis for designing measures to redistribute burden for each aggregation. Looked at the other way round, each principle can be used with at least one aggregation except possibly for "transitional compensation...", which may need to be used with individual firms.⁷²

If Canadian governments are primarily concerned about the distribution of the ultimate burden on individuals, it appears that attempts to redistribute the burden will probably be made on the basis of the "egalitarian", "ability to pay", or "redistributive" principles. Choices will have to be made about which of these principles would serve as the primary basis for a redistribution of burden.

If Canadian governments are primarily concerned about the distribution of the initial burden on industry sectors and firms, it appears that attempts to redistribute the burden will probably be made on the basis of the "transitional compensation...", or "historical beneficiaries..." principles. As noted in section 4.1.2, it may be possible to pursue several of these principles at the same time as they do not necessarily conflict. It may also be possible to apply "ability to pay" and "redistributive" principles to industry sectors and firms if desired.

⁷² As illustrated by the fact that different firms within a given sector can take very different approaches to managing the risk of future climate change mitigation measures.

If Canadian governments are primarily concerned about the distribution of the initial burden on jurisdictions, it appears that attempts to redistribute the burden can be based on all of the identified equity principles except for "transitional compensation...". However, choices will need to be made between the different potential equity principles because some of them will clearly conflict.

The problem of different equity principles being in conflict becomes even more problematic if Canadian governments decide that efforts to redistribute the burden should focus on individuals, industry sectors and governments. Under such circumstances, it is clear that compromises will have to be made and the result of an effort to redistribute the burden will be partial progress towards meeting a number of different equity objectives.

4.3 Policy measures to redistribute burden

Once Canadian governments have used equity principles to assess the equity of the distribution of burden for a relevant aggregation, they may find that the distribution is inequitable. What happens then? Fortunately, governments have a number of policy options at their disposal.

Frequent reference has been made in this report to measures included in a climate change mitigation policy package with the sole or primary purpose of redistributing the burden resulting from other measures in the package. Such redistributive measures will be critical in ensuring outcome-based equity. Some more obvious examples include:

- Gratis allocation of permits in a tradeable emission permit system to provide relative benefit to certain emitters
- Specification of baselines in an emission reduction credit trading system
- Targeted recycling of revenue from auctioning emission permits or a carbon tax
- Use of revenue from auctioning emission permits or a carbon tax to reduce personal or corporate income tax rates
- Targeted exemptions from coverage by emission permit system, carbon tax or regulatory standards affecting emission rates
- Binding voluntary covenants with firms or groups of firms set at levels that provide relative benefit relative to other firms or groups of firms
- New mechanisms of intergovernmental transfer additional to pre-existing mechanisms

While many options are available, it should be noted that jurisdictional conflicts may arise from certain putative redistributive measures. For example, provincial governments, not the federal government, regulate the electricity sector. The federal government would therefore face difficulties in implementing a redistributive measure based, for example, on adjusting electricity prices.

Finally, it is worth recalling that the application of redistributive measures may need to be reassessed on a regular basis because the costs and distribution of burden change over time (see sections 3.2 and 4.1.2). Accordingly, the time period over which redistributive measures are in effect without adjustment will need to balance the objectives of limiting uncertainty for investors and not locking in particular redistributions of burden while circumstances change.

4.4 Summary of key conclusions for EABSWG

While the focus of this report is outcome-based equity, the report concludes that Canadian governments may need to consider procedural equity, allocation-based equity and outcome-based equity when designing a package of climate change mitigation measures. It notes that there is no guarantee that allocation-based equity principles will produce an outcome that will meet outcome-based equity principles.

The authors have reviewed the literature on equity principles and have identified seven outcome-based equity principles that could potentially be used to assess the equity of the distribution of burden. No effort has been made to prioritize these equity principles. After all, equity principles reflect ethical views about how people should be treated. There is no correct answer: many contradictory perspectives exist on ethical issues, often conditioned by self-interest, and negotiations between governments or other negotiators will need to aim at compromise rather than consensus on equity principles.

Nonetheless, the report does examine how the seven equity principles relate to the aggregations of burden bearers identified in chapter 2. It is clear that all of the equity principles could be applied to an assessment of burden, but that some of the principles relate more closely to the burden borne by individuals whereas other equity principles relate more closely to the burden borne by industry sectors and firms. All but one of the principles could be applied to jurisdictions.

The report notes that pursuit of any one of the equity principles with regard to a particular aggregation of burden bearers should be possible through redistributive policies. At the same time, it is unlikely that agreement will be reached on a single equity principle. As more equity principles, and more aggregations of burden bearers, are considered, however, the more likely it is that redistributive policies will be required to pursue contradictory objectives. At that point, policy makers will be required to make compromises that result in partial pursuit of conflicting equity principles.

The report concludes that while Canadian governments have a range of policy options to address inequities in the distribution of burden, there is a risk that redistribution efforts will create jurisdictional conflicts. It also notes that redistribution efforts must be regularly reviewed in light of the fact that the level and distribution of burden will change over time.

5. Concluding note on assessing the equity of burden distribution

This report has attempted to describe the process Canadian governments will need to go through in order to determine the equity of the distribution of the burden arising from the implementation of a package of climate change mitigation measures. Specifically, three broad questions need to be answered:

- How should burden be defined?
- How should burden be measured?
- How should the equity of the distribution of burden be assessed?

This report has demonstrated that answering each of these questions is a complex process that requires discussion and decisions on a number of controversial issues. What costs should form part of burden? What baseline should burden be measured against? What equity principles should be used to assess the distribution of burden?

In discussing these issues, this report has attempted to present a broad range of possible approaches that provide a framework for discussion. While some effort has been made to narrow down the broad range of approaches, the authors have not presented an "answer" in any of these areas for the EABSWG.

Instead, the authors hope this report can serve as a useful template for discussion of the issues — discussions that are absolutely fundamental to management of the climate change issue in Canada but also complex and controversial.

Appendix 1. Some non-monetary costs and benefits of climate change mitigation measures

The following list does not pretend to be complete. It contains elements of what are often referred to as co-benefits or ancillary benefits of climate change mitigation measures. Such benefits (which may in some cases be negative) will likely also occur in areas such as agriculture, land-use practices, waste management and energy security.⁷³

Changes in the rate of unemployment. By restricting certain kinds of economic activity and encouraging others, climate change mitigation measures are certain to have significant effects on employment patterns. (Un)employment is perhaps the most obvious non-monetary cost/benefit that can be extracted from standard economic models. Care needs to be taken in aggregating unemployment because small changes in aggregate unemployment can mask larger differences between those who lose jobs and those who gain them (who will generally be different). Unemployment data therefore needs to detail job losses and gains.

Changes in the quantity or quality of goods or services. Many climate change mitigation measures aim to reduce consumption of goods or services with high associated greenhouse gas emissions by causing an increase in their price. This would result in both a monetary cost or benefit to consumers (who would consume a reduced amount of the good or service at a higher price per unit) plus a reduction in the quantity of the good or service enjoyed. For example, increased gasoline prices are expected to lead to a reduced level of car use. This reduction can be converted into dollar terms as the loss of consumer surplus, a well-defined quantity in economics that can be extracted from standard models. It is included here as a non-monetary cost because it has no impact on the consumer's monetary balance. It is also possible that climate change mitigation measures could change the *quality* of goods or services. For example, buses could travel more quickly (thereby providing higher-quality service) if there were fewer cars on the road. It is not clear how such a change could be converted into dollar terms.

Benefits to human health of reduced air pollution. Fossil fuel combustion is the largest source of greenhouse gas emissions. It can also be an important source of toxic air contaminants or their precursors. Measures to mitigate climate change by reducing fossil fuel combustion can therefore create benefits to human health by reducing emissions that contribute to air pollution. Various methods exist to convert these benefits into dollar terms, although there is disagreement, for example, as to whether that should be done in terms of willingness to pay for improved health or avoided costs of policies specifically designed to reduce air pollution (the latter potentially yielding lower numbers). In addition, models used to project health benefits are less well developed than standard economic models. A partial analysis of benefits to human health from reduced air pollution resulting from packages of measures to meet Canada's Kyoto target, conducted by the Analysis and Modelling Group (AMG) under the National Climate Change Process, valued those benefits at \$300 to \$500 million per year based on estimates of willingness to pay.⁷⁴ Because they are local and immediate, these benefits are distributed both in space and time in a similar way to those of the monetary costs of the measures. This means that may be considered to offset those costs in a relatively straightforward way.

⁷³ Intergovernmental Panel on Climate Change (2001a), *op.cit.*, p.9.

⁷⁴ Analysis and Modelling Group, *op.cit.*, p.xvi.

Environmental benefits of reduced air pollution. Environmental benefits occur in tandem with, benefits to human health from reduced air pollution (see previous point). Evaluation of these environmental benefits presents similar methodological challenges to the health benefits. In the AMG analysis cited above, environmental benefits were valued at less than 5% of the health benefits. However, the only environmental benefits considered were household material soiling, materials damages and agricultural crop reductions.⁷⁵

Environmental/health/social costs of climate change mitigation technologies. Climate change mitigation measures will tend to favour technologies with lower associated greenhouse gas emissions. But use of these technologies can create other environmental, health or social costs unrelated to climate change. For example, nuclear power is commonly objected to on environmental or health grounds; large hydroelectric projects are objected to on environmental and/or social grounds.

Changes in economic indicators that incorporate social and/or environmental components. There is increasing interest in "Genuine Progress Indicators", and other indicators of sustainable development as alternatives to classic indicators such as gross domestic product (GDP).⁷⁶ These alternative indicators are at a very early stage of development, with no broad agreement on how they should be defined. Their calculation might in some cases challenge the capacity of existing models, although elements such as depletion of specific natural resources could be obtained straightforwardly. The magnitude of changes in these indicators resulting from climate change mitigation measures would depend on how the indicators were defined.

Changes in stocks of natural resources. This is one well-defined element of the "depletion of natural capital"⁷⁷ that some of the indicators in the previous paragraph seek to capture. It is particularly relevant to climate change when the resources in question are fossil fuels and biomass.

Environmental benefits of lessened climate change. Lessened climate change is beyond the scope of this report but it is the ultimate benefit for which the costs of climate change mitigation measures are incurred. The avoided monetary costs of the impacts of climate change may give a sense of the magnitude of the environmental benefits of lessened climate change, although those costs do not fully capture the value that many people place on the environment. According to the Intergovernmental Panel on Climate Change, "increases in global mean temperature would produce net economic [i.e. monetary] losses in many developing countries for all magnitudes of warming studied (low confidence), and losses would be greater in magnitude the higher the level of warming (medium confidence). In contrast, an increase in global mean temperature of up to a few °C would produce a mixture of economic gains and losses in developed countries (low confidence), with economic losses for larger temperature increases (medium confidence)."⁷⁸

⁷⁵ Environmental and Health Impacts (EHI) Subgroup (2000), *The Environmental and Health Co-Benefits of Actions to Mitigate Climate Change*, Report to the Analysis and Modelling Group, National Climate Change Process, p.49, 60-67.

⁷⁶ See, for example, the work by the Pembina Institute (<http://www.pembina.org/green/gpi/>) and the National Round Table on the Environment and the Economy (http://www.nrtee-trnee.ca/eng/programs/Current_Programs/SDIndicators/).

⁷⁷ Where preservation of natural capital is considered desirable not out of monetary considerations, but for its own sake.

⁷⁸ Intergovernmental Panel on Climate Change (2001c), *Summary for Policymakers – Climate Change 2001: Impacts, Adaptation and Vulnerability*, p.8. Available at <http://www.ipcc.ch>.

Benefits of lessened climate change are difficult to compare to costs incurred in Canada from climate change mitigation measures because the former will occur over a much longer time horizon than the latter; and because the former are distributed globally while the latter is national and sub-national.⁷⁹

⁷⁹ Canada contributes only about 2.3% of global greenhouse gas emissions (although this is a large amount on a per-capita basis). Canadian mitigation measures therefore have a very small impact on Canada, while mitigation measures taken in the rest of the world have a very large impact on Canada.

Appendix 2. Mechanisms through which the implementation or not of climate change mitigation measures in other countries can lead to costs and benefits in Canada

Price of imports. The prices and therefore quantities imported into Canada of products whose production or use is emissions-intensive will be affected by the implementation of climate change mitigation measures in other countries. On the one hand, the price of imports whose production is emissions-intensive bought from an international market dominated by countries implementing measures to put a price on greenhouse gas emissions⁸⁰ will rise. On the other hand, the price of imports whose use is emissions-intensive (e.g., coal) will tend to fall in response to falling international demand from countries implementing climate change mitigation measures.⁸¹

Reduction in Canadian competitiveness. The international competitiveness of Canadian producers of some products whose production is emissions-intensive could be reduced as a result of differences between climate change mitigation policies implemented in Canada and elsewhere. Assume, for example, that Canada implements measures to put a price on greenhouse gas emissions. When Canadian products whose production is emissions-intensive are then sold into an international market dominated by countries implementing similar measures, the relative competitive position of Canadian producers will not be affected. But when the products are sold into an international market where countries not implementing climate change mitigation measures⁸² are significant producers, Canadian producers will not be able to raise their prices to pass on costs resulting from the Canadian measures; they will lose competitiveness, becoming less profitable, perhaps fatally so in some cases. Investment in new production in sectors suffering a loss of competitiveness in this way could be expected to shift to some extent away from Canada.

International demand (specific). Three cases can be distinguished:

- Demand for Canadian products whose production is relatively emissions-unintensive will tend to rise in countries implementing climate change mitigation measures and which currently produce those products in an emissions-intensive manner domestically (e.g. Canadian hydroelectricity substituting for US coal-fired electricity).
- Demand for Canadian products whose use is relatively emissions-unintensive will tend to rise in countries implementing climate change mitigation measures (e.g., fuel-switching in the US from natural gas to coal). But if the production of these products results in significant emissions (as is the case of natural gas), then that increased demand will cause an increase in Canadian emissions, necessitating additional Canadian mitigation measures and related additional costs.
- Demand for Canadian products whose use is relatively emissions-intensive will fall in countries implementing climate change mitigation measures. If the production of those products is also emissions-intensive (as in the case of oil), then there could be a loss of competitiveness (see previous point) in addition to the reduced international demand.

⁸⁰ E.g., a carbon tax or a tradeable emissions permit system.

⁸¹ In principle, if the cost of mitigating the emissions from the use of such imports is not fully reflected in the price, Canada could impose import duties on them. In practice, the ability to impose import duties may be restricted somewhat by international trade agreements to which Canada is a party.

⁸² Notably, countries not included in Annex B of the Kyoto Protocol.

International demand (general). Demand for Canadian exports as a whole (irrespective of how emissions-intensive their use is) will tend to fall in countries whose gross domestic product (GDP) is smaller than it would otherwise be as a result of measures taken there to mitigate climate change.

Figure 1. Options for equity-relevant baselines
 (see text of section 3.1 for explanation)

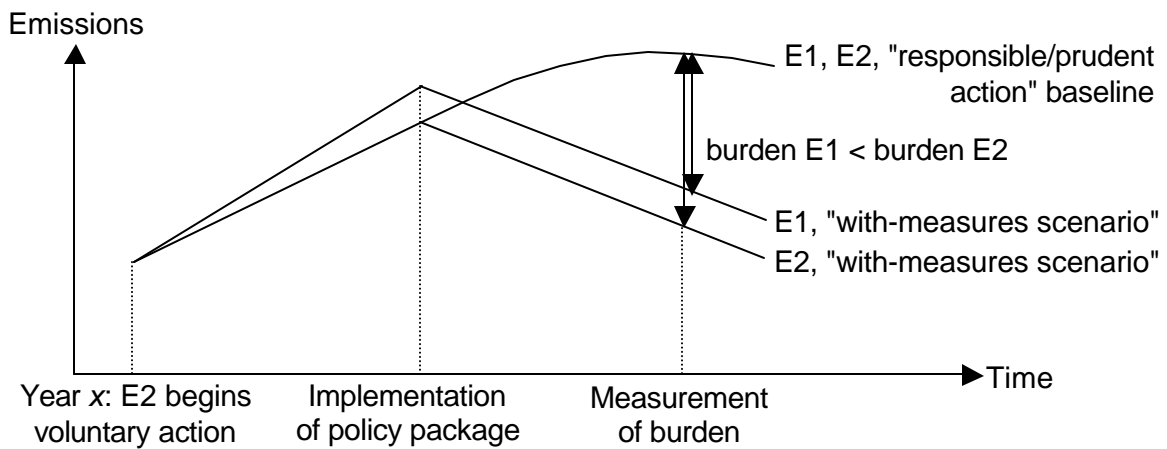
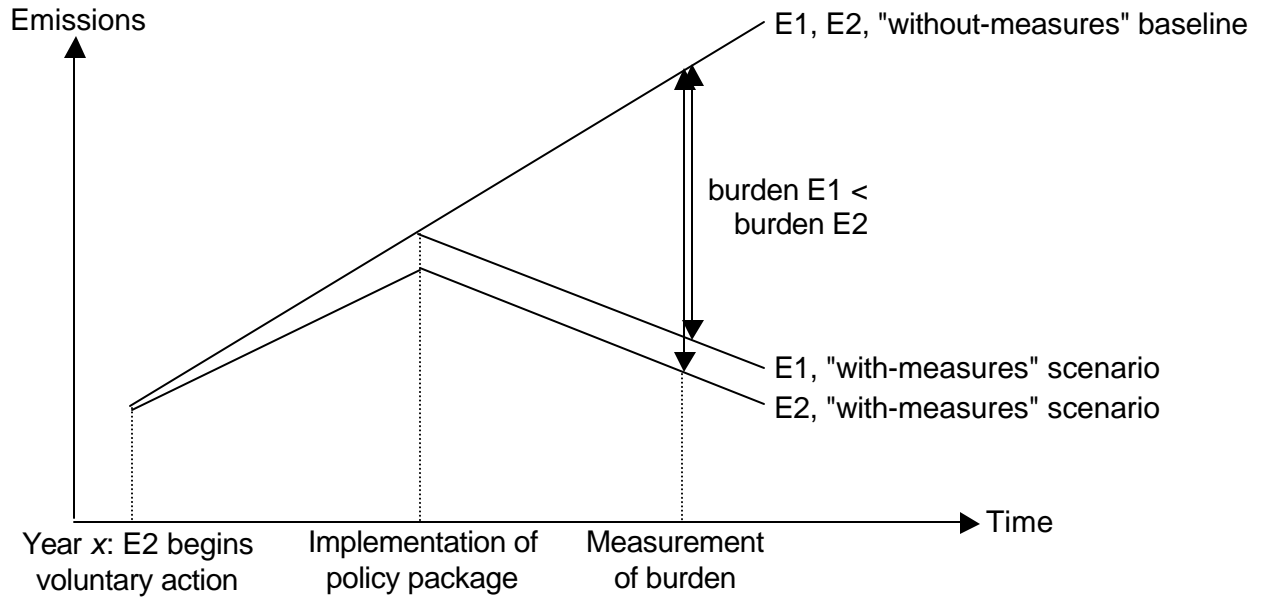


Figure 2. Equity-relevant baselines over the transition
(see text of section 3.1 for explanation)

